Misophonia: Incidence, Phenomenology, and Clinical Correlates in an Undergraduate Student Sample

Monica S. Wu,[1,2] Adam B. Lewin,[1,2] Tanya K. Murphy,[1] and Eric A. Storch[1,2,3]

[1] *University of South Florida Morsani College of Medicine*
[2] *University of South Florida, Department of Psychology*
[3] *Rogers Behavioral Health - Tampa Bay*

Objective: Individuals with misophonia display extreme sensitivities to selective sounds, often resulting in negative emotions and subsequent maladaptive behaviors, such as avoidance and anger outbursts. While there has been increasing interest in misophonia, few data have been published to date. **Method:** This study investigated the incidence, phenomenology, correlates, and impairment associated with misophonia symptoms in 483 undergraduate students through self-report measures. **Results:** Misophonia was a relatively common phenomenon, with nearly 20% of the sample reporting clinically significant misophonia symptoms. Furthermore, misophonia symptoms demonstrated strong associations with measures of impairment and general sensory sensitivities, and moderate associations with obsessive-compulsive, anxiety, and depressive symptoms. Anxiety mediated the relationship between misophonia and anger outbursts. **Conclusion:** This investigation contributes to a better understanding of misophonia and indicates potential factors that may co-occur and influence the clinical presentation of a person with misophonia symptoms. © 2014 Wiley Periodicals, Inc. J. Clin. Psychol. 70:994–1007, 2014.

Keywords: misophonia; obsessive-compulsive disorder; adult; phenomenology; impairment

Misophonia, literally meaning "hatred of sound" (Jastreboff & Jastreboff, 2002), is a form of decreased sound tolerance that is characterized by extreme sensitivity to selective sounds.

We acknowledge Robert F. Dedrick, Ph.D., for his contributions and guidance regarding measurement research.

Ms. Wu has no financial disclosures to report. Dr. Lewin receives grant funding from the University of South Florida Research Council, National Institutes of Health, Agency for Healthcare Research and Quality, Centers for Disease Control, National Alliance for Research on Schizophrenia and Affective Disorders, Joseph Drown Foundation, and International OCD Foundation. He is a consultant for Prophase, Inc. and has received speaker's honorariums from the Tourette Syndrome Association. He received travel reimbursement from Roche Pharmaceuticals. Dr. Storch has received grant funding in the last 3 years from the National Institutes of Health, All Children's Hospital Research Foundation, Centers for Disease Control, Agency for Healthcare Research and Quality, National Alliance for Research on Schizophrenia and Affective Disorders, International OCD Foundation, Tourette Syndrome Association, and Ortho McNeil Scientific Affairs. He receives textbook honorarium from Springer publishers, American Psychological Association, and Lawrence Erlbaum. Dr. Storch has been an educational consultant for Rