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**Implementing the Reconsolidation Paradigm in Treating
Misophonia**

by

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A thesis submitted in partial fulfillment
of requirements for degree of
Master of Arts Psychology, Hunter College
The City University of New York

2024

4/16/2024

Date

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Abstract

Misophonic patients experience extreme sense of disgust when exposed to acoustic and/or visual triggers. In this longitudinal study, the reconsolidation paradigm was applied to treat 25 patients during a month. The findings reveal that reminders in a control setting did not improve maladaptive memories, but counterconditioning update ameliorated symptoms.

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1. Introduction

“Memory is a way of holding onto the things you love, the things you are, the things you never want to lose” (Kevin Arnold), And in some instances, the things you need to update in order to change (Angel Prats)

Remembering our memories, even the darkest ones, makes us understand why we experience what we experience, our present, and who we are. The many maladaptive memories become the origin of psychiatric disorders and influence personality traits (Johnson et al., 2005). We can find these types of memories at the epicenter of post-traumatic stress disorder (PTSD), phobias, and also in some dysregulated behaviors such as alcoholism and drug abuse (Milton & Everitt, 2012). Among the many disorders affected by maladaptive memories, we find misophonia.

Misophonic patients experience extreme sense of disgust when exposed to acoustic and/or visual triggers. The most common triggers are those related to oral consumption such as chewing, slurping, gum chewing, but there are others related to repetitions such as pen clicking, keyboard typing, scraping sounds and loud breathing. Being near such triggering sounds, and even just watching them, causes misophonia patients to develop aversion symptoms such as anger, anxiety and in some extreme cases panic-like attacks (Wu et al, 2014; Schröder et al., 2015; Ferrer-Torres, et al., 2022). Other than the feeling of disgust, patients also experience muscle tension and/or physiological arousal (increased heartbeat, sweaty palms...) (Edelstein et al., 2013).

Due to the scarcity of studies on misophonia to date, there has not been definitive evidence allowing for consensus as to whether it is a comorbidity found in other psychiatric disorders or if

it is a condition in of itself (Potgieter, et al., 2019). This issue impedes it to be added to the DSM-V (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition). In regards to its etiology, the most commonly used explanation for the origin of misophonia is a maladaptive conditioning. Misophonia is considered a conditioned response that was originally unconditioned but through association with a negative outcome became conditioned. Unfortunately, the little information available on misophonia makes it difficult to propose ideal diagnostic criteria, let alone methods of treatment. Several diagnostic tools have been hypothesized to accurately evaluate misophonic symptoms, but none has been completely validated, replicated and generalized (Potgieter, et al., 2019). Several clinical cases have investigated the role of different psychiatric therapies on remediating the aversive misophonic symptoms patients disclose. Among the most popular types of treatments implemented for misophonia we find Cognitive Behavioral Therapy (CBT) with and without exposure therapy element, Acceptance and Commitment Therapy (ACT), and Dialectical Behavioral therapy (DBT). No treatment has been successful at completely correcting misophonia symptomatology; at best, some treatments have shown to temporarily reduce the symptoms, but with extreme variability (Mattson, et. al., 2023).

In another field of study with relatively the same years of existence as the term misophonia we find reconsolidation (both getting recognition at the outset of the 21st century). A molecular, anatomical, and cognitive process considered to be the paradigm that allows for updating memories (Hupbach et al., 2007; Schiller et al., 2010; Nader, 2015; Lee et al., 2017). This process in which a reminder of a maladaptive memory is required to destabilize a prior consolidated memory has been studied in its potential capacity to interfere and modify the valence of memories. Reconsolidation, which has been studied in both animal and human models, has shown to be able

to manipulate/update declarative, procedural and emotional memories through amnesic agents or by introducing additional information that competes with the original memory (Agren, 2014; Lee et al., 2017). It is in this application that reconsolidation is intended to be used as a mechanism through which maladaptive memories can be remediated. To this extent, several clinical trials have taken place in improving the treatment mechanisms used in conditions such as phobias, alcoholism, drug abuse and PTSD, among others (Gray & Liotta, 2012; Das et al., 2015; Xue et al., 2015; Bjorkstrand et al., 2016; Dunbar & Taylor, 2017; Vermes et al., 2020).

Both reconsolidation and misophonia are relatively new topics with many questions to be answered. The main objective of this research is to shed some light on misophonia while also analyzing the role reconsolidation could have as a potential treatment mechanism. The study undertaken in this master thesis is part of a larger research project being carried out at Mt Sinai Hospital (Icahn School of Medicine) under the direction of Dr. Daniela Schiller, who has granted us access to the data. This project (NCT05928689) is funded through The Misophonia Research Fund as a part of the REAM Foundation, a private family foundation. To the best of our knowledge the implementation of reconsolidation mechanisms in a misophonia sample is novel and has not been attempted before.

In sum, in this master thesis I hypothesized that participants undergoing a reminder of their trigger prior to receiving counterconditioning (i.e., reconsolidation updating) will show a significant reduction of their aversive responses compared to misophonic participants that do not get a reminder. In this way, we hope to address whether reconsolidation therapy in the form of counterconditioning is sufficient in reducing aversion to misophonic triggers.

2. Misophonia

This chapter will introduce the phenomenon of misophonia, a proposed condition that has a great impact on the daily lives of the people that suffer from it. I will explain its symptoms, the relevant findings, and issues in the study of misophonia. By synthesizing the literature of this understudied condition, I hope to contribute to a more holistic perspective that will hopefully lead the reader to better understand misophonia, its implications for clinical practice, and its research opportunities.

Misophonia is a relatively new condition coined by Jasterboff in 2001 (Jasterboff, 2001). Even though the original term was intended to be “An abnormally strong reaction occurring to a sound with specific pattern and/or meaning to an individual ” (Jasterboff & Jasterboff, 2014), it is the literal Greek/Latin translation that receives the most popularity *miso* = hate, of the *phonia* = sound (Potgieter et al., 2019).

People suffering from this condition are characterized as experiencing disproportionately extreme aversion to certain sounds (triggers) differently from the general population. The triggers tend to be diverse and multiple for each individual, the most common are chewing, slurping, lip smacking, sniffing, screeching, and throat clearing. To these individuals, being exposed to the triggers, activates both limbic and autonomic systems causing them to experience strong responses related to feelings of anxiety, disgust, and anger (Potgieter et al., 2019). Misophonia is different from Hyperacusis— an auditory condition in which noise is perceived to be too loud, to the point that it can cause discomfort and pain— in that the volume of the triggering sound is not related to the outcome (Jasterboff & Jasterboff, 2014). To misophonic patients, even just observing an individual doing the activity related to the trigger without sound is sufficient to trigger them. This has been

considered one of the trademarks of misophonia. This misokinesia (hatred of movement—referring to the image of the movement related to trigger) element makes misophonic patients aversive to socialize, eat with others and, in extreme cases, cause the patient to become incapable to attend classes or go to work due the fear of being triggered (Swedo et al., 2022). Patients with misophonia tend to report inability to focus after being triggered, hyperfixation on the triggering individual, and hypervigilance of perceived follow up triggers (Potgieter et al., 2018). Interestingly, misophonic patients tend to deem misophonic triggers as stronger when the sounds are produced by an individual close to them such as a family member or a partner (Bernstein et al., 2013). Even though the triggers are stronger when coming from their immediate social network, the sounds that are emitted by the patients themselves do not become triggering. Another common trademark experienced in misophonia patients is the presence of involuntary physiological movements such as clenching teeth, keratosis pilaris (chicken skin) or jerk movements when exposed to the patients' triggers (Schröder et al., 2018; Eijsker et al., 2021).

The novelty of misophonia raises a plethora of unanswered questions. What is its prevalence, how does it come to be, who is affected, how may we treat it and many more questions. What is known though is that misophonia is a complex response experienced due to sensory information that arises from a specific context with varying valence. To date, research has delved into the prevalence of misophonia and out of the few studies, there is discrepancy. Wu et al. (2014) found that out of 483 American undergraduate students, 20% reported significant misophonia impairment symptoms. In contrast, a similar study performed in China found that 20% of 415 students declared experiencing sound sensitivity “often” or “always”, but only 6% of these had significant misophonia impairment (Zhou et al., 2017). These findings not only lead to the conclusion that there is a lack of consensus

in misophonia, but also that it may be more prevalent in specific populations. Through case study reports, the scientific community has estimated that even though misophonia symptoms tend to appear at different time spans, the patients report experiencing their first anger, disgust, and anxiety symptoms related to their triggers at early stages of development. Estimations to date postulate that on average misophonic symptoms appear around the age of 12 (Dozier, 2015; Jager et al, 2020).

In regards to how misophonia may have come to be, plenty of hypotheses have emerged, but no consensus has been reached. Some researchers have tried to explain the misophonia inception as rooted in a temporary hearing loss experienced by patients at childhood, which may have led the patient to develop higher sensitivity to specific sounds (Aazh et al., 2022). Others have suggested that the origin of misophonia may be due to the anatomical proximity between the auditory cortex with the Anterior Insular Cortex, which led the patients to create spurious associations similar to those experienced by synesthesia patients (e.g., hear-color, taste-word) (Edelstein et al., 2013). To date though, the first and most prevalent explanation for misophonia is believed to be due to a simple conditioned response—a classic Pavlovian conditioning (Dozier et al., 2023).

According to this hypothesis, an unconditioned stimulus (trigger) became associated with an unpleasant experience which caused an unconditioned response (anger, disgust). Over time, the trigger becomes conditioned and consolidated; thus, every time the trigger is present, the patient experiences the now conditioned response: anger, disgust, as well as physiological responses.

Even though very limited studies have been done in the field of misophonia due to its novelty and the lack of awareness, some studies have brought forward that a genetic component may also be at play (Brout et al., 2018; Sanchez & Silva et al., 2018). Through case studies, researchers have reported that it is habitual to find a parent or a sibling of a misophonic patient to also exhibit misophonic symptoms. A case study describes a report of 15 individuals from the same family in Brazil, in which all individuals suffer from misophonia (Sanchez & Silva et al., 2018). Even though this poses some evidence for misophonia to be considered a psychiatric condition, more studies will need to be carried out to draw significant conclusions.

Misophonic patients also tend to suffer additional psychiatric issues, making it difficult to characterize misophonia alone. Misophonic patients tend to report having other disorders such as post traumatic stress disorder, obsessive compulsive disorder, generalized anxiety disorder, as well as major depressive disorder (Erfanian et al., 2017; Quek et al., 2018). Because misophonia is often comorbid with other disorders, this has brought out questions of whether misophonia is a symptom or a condition in of itself. Something which has some members of the Psychiatry community in dissent— genetic condition or symptom of disorders?.

Researchers have tried to characterize misophonia as a condition since Schröder, Volnik & Denys (2013) brought forward the diagnostic criteria to characterize misophonia. Although it has not been accepted into the DSM-V, researchers have tried to find anatomical and functional differences to single out misophonia and to make a claim of it being a condition. To do so, researchers have relied on physiological and neuroimaging techniques such as galvanic skin response (GSR), electroencephalograms (EEG) and Functional Magnetic Resonance Imaging (fMRI).

In the field of physiological responses, researchers such as Kumar et al. (2017) have studied the physiological reactivity experienced by misophonic patients. In this study, Kumar et al. analyzed the skin reactivity of misophonic patients and healthy controls. The results showed that misophonia patients experience higher galvanic skin responses to auditory stimuli than healthy controls, suggesting that there is a dysregulation of the autonomic nervous system where patients experience high sympathetic arousal while potentially reducing the parasympathetic system response. In the field of neuroimaging, implementing EEG imagery studies, Schröder et al. (2014), showed that misophonia patients have reduced mean amplitude of the auditory N1 (part of the event related potential—the electric response to a specific event), which indicates differences in the early processing (attention and detection) of auditory stimuli. This suggests that misophonic patients are unable to filtrate or habituate to the incoming sounds. These findings led Schröder et al. (2014) to propose that being unable to process the information and habituate to the trigger may result in hypersensitivity to the specific stimuli, which leads to increased physiological and emotional responses compared to controls. Although this correlation is a potential explanation, further studies are needed to corroborate the pattern and the explanation.

In relation to fMRI studies, the few studies completed to date have postulated that Misophonia patients have aberrant neural responses compared to control groups. Studies in this field have found that misophonic patients exhibit hyperactivation of the bilateral auditory cortex with the left amygdala (Giorgi, 2015), increased activity in the auditory cortex (Schröder et al., 2015) and disrupted functioning of the connection between anterior insular cortex and superior temporal cortex, ventromedial prefrontal cortex, posteromedial cortex, hippocampus and amygdala (Kumar

et al., 2017). In the most recent work in this field, undertaken by Eijsker et al. (2021), in which misophonic patients underwent fMRI with their eyes closed, it was found that patients had greater volume of gray matter compared to controls, specifically in the right amygdala; altered connectivity between the amygdalae and the cerebellum; and greater connectivity within lateral occipital cortices and fusiform gyri found in the ventral attention network.

Findings such as these bring forward that both functional and anatomical abnormalities are implicated in misophonia. These reports explain why misophonic patients report feeling anxiety, anger, and discomfort upon being triggered, and are predisposed to hyperawareness. Corroboration of these findings needs to be done in order to verify these findings and give strength to the claim of misophonia being a singular condition.

When it comes to treatment, the lack of consensus and awareness on misophonia has impeded the development and research of potential therapeutic interventions. Not many of the established therapeutic techniques have proven efficient in treating these patients. Cognitive behavioral therapy through exposure therapy, as a second-generation mechanism, has shown the best promise to date (Mattson et al., 2023). The scarcity of clinical reports in this field, limits any definite conclusions on best therapeutic practice. Thus, in this thesis, I hope to shed some light on mechanisms that may make misophonia treatment more efficient.

3. Reconsolidation

In this chapter, I will review the literature of reconsolidation. I will bring forward its hypothesized role, the application it has in treating maladaptive memories that are at the center of many disorders, and argue the benefit it could have in treating misophonia patients.

To begin, we must first understand consolidation since reconsolidation depends on it. Consolidation is the required period of stabilization needed for acquiring new memories. This is demonstrated in part by the impairment found in interruptions of consolidation due to amnesic treatments or new learning occurring soon after initial learning (McGaugh, 2000). Similar to the evidence that demonstrates consolidation, there is evidence suggesting the existence of post-retrieval restabilization. In this case, evidence suggests that previously consolidated memory can be destabilized if amnesic treatment or new learning happens after a memory is retrieved (Nader, 2000; Nader, 2015; Lee et al., 2017). This destabilization has given rise to the concept of post-retrieval reconsolidation, where the memory that has been retrieved becomes destabilized and requires reconsolidation in order to become stabilized once more.

Several memory systems have been demonstrated to be capable of modification. Studies indicate that declarative, procedural, and emotional memories have the potential to be manipulated through the reconsolidation paradigm (Hupbach, 2007; Monfils et al., 2009; Schiller et al., 2010; Agren, 2014; Scully et al., 2016). Its potential to treat maladaptive memories are being put to the test nowadays and the thought that memories can only be consolidated once has decreased in popularity.

The field of reconsolidation, as mentioned before, works on the premises that memories upon being retrieved and expressed enter a malleable state where one can manipulate them by either reducing (amnesic) or increasing the emotional valence attributed to them (Lee et al., 2017; Deng et al., 2023). This change in emotional valence can be obtained by either incorporating new experiences, psychological and physiological changes, and or through interventions (both invasive and non invasive) (Deng et al., 2023). The mechanisms through which this takes place are complex and involve molecular, cellular and synaptic plasticity processes (Lee et al., 2017).

Regarding the functionality of reconsolidation, it has been hypothesized that it allows us the capacity to update our memories with new information (Hupbach et al., 2007). This is supported by the bidirectional nature of reconsolidation. Memories from our past can be strengthened or weakened by the addition of new information. Thus, what was once traumatic may fade away thanks to prolonged updating in reconsolidation or, on the other hand, it can worsen the emotional valence one had about its trauma. Experimental studies trying to test this hypothesis have delved into updating these maladaptive memories in order to change the outcomes they cause. Some of the more significant studies to date have delved in the application of reconsolidation in PTSD, phobias and drug use.

In a clinical study where reconsolidation mechanisms were used to treat heroin addicts, those who underwent a reminder of the drug (video clip) and received extinction training (repeated exposure to heroin cues) had lower craving for the drug 6 months after (Xue et al., 2012). This is in contrast to the other groups in the study which did not get drug reminders or that took a 6h break before extinction training (i.e., outside the reconsolidation window). Findings in this study imply the efficacy the reconsolidation may have in treating drug disorders and the role it can play for relapse

prevention. In another study using alcohol-related memory manipulation, alcoholics that were presented with actual alcohol followed by counterconditioning (alcohol cue paired with disgusting image) showed a perceived reduction of attentional bias, cravings upon being cued, and lower liking ratings (Das et al., 2015). Other groups with different conditions (drank alcohol or drank non alcoholic drinks) were less effective, which indicates that there is a specific type of violation needed to destabilize the memory alcoholics have (Das et al., 2015). This indicates that the type of reminder is important in activating the memory and that counterconditioning is effective at mitigating some of the adverse effects maladaptive memories have.

In another pilot study, a small sample of PTSD patients underwent Rewind Technique, a reconsolidation protocol where the patients are cued to remember their traumatic events and imagine it as if it were a movie (Gray et al., 2012). The majority of the participants no longer met criteria for PTSD diagnosis after the intervention. Replication of this is still required to verify the efficacy of the Rewind Technique in reducing PTSD, but this study showcases the applicability of reconsolidation mechanisms. In regards to reconsolidation used in clinical studies of phobia treatments, retrieval-extinction protocols show mixed results when targeting a sample population with arachnophobia (Shiban et al., 2015). In Shiban et al. (2015), although retrieval-extinction efficiency was not clear and protocol optimization is required, the post-retrieval exposure to spiders significantly decreased. Thus, the participants suffering arachnophobia may have benefited from reconsolidation updating. In a separate study, also focused on phobias, Agren et al. (2017) demonstrated that reminders in an in vivo or imaginary extinction protocol disrupted the reconsolidation process regardless of the type of reminder.

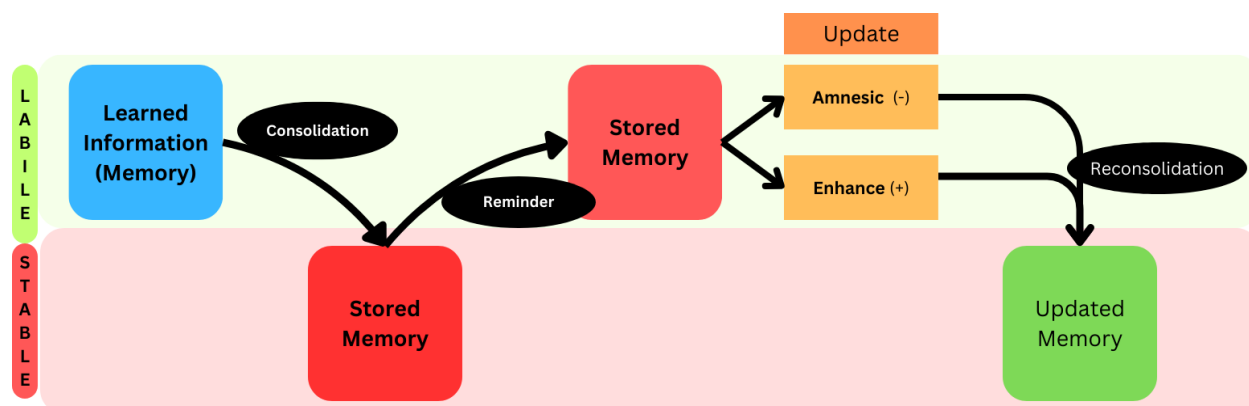


Figure 1. The reconsolidation process.

Once a memory is being reactivated it destabilizes and must begin the process of reconsolidation (see figure#).. If we implement updating via extinction, counterconditioning, or interference, we can change the emotional valence that image has over the person. Extinction would be through repetitive exposition of the person to a trigger image without experiencing side effects (e.g., a dog collar is not a dangerous dog). Counterconditioning would be experiencing a gain or loss associated with the triggering image (e.g., monetary compensation). Another updating mechanism for reconsolidation would be interference, where one information competes with the other to consolidate. Once this additional information is associated with the original memory it becomes reconsolidated. The memory which is now updated with the new information could be more accentuated thanks to having gone through enhancing mechanisms or less accentuated through amnesic mechanisms.

Through experiments using animal and human models, scientists have estimated that the reconsolidation period takes about 6 hours (Lee et al., 2017). That is, from the moment the reminder is given, the memory is labile for the first 6h, once the period has passed the memory is consolidated and no updates are able to modify it.

The elements discussed in this section: the reconsolidation paradigm, the update mechanisms, prior findings, and the timeframe required for consolidation are the cornerstones from which we develop our study. Therefore in this thesis, I will analyze the reconsolidation paradigm with the updating mechanism of counterconditioning in the hope of changing the emotional valence misophonia patients experience.

4. Study

This Master's thesis is based on a subsection of a larger study directed by Dr Daniela Schiller taking place at Mt Sinai Icahn School of Medicine (NCT05928689) funded through The Misophonia Research Fund as a part of the REAM Foundation, a private family foundation. Due to the nature of the study and the fact that it is ongoing, only 2 out of 5 groups it is composed of are being analyzed in this work. The original population will be introduced in the sections below to explain the onboarding process.

4.1 Participants

In this study, a total of 25 participants who were “diagnosed” or self-identified as misophonic, between the ages of 18 - 55, were recruited through advertisements in social media platforms, pool samples of SoQuiet members (a platform dedicated to people with Misophonia, where they can gather information, resources and apply for research grants) and posters around New York City. Out of the initial pool of 284 prospective participants who expressed interest in our study, 42.4% (123) were deemed not eligible for our study. Eligible criteria were established for participants to

express misophonia triggers and some reported distress when confronted with a trigger (see appendix # for exclusion criteria). An additional approximately 10% of the remaining participants did not consent to have their data stored in our system. Lastly, those participants who did not successfully score above threshold in 3 misophonia questionnaires out of 4 were also dropped (15%). We implemented these 4 questionnaires due to no consensus in the field regarding the psychometric properties of each of the individual questionnaires, including reliability or validity and generalizability (Roshenthal et al., 2021). Following the completion of the questionnaire, 20% more participants dropped from the study due to un-responsiveness, inability to commute or personal reasons.

The composition of our remaining 84 participants (30%) was divided among the 5 groups of the larger study, taking into account the individual's preference. At the time that this thesis was being written 25 participants fell under the groups analyzed.

Descriptive Statistics						
	Age	age_miso	Education	Eco Stat	#siblings	status
Valid	25	25	25	25	25	25
Missing	2	2	2	2	2	2
Mean	34.975	10.840	8.200	6.240	1.640	0.520
Std. Deviation	9.773	4.638	0.803	2.259	1.019	0.858
Minimum	21.076	3.000	6.000	1.000	0.000	0.000
Maximum	52.981	20.000	9.000	9.000	4.000	3.000

Table 1. Summarizing the descriptive data of the sample.

Demographics of the sample (see table 1) were primarily composed of caucasian females (86%) averaging the age of 35.09 (SD=10.45). Regarding our sample socioeconomic attributes, the majority of our participants (47%) held a college degree and 33% had completed graduate programs (Master, PhD). The average income of our sample reported having an income between \$75,000 and \$100,000 (SD =2.3). Participants also described on average experiencing their first misophonia triggers at 11 years of age (SD=4.8), this finding is closely related to that reported in other studies where it is estimated to be at 12 years of age (Dozier, 2015; Potgieter, et al., 2013).

4.2 Apparatus and Materials

Surveys and questionnaires

Our study implemented a battery of surveys and questionnaires through REDCap (Research Electronic Data Capture) online software (REDCap, 2023). This allowed us to track the entirety of the participants task completions, send surveys as well as collect survey data. The exclusion criteria for participating in our study was established as passing (scoring above average) in a minimum of 3 of the following validated and reliable questionnaires:

a) **Misophonia Assessment Questionnaire (MAQ)** - (Score < 18) See appendix 1

First misophonia assessment tool created by Marsha Johnson et al. (2013), designed to identify the degree misophonia affects the life of the patient. It is composed of 21 phrases the patient needs to rate from 0 to 3. MAQ is centered around noise triggers, and does not account for visual implications.

b) **Misophonia Questionnaire from USF (MQ)** - (Score < 24) See appendix 2

The Misophonia Questionnaire, first published by Wu et al., 2014; from the University of South Florida, consists of 3 scales. MQ tries to identify the sensitivity (8 items), frequency of behavioral responses (11 items) and severity the patients have when exposed to their triggers.

c) **Amsterdam Misophonia Scale (AMISO)** (Score < 9) See appendix 3

This questionnaire, adapted from Yale-Brown Obsessive-Compulsive Scale, assesses the level of interference misophonia causes to the patients. It includes the word trigger to encompass any sounds, sight, touch or motion considered aggravating to the patient. AMS is an 18 item questionnaire that has been revised and developed by Schröder, Vulnik, and Denys (2013).

d) **Amsterdam Misophonia Scale (revised) (AMISOr)** - (Score < 18) See appendix 4

This questionnaire is a revision to AMISO undertaken by Schröder, Vulnik, van Loon and Denys in 2017. It was revised to improve the reliability and validity of AMISOS while making it more comprehensive.

To establish any psychopathology in the patients, researchers implemented the use of Mini International Neuropsychiatric Interview (MINI) (Sheehan et al., 1998). This allowed us to account for diagnosis of Depression, General Anxiety, Social Anxiety, Mania, Panic disorders, PTSD, OCD, Substance use disorder, Schizoid or Delusional comorbidities.

Approach Avoidance Task - (AA)

The misophonia triggers were short clips (30 seconds) of a person: wet chewing, gulping, slurping, sniffing or scraping; that had been used and validated in similar studies of misophonia by the

Davidenko lab at Duke University (Samermit et al., 2022). Using PsychoPi the videos were embedded into a task for participants to be able to choose between watching the particular video they stated had triggered them the most or a static screen. Each video had a specific monetary compensation of \$0, \$0.2, \$0.4, \$0.6, \$0.8 or \$1 and responses were recorded and totaled by PsychoPi Software. A total of 20 video events were recorded with a total compensation of \$12 if participants watched the trigger video all the time. Response times and attention tasks were also embedded and recorded into this Psychopy task. The same task was also brought online through Pavlovia Software so that the participants could use it at the different follow up times throughout the study.

Counterconditioning

A counterconditioning video was created using the same process established above using PsychoPi. In this case the participants did not have an option to choose from, but got compensated (\$4 for each trigger video and \$0 for each static video) as a conditional stimulus. The implementation of this task was intended to be used as the mechanism through which the emotional valence of the trigger could be updated. In doing so, the trigger was hoped to be associated with the positive valence of obtaining monetary compensation instead of the original feeling of anger, disgust or anxiety that the trigger had had.

Analysis

The analysis of all the data collected was analyzed through JASP (version 0.16.1 JASP team, 2022).

4.3 Measures

Misophonia reactivity - the desire to not be exposed to a specific trigger in fear of the physical, emotional and psychological repercussions that arise from such triggers was measured through several parameters. Surveys and questionnaires (MAQ, MQ, AMISOS and AMISOSr) that are designed to analyze misophonia reactivity were implemented at different periods of time for self-declared statuses of misophonia reaction. Through the analysis of reaction changes we hoped to see a trend dependent on the treatment the participant underwent. Another measurement of misophonia reactivity is the scores each participant obtained in their follow up Approach Avoidance task compared to their initial score.

Reconsolidation - the process through which memories can be recalled, and re-stored after being modified into stabilized long-term memories. The study analyzed this process by having reminders of the participant triggers (11 sec video) or control reminders (control - static video) prior to intervention and distraction tasks. Approach Avoidance task in this parameter also functions as a reconsolidation measurement. Since, the participants that undergo reminder are expected to have gone through an update memory the Approach Avoidance task is expected to be a proper indicator of the evolution and power reconsolidation had on the participants.

4.4 Procedure

Once participants showed interest in participating in the study, they received a phone call from the research team. This preliminary phone screen served as an introduction to the study, where researchers explained the process step by step, asked them questions to determine their eligibility as well as determined the test subgroup they may be eligible for. After determining what subgroup the participants pertained to, they underwent a zoom call where they gave their consent. During

this time, the participant granted researchers permission to record the zoom call while they performed the MINI diagnostic questionnaire. The purpose of the MINI and the recording was explained to the participant as being needed to know if they had any potential psychological condition that could explain their Misophonia, as well as getting validated opinion from psychologists and psychiatrists in the team. Once the consent call was finished, the participant would receive a battery of surveys and questionnaires MAQ, MQ, AMISOS and AMISOSr as well as the additional surveys pertaining to personality, emotionality, and psychological state of mind. At this point the participant also received the link for their first Approach Avoidance test. Once consent was obtained and surveys had been completed successfully (Misophonia score pass), the participant scheduled a visit at the Seaver Center at Mount Sinai. Participants who had been selected for the behavioral trial got designated to either manipulation (group 1) or to control (group 2) (see Figure 2). Group 1 underwent a reminder of their trigger (reconsolidation) and counterconditioning, while group 2 underwent counterconditioning without reminder (static screen). Designation to either group 1 or 2 was chosen by a simple coin toss as a method of randomization.

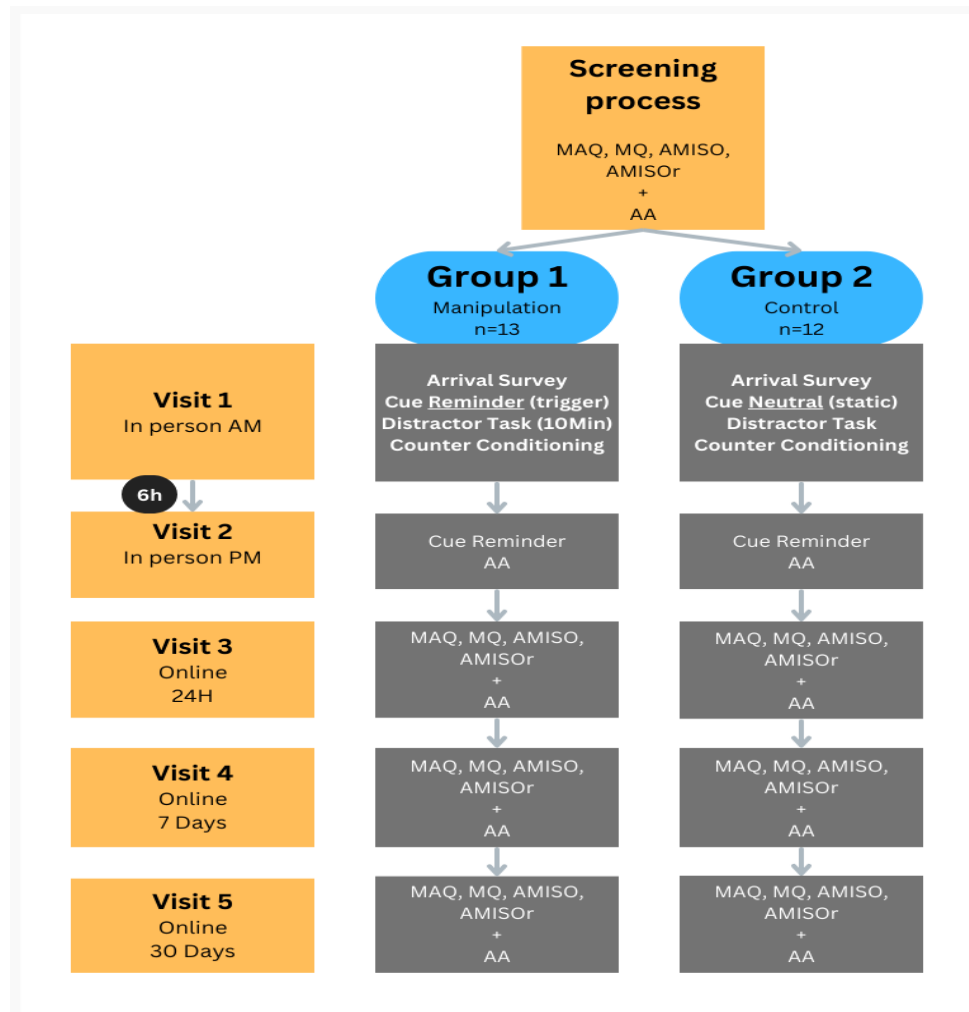


Figure 2. Experimental and Control Group Schedule of Events

In their first in person visit (Visit 1), all participants filled in a survey reporting their stress level of that day. After the arrival survey researchers asked the participants to declare whether they had refrained from taking any medication 24h prior to arriving, whether they had used drugs of abuse or if they happened to be pregnant. Once answers were collected all participants were directed to watch a video. The video was either a triggering video (reminder) or a static screen. The volume of the video was set to 8 bars for all participants. Participants were then instructed to rate their experience of the video. Following this, the clinician performed a distraction task on the

participants, lasting 10 minutes. The distraction task consisted of some subparts of the Wechsler Adult Intelligence task (WAIS-IV), specifically: digit span and simple arithmetic questions. The participants had to repeat the numbers read to them in a specific order or answer simple math questions. This distraction task was implemented to prevent participants from interacting and reactivating the memory of their misophonia triggers. Once this was completed a counterconditioning video was shown to the participants, where the participants obtained monetary compensation for watching the videos (they had no choice as to what they could watch).

Six hours after visit 1 took place, participants had to come back to the center to start session 2 (Visit 2). All participants watched their respective short clip video reminding them of their trigger regardless of what group they were in. After this, the participants were then presented with an Approach Avoidance task (same task they had done in their screening process). After finishing the Approach Avoidance task, Visit 2 was completed and participants were sent home.

Participants received 3 online follow ups after in person session 1 and 2. These were 24 hours after the in person visit (Visit 3), a week after (Visit 4) and a month after (Visit 5). All three follow ups were identical. The participant filled in the 4 misophonia surveys (MAQ, MQ, AMISOS and AMISOSr) and completed an approach avoidance task. Participants were instructed to use a computer and headphones to complete the Approach Avoidance task and the volume was specified.

The total time spent completing surveys and tasks was estimated to be approximately 5h & 30 min and compensation was postulated to be \$20/h. Therefore, the participants were paid \$110 with the

option of an additional bonus depending on how they interacted with the Approach Avoidance. The Approach Avoidance tasks gave the participant the chance to collect an additional \$12 each time they completed the task. The total compensation ranged from \$110 to \$170 maximum depending on the participant choices in the Approach Avoidance task.

5. Results

The effects of reconsolidation in the misophonic samples were analyzed using Linear Mixed Models ANOVA (analysis of variance) to analyze the data in relation to the time frame (Screening, Visit 1, 2, 3 and 4) as the within-subjects parameter and group (1 and 2) as the between-subject factor.

5.1 Approach Avoidance (AA)

The results obtained by the analysis revealed that there was no significant main effect on the Approach Avoidance scores when accounting for session as a fixed effect ($F(4, 75.40) = 1.40, p = .24$) nor group as fixed ($F(1, 23.78) = .031, p = .86$) and no significant interaction between session and group ($F(4, 75.40) = .42, p = .79$). These findings suggest that neither the type of session nor the group had an impact on the approach avoidance score in our study (See Table 2).

ANOVA Summary

Effect	df	F	p	VS-MPR*
Session	4, 75.40	1.405	0.241	1.073
Group	1, 23.78	0.031	0.861	1.000
Session * Group	4, 75.40	0.422	0.792	1.000

Note. 18 observations (missing sessions) were removed due to missing values.

Note: All random slopes involving "Group" have been removed for the random effects grouping factor 'FFID'. -- Factor 'Group' does not vary within the levels of random effects grouping factor 'FFID'.

Note. Model terms tested with Satterthwaite testMethod.

Note: Random slope of "Session" for the random effects grouping factor 'FFID' removed -- Too few observations to estimate random slope of "Session" for random effects grouping factor 'FFID'.

Note. The following variable is used as a random effects grouping factor: 'FFID'.

Note. Type III Sum of Squares

* Vovk-Sellke Maximum p -Ratio: Based on a two-sided p -value, the maximum possible odds in favor of H_1 over H_0 equals $1/(-e p \log(p))$ for $p \leq .37$ (Sellke, Bayarri, & Berger, 2001).

Table 2. Linear Mixed Models ANOVA analyzing AA in relation to the time frame as the within-subjects parameter (Screening, Visit 1, 2, 3 and 4) and the group (1 and 2) as the between-subject factor.

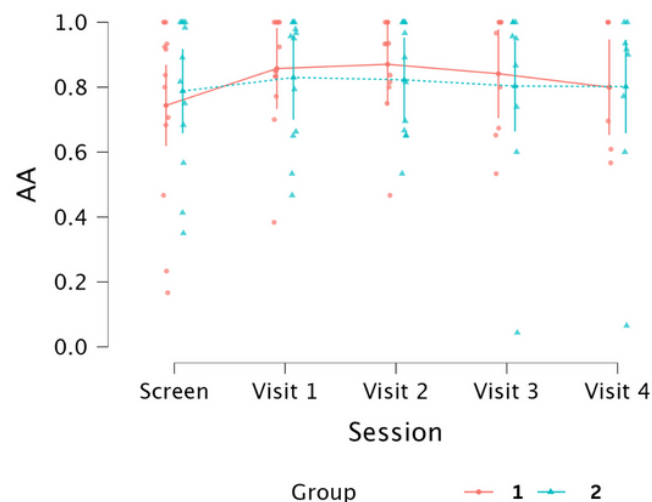


Figure 3. AA scores - Graph represents the longitudinal progression of the two groups in each of their visits. Screen = pre-intervention, Visit 2 = 24h after intervention, Visit 3 = 7 days after intervention, Visit 4 = 1 month after Intervention.

Although no statistical significance was reached, visual interpretation of the data (see figure 3) suggest that group 1 (which underwent reminder) did have a slight improvement of AA from Screening session ($M = .744$, 95% CI [.622, .865]) to Visit 1 (In person session) ($M = 0.857$ (95% CI [.736, .979]) and Visit 2 (24h after in person) ($M = .870$, 95% CI [.746, .994]). However, even though Paired Sample T Test shows some size difference (see table #) between Approach

Avoidance scores at screening compared to Visit 1 ($t = -2.019$, $p = .055$), post-hoc pairwise comparison revealed that this improvement was not statistically significant after comparing multiple comparisons (Bonferroni correction, $p > .05$). (See table 3)

Paired Samples T-Test

Measure 1		Measure 2	t	df	p
AA_S	-	AA_1	-2.019	24	0.055
AA_S	-	AA_2	-1.909	23	0.069
AA_S	-	AA_3	-0.842	17	0.411
AA_S	-	AA_4	-0.142	14	0.889

Note. Student's t-test.

Table 3. Describing the differences between AA Screening to each of the different session scores of AA. Screen = AA_S, visit 1 (6h after intervention) = AA_1, visit 2 (24h after intervention) = AA_2, visit 3 (7 days after intervention) = AA_3, visit 4 (30 days after intervention) = AA_4.

These findings suggest that although a trend can be visually inferred, the data is not sufficient to draw statistical conclusions. Therefore, at most, this trend seems to indicate AA could pose some benefits in treating misophonic patients.

5.2 Questionnaires

In a similar matter, linear mixed model analysis was performed to analyze the evolution of misophonic triggers through the questionnaires. What follows is a synopsis of the findings after Vovk-Sellke Maximum p-Ratio correction.

MAQ

There was a significant main effect on Session ($F(3, 57.19) = 3.582$, $p = 0.019$), indicating that there was a significant change in the participant responses at the different sessions, but no such

findings were found while accounting for Group ($F(1, 23.02) = 0.133, p = 0.719$). Statistical analysis taking into consideration the interaction between Session and Group was also deemed not significant ($F(3, 57.19) = 2.121, p = 0.108$) (See table and figure 4).

ANOVA Summary MAQ

Effect	df	F	p	VS-MPR*
Session	3, 57.19	3.582	0.019	4.857
Group	1, 23.02	0.133	0.719	1.000
Session * Group	3, 57.19	2.121	0.108	1.534

Note. 37 observations were removed due to missing values.

Note: All random slopes involving "Group" have been removed for the random effects grouping factor 'FFID'. -- Factor 'Group' does not vary within the levels of random effects grouping factor 'FFID'.

Note. Model terms tested with Satterthwaite testMethod.

Note: Random slope of "Session" for the random effects grouping factor 'FFID' removed -- Too few observations to estimate random slope of "Session" for random effects grouping factor 'FFID'.

Note. The following variable is used as a random effects grouping factor: 'FFID'.

Note. Type III Sum of Squares

* Vovk-Sellke Maximum p -Ratio: Based on a two-sided p -value, the maximum possible odds in favor of H_1 over H_0 equals $1/(-e p \log(p))$ for $p \leq .37$ (Sellke, Bayarri, & Berger, 2001).

Table 4. Linear Mixed Models ANOVA analyzing MAQ in relation to the time frame as the within-subjects parameter (Screening, Visit 1, 2, 3 and 4) and the group (1 and 2) as the between-subject factor.

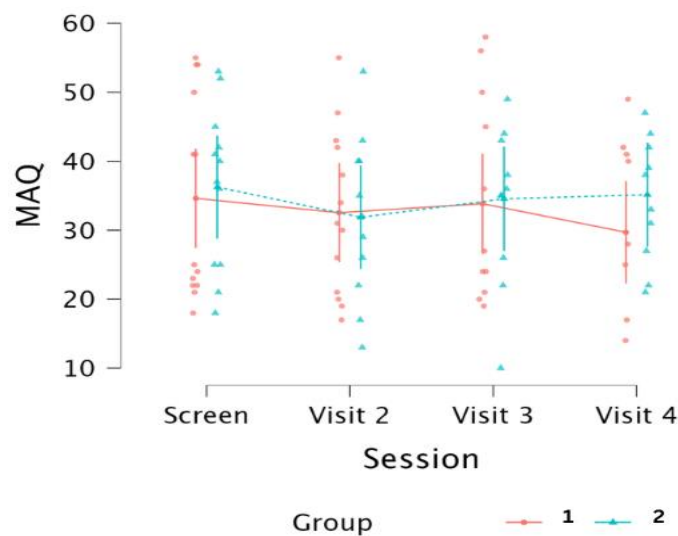


Figure 4. MAQ scores - Graph represents the longitudinal progression of the two groups in each of their visits. Screen = pre-intervention, Visit 2 = 24h after intervention, Visit 3 = 7 days after intervention, Visit 4 = 1 month after Intervention.

MQ

The results of the analysis revealed that there was no significant main effect on MQ while accounting for session ($F(3, 57.08) = 2.499, p = 0.069$) nor group as fixed ($F(1, 22.97) = 0.005, p = 0.943$) and no significant interaction between session and group ($F(3, 57.08) = 2.317, p = 0.085$) (see Table and Figure 5).

ANOVA Summary

Effect	df	F	p	VS-MPR*
Session	3, 57.08	2.499	0.069	2.000
Group	1, 22.97	0.005	0.943	1.000
Session * Group	3, 57.08	2.317	0.085	1.753

Note. 37 observations were removed due to missing values.

Note: All random slopes involving "Group" have been removed for the random effects grouping factor 'FFID'. -- Factor 'Group' does not vary within the levels of random effects grouping factor 'FFID'.

Note. Model terms tested with Satterthwaite testMethod.

Note: Random slope of "Session" for the random effects grouping factor 'FFID' removed -- Too few observations to estimate random slope of "Session" for random effects grouping factor 'FFID'.

Note. The following variable is used as a random effects grouping factor: 'FFID'.

Note. Type III Sum of Squares

* Vovk-Sellke Maximum p -Ratio: Based on a two-sided p -value, the maximum possible odds in favor of H_1 over H_0 equals $1/(-e p \log(p))$ for $p \leq .37$ (Sellke, Bayarri, & Berger, 2001).

Table 5. Linear Mixed Models ANOVA analyzing MQ in relation to the time frame as the within-subjects parameter (Screening, Visit 1, 2, 3 and 4) and the group (1 and 2) as the between-subject factor.

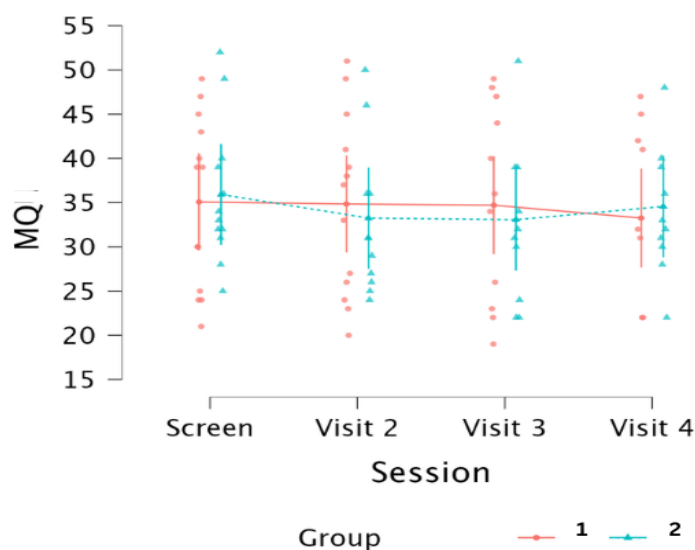


Figure 5. MQ scores - Graph represents the longitudinal progression of the two groups in each of their visits. Screen = pre-intervention, Visit 2 = 24h after intervention, Visit 3 = 7 days after intervention, Visit 4 = 1 month after Intervention.

AMISOSr

Analysis of variance of the AMISOSr questionnaire indicated that there was a significant main effect of session ($F(3, 57.03) = 3.415, p = 0.023$), but no significance in effect was observed in groups ($F(1, 22.86) = 1.432, p = 0.244$). The interaction between groups and sessions was also not significant ($F(3, 57.03) = 0.479, p = 0.698$) (see Figure and Table 6).

ANOVA Summary

Effect	df	F	p	VS-MPR*
Session	3, 57.03	3.415	0.023	4.201
Group	1, 22.86	1.432	0.244	1.069
Session * Group	3, 57.03	0.479	0.698	1.000

Note. 37 observations were removed due to missing values.

Note: All random slopes involving "Group" have been removed for the random effects grouping factor 'FFID'. -- Factor 'Group' does not vary within the levels of random effects grouping factor 'FFID'.

Note. Model terms tested with Satterthwaite testMethod.

Note: Random slope of "Session" for the random effects grouping factor 'FFID' removed -- Too few observations to estimate random slope of "Session" for random effects grouping factor 'FFID'.

Note. The following variable is used as a random effects grouping factor: 'FFID'.

Note. Type III Sum of Squares

* Vovk-Sellke Maximum p -Ratio: Based on a two-sided p -value, the maximum possible odds in favor of H_1 over H_0 equals $1/(-e p \log(p))$ for $p \leq .37$ (Sellke, Bayarri, & Berger, 2001).

Table 6. Linear Mixed Models ANOVA analyzing AMISOSr in relation to the time frame as the within-subjects parameter (Screening, Visit 1, 2, 3 and 4) and the group (1 and 2) as the between-subject factor.

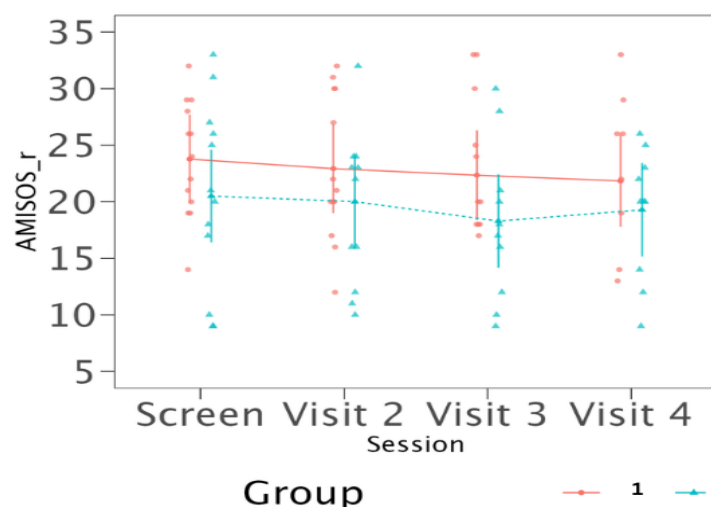


Figure 6. AMISOSr scores - Graph represents the longitudinal progression of the two groups in each of their visits. Screen = pre-intervention, Visit 2 = 24h after intervention, Visit 3 = 7 days after intervention, Visit 4 = 1 month after Intervention.

AMISOS

The linear mixed model of AMISOS revealed through the analysis of variance that there was no significance in the main effect of session ($F(3, 57.30) = 2.493, p = 0.069$) nor group main effect ($F(1, 23.00) = 1.595, p = 0.219$) and the interaction between session and group also indicated no statistically significant difference ($F(3, 57.30) = 1.170, p = 0.329$) (see Table and Figure 7).

ANOVA Summary

Effect	df	F	p	VS-MPR*
Session	3, 57.30	2.493	0.069	1.993
Group	1, 23.00	1.595	0.219	1.106
Session * Group	3, 57.30	1.170	0.329	1.006

Note. 37 observations were removed due to missing values.

Note: All random slopes involving 'Group' have been removed for the random effects grouping factor 'FFID'. -- Factor 'Group' does not vary within the levels of random effects grouping factor 'FFID'.

Note. Model terms tested with Satterthwaite testMethod.

Note: Random slope of 'Session' for the random effects grouping factor 'FFID' removed -- Too few observations to estimate random slope of 'Session' for random effects grouping factor 'FFID'.

Note. The following variable is used as a random effects grouping factor: 'FFID'.

Note. Type III Sum of Squares

* Vovk-Sellke Maximum p -Ratio: Based on a two-sided p -value, the maximum possible odds in favor of H_1 over H_0 equals $1/(-e p \log(p))$ for $p \leq .37$ (Sellke, Bayarri, & Berger, 2001).

Table 7. Linear Mixed Models ANOVA analyzing AMISOS in relation to the time frame as the within-subjects parameter (Screening, Visit 1, 2, 3 and 4) and the group (1 and 2) as the between-subject factor.

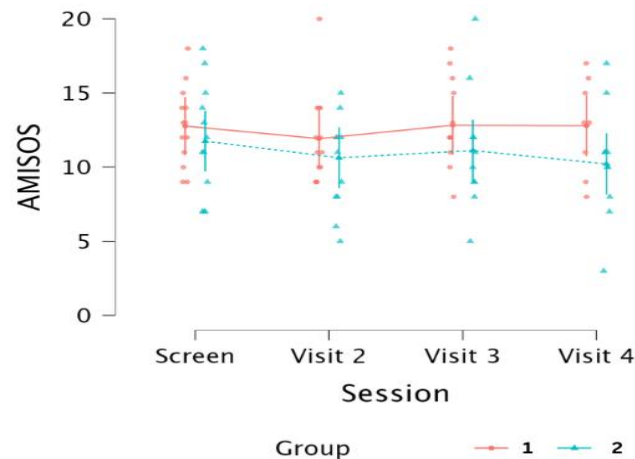


Figure 7. AMISOS scores - Graph represents the longitudinal progression of the two groups in each of their visits. Screen = pre-intervention, Visit 2 = 24h after intervention, Visit 3 = 7 days after intervention, Visit 4 = 1 month after Intervention.

6. Discussion, Recommendations, & Conclusions

The results from the analysis showcase the longitudinal evolution of the two groups in their scores of AA and the 4 questionnaires. Even though the findings did not indicate any significance in respect to reconsolidation, there is a case to be made on the role of counterconditioning. Nevertheless, with the data collected so far, the hypothesis that “participants that undergo a reminder of their trigger prior to receiving counterconditioning will show a significant reduction of their aversive responses compared to misophonic participants that do not get a reminder” has not been supported.

In contrast to the hypothesis, the results seem to indicate that counterconditioning (which was given to both groups) improves misophonic symptoms. In both groups, avoidance of the misophonic triggers decreased, while the misophonic scores from the questionnaires decreased, indicating that the misophonic triggers were losing their aversive effects. These findings are interesting since they indicate that a therapeutic and experimental protocol relying on counterconditioning could potentially change emotional valence associated with misophonic triggers. In other words, even though reconsolidation did not seem to play a role in AA and some of the questionnaires, in this limited sample, counterconditioning on its own does show some promise. Further studies would benefit from having a true control group where the participants do not get any intervention, neither reconsolidation reminder nor counterconditioning.

In regards to the Approach-Avoidance task results, the biggest significance was deemed to be between Screening and Visit 1 and 2. The lower scores at screening could have been caused by the novelty of the triggering video. However, since the trigger video was constant throughout the experiment, the results may also be due to the habituation and practice the subjects experienced. Therefore, the aversion to the video may have lost its power, causing both groups to respond similarly regardless of intervention. Findings in the questionnaire analysis indicate that out of the 4 questionnaires analyzed, MAQ and AMISOSr had significant changes in regards to the session. This is specifically true in scoring going from Screening to Visit 2. Visit 2 scores happened 24h after counterconditioning (in person sessions), and no effect was found comparing the two groups' evolution.

In respect to the difference between groups, it may well be the case that misophonia is an ingrained maladaptive memory that has been exposed to consolidation and reconsolidation over a multiplicity of times. This may cause the negative valence of the trigger to be more stable than we anticipated. In order to change the valence, we may have to repeat the reconsolidation update multiple times at different sessions before a significant improvement can be found. Similar results and conclusions are found in other studies where the reconsolidation paradigm was put to test in smoking and alcohol cessation as well as in animal models (Suzuki et al., 2004). In these studies, the longer the participant smoked/drank, the less effect reconsolidation had in the craving (Das et al., 2015). Thus, there is a case to be made that reconsolidation is affected by the years a memory has. In this study the participants reported experiencing their first misophonic symptoms, on average, at age 11 and the age of our participants oscillated around 35 years of age. In other words, in this study researchers were trying to treat a maladaptive memory that is 24 years old with a single reconsolidation update intervention. To verify this hypothesis, further studies would need to analyze the efficiency reconsolidation poses to maladaptive memories in respect to the period of time elapsed since the memory was first consolidated. As mentioned in the misophonia chapter, not many studies have been done in the acquisition of misophonia. Even though it is estimated to appear at around age 12, no study has tried to remediate misophonia in preteens. Analyzing the effect of reconsolidation in this group (preteens) and comparing it to our sample (average 35 years of age) may demonstrate the age dependency of the reconsolidation paradigm.

Another factor to consider in explaining the results is the monetary compensation given to the participants. Compensation was provided constant (no option) in the counterconditioning and variable during Approach Avoidance (dependent of choice). Implementing monetary

compensation as the positive reinforcer through which to change the emotional valence of the trigger may not have been sensitive enough in conditioning or tracking the responses. Individual perspectives on monetary compensation appraisal would lead to a more robust analysis.

It may also have been the case that in an uncontrolled manner both groups underwent reconsolidation. The expectancy of being triggered at the in-person visit 1, may have caused the participants to reactivate their misophonic memories, activating their reconsolidation process which ended up being updated regardless of experiencing the cue reminder (group 1) or the static screen (group 2). Or on the other hand, perhaps the reminder that was given to Group 1 was not efficient in triggering the misophonia of the patient, thus not reactivating and destabilizing the maladaptive memory.

Further studies with larger samples are needed to analyze the efficacy of reconsolidation. Increasing the sample size may result in more robust conclusions and perhaps even change the findings. In addition, a more personalized assessment of monetary values in each participant could determine the efficacy that monetary reward might have as an update mechanism (modify memory). Lastly, comparing the sample to younger subsets would allow us to determine whether the time period elapsed since the memory was first consolidated plays a role in the need for repeated reconsolidation paradigms in order to change memories valence.

In summary, in this study we set to test the reconsolidation paradigm potential in updating misophonia maladaptive memories. Our analysis did not conclude that there was a significant difference between undergoing theorized reconsolidation compared to no reconsolidation.

Although there was a slight improvement in the approach avoidance task in the experimental group (group1-Reminder), the small sample from which this analysis arises does not allow for a definite conclusion. However, the results do indicate that there is an amelioration of the symptoms in both groups, indicating that counterconditioning, which was given to both groups, is a prospective therapeutic mechanism.

Appendixes

1. Misophonia Assessment Questionnaire (MAQ)

By Marsha Johnson, revised by Tom Dozier 07/20/13

If a parent or caregiver, please answer for the child as best you are able, or substitute the words, “I feel that my child’s sound issues” for the words “my sound issues”.

RATING

SCALE:

0 = not at all, 1 = a little of the time, 2 = a good deal of the time, 3 = almost all the time

1. My sound issues currently make me unhappy.
2. My sound issues currently create problems for me.
3. My sound issues have recently made me feel angry.
4. I feel that no one understands my problems with certain sounds.
5. My sound issues do not seem to have a known cause.
6. My sound issues currently make me feel helpless.
7. My sound issues currently interfere with my social life.
8. My sound issues currently make me feel isolated.
9. My sound issues have recently created problems for me in groups.
10. My sound issues negatively affect my work/school life (currently or
11. My sound issues currently make me feel frustrated.
12. My sound issues currently impact my entire life negatively.
13. My sound issues have recently made me feel guilty.
14. My sound issues are classified as ‘crazy’.
15. I feel that no one can help me with my sound issues.
16. My sound issues currently make me feel hopeless.
17. My sound issues will only get worse with time.
18. My sound issues currently impact my family relationships.
19. My sound issues have recently affected my ability to be with other
20. My sound issues have not been recognized as legitimate.
21. I am worried that my whole life will be affected by sound issues.

2. Misophonia Questionnaire (MQ)

By Wu, Lewin, Murphy, & Storch, 2014; Cash, 2015

The Misophonia Questionnaire was developed for a study at the University of South Florida, and it was also used in a recent doctoral dissertation. The study considered a score of 7 or higher on the misophonia severity scale (part 3, 1-15 rating) to be “clinically significant.” This means that misophonia created a serious problem in their life that warranted seeking treatment. Adding the score of all 20 questions provides an overall measure of misophonia severity.

Part 1. Misophonia Symptom Scale

Directions: Please rate how much the following statements describe you on a scale from 0 to 4.

0: Not at all True

1: Rarely True

2: Sometimes True

3: Often True

4: Always True

In comparison to other people, I am sensitive to the sound of:

1. People eating (e.g. chewing, swallowing, lips smacking, slurping, etc.).
2. Repetitive tapping (e.g. pen on table, foot on floor, etc.).
3. Rustling (e.g. plastic, paper, etc.).
4. People making nasal sounds (e.g. inhale, exhale, sniffing, etc.).
5. People making throat sounds (e.g. throat-clearing, coughing, etc.).
6. Certain consonants and/or vowels (e.g. “k” sounds, etc.).
7. Environmental sounds (e.g. clock ticking, refrigerator humming, etc.).
8. Other: _____

Part2. Misophonia Emotions and Behaviors Scale

Directions: If any of the aforementioned statements were given a value of “1 – Rarely True” or higher, please continue onto the following section and rate how often the subsequent statements occur, 0 being “Never” and 4 being “Always.”

0: Never

1: Rarely

2: Sometimes

3: Often

4: Always

Once you are aware of the sound(s), because of the sound(s), how often do you:

1. Leave the environment to a place where the sound(s) cannot be heard anymore?
2. Actively avoid certain situations, places, things, and/or people in anticipation of the sound(s)?
3. Cover your ears?
4. Become anxious or distressed?
5. Become sad or depressed?
6. Become annoyed?
7. Have violent thoughts?
8. Become angry?
9. Become physically aggressive?
10. Become verbally aggressive?
11. Other: _____

Part 3. Misophonia Severity Scale

Directions: Please rate the severity of your sound sensitivity on the following scale from 1 (minimal) to 15 (very severe). Please consider the number of sounds that you are sensitive to, the degree of distress, and the impairment in your life due to your sound sensitivities.

____ If you do not have any sound sensitivities, please check here.

1-3: Minimal within range of normal or very mild sound sensitivities. I spend little time resisting or being affected by my sound sensitivities. Almost no or no interference in daily activity.

4-6: Mild sound sensitivities. Mild sound sensitivities that are noticeable to me and to an observer, cause mild interference in my life and which I may resist or be affected for a minimal period of time. Easily tolerated by others.

7-9: Moderate sound sensitivities. Sound sensitivities that cause significant interference in my life and which I spend a great deal of conscious energy resisting or being affected by. Require some help from others to function in daily activity.

10-12: Severe sound sensitivities. Sound sensitivities that are crippling to me, interfering so that daily activity is “an active struggle.” I may spend full time resisting my sound sensitivities or being affected by them. Require much help from others to function.

13-15: Very severe sound sensitivities. Sound sensitivities that completely cripple me so that I require close supervision over eating, sleeping, and so forth. It is hard to function on a day-to-day basis because of this.

3. Amsterdam Misophonia Scale (AMISOS)

By Schröder, Vulink, & Denys, 2013.

Note: This form has been modified by replacing “sounds” with “triggers” to include visual and sound triggers.

The Amsterdam Misophonia Scale (A-MISO-S) is an adaptation of the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) and was developed by researchers in Amsterdam. The severity of your misophonia is determined by the sum of the points from these questions.

AMSTERDAM MISOPHONIA SCALE: Rate the characteristics of each item during the prior week up until and including the time you fill out this survey. Scores should reflect the average (mean) occurrence of each item for the entire week.

Q1. How much of your time is occupied by misophonic triggers? How frequently do the (thoughts about the) misophonic triggers occur?

0: None

1: Mild – less than 1 hr/day, or occasional (thoughts about) triggers (no more than 5 times a day)

2: Moderate – 1 to 3 hrs/day, or frequent (thoughts about) triggers (no more than 8 times a day, most of the hours are unaffected).

3: Severe – greater than 3 hrs and up to 8 hrs/day or very frequent (thoughts about) triggers.

4: Extreme – greater than 8 hrs/day or near constant (thoughts about) triggers.

Q2. How much do these misophonic triggers interfere with your social, work or role functioning? (Is there anything that you don't do because of them? If currently not working, determine how much performance would be affected if you were employed.)

0: None

1: Mild – slight interference with social or occupational/school activities, but overall performance not impaired.

2: Moderate – definite interference with social or occupational performance, but still manageable.

3: Severe – causes substantial impairment in social or occupational performance.

4: Extreme – incapacitating.

Q3. How much distress do the misophonic triggers cause you? (In most cases, distress is equated with irritation, anger, or disgust. Only rate the emotion that seems triggered by misophonic triggers, not generalized irritation or irritation associated with other conditions.)

0: None

1: Mild – occasional irritation/distress.

2: Moderate – disturbing irritation / anger / disgust, but still manageable.

3: Severe – very disturbing irritation/anger/disgust.

4: Extreme – near constant and disturbing anger/disgust.

Q4. How much effort do you make to resist the (thoughts about the) misophonic triggers? (How often do you try to disregard or turn your attention away from these triggers? Only rate effort made to resist, not success or failure in actually controlling the thought or sound.)

0: Makes an effort to always resist, or symptoms so minimal, doesn't need to actively resist.

1: Tries to resist most of the time.

2: Makes some effort to resist.

3: Yields to all (thoughts about) misophonic triggers without attempting to control them, but does so with some reluctance.

4: Completely and willingly yields to all obsessions.

Q5. How much control do you have over your thoughts about the misophonic triggers? How successful are you in stopping or diverting your thinking about the misophonic triggers? Can you dismiss them?

0: Complete control.

1: Much control – usually able to stop or divert thoughts about misophonic triggers.

2: Moderate control – sometimes able to stop or divert thoughts about misophonic triggers.

3: Little control – rarely successful in stopping or dismissing thoughts about misophonic triggers, can only divert attention with difficulty.

4: No control – experience thoughts as completely involuntary, rarely able to alter thinking about misophonic triggers.

Q6. Have you been avoiding doing anything, going any place, or being with anyone because of your misophonia? (How much do you avoid, for example, by using other loud sounds, such as music?)

0: No deliberate avoidance.

1: Mild, minimal avoidance. Less than an hrs/day or occasional avoidance.

2: Moderate, some avoidance. 1 to 3 hrs/day or frequent avoidance.

3: Severe, much avoidance. Greater than 3 up to 8 hrs/day. Very frequent avoidance.

4: Extreme very extensive avoidance. Greater than 8 hr/day. Doing almost everything you can to avoid triggering symptoms.

Finally:

What would be the worst thing that could happen to you if you were not able to avoid the misophonic triggers?

Describe:

The sum score of these questions determines the severity rating as follows:

– 0-4: Subclinical (meaning you do not need treatment)

– 5-9: Mild

– 10-14: Moderate

– 15-19: Severe

– 20-24: Extreme

4. Amsterdam Misophonia Scale Revised (AMISOSr)

By Schröder & Spape 2014, Translation Jager & Wattenberg 2018

In comparison to others I am sensitive to:

(multiple answers possible)

- Eating sounds (e.g. chewing, smacking, slurping, swallowing) ○ Nasal sounds (e.g. sniffing, breathing in, breathing out)
- Throat sounds (e.g. harrumphing, coughing)
- Specific sounds (e.g. 'k' sound) Repeating clicking sounds (e.g. nails on a blackboard, pen clicking) ○
- Crinkling sounds (e.g. paper, plastic)
- Ambient noises (e.g. clock ticking noise or similar devices)

Which emotions are evoked by listening to those sounds?*(multiple answers possible)*

- ☐ Irritation
- ☐ Anger
- ☐ Disgust
- ☐ Other:

Review your experience from hearing your misophonia sounds *in the last 3 days*. Read instead of “sounds” your most disturbing misophonia sounds and instead of “emotion” your typical emotion. Choose the answer that is most applicable for you.

1. How many time do you spend a day (thinking about) these sounds?	0 hour 0	< 1 hour 1	1-3 hour 2	3-8 hour 3	>8 hour 4
2. To what extent do you focus on these sounds?	not 0	mild 1	moderate 2	severe 3	extreme 4
3. To what extent do you experience impairment due to these sounds?	not 0	mild 1	moderate 2	severe 3	extreme 4
4. How intense is your feeling of irritability/anger when you hear these sounds?	not 0	mild 1	moderate 2	severe 3	extreme 4
5. To what extent do you feel helpless against these sounds?	not 0	mild 1	moderate 2	severe 3	extreme 4
6. To what extent are you suffering from these sounds?	not 0	mild 1	moderate 2	severe 3	extreme 4
7. To what extent are you suffering from the avoidance of these sounds?	not 0	mild 1	moderate 2	severe 3	extreme 4
8. To what extent are the sounds limiting your life (work, household etc.)?	not 0	mild 1	moderate 2	severe 3	extreme 4

9. To what extent are you avoiding specific places or situations because of the sounds?	not 0	mild 1	moderate 2	severe 3	extreme 4
10. To what extent can you shift your attention when you are hearing these sounds?	always 0	usually (75%) 1	sometimes (50%) 2	seldom (25%) 3	never 4

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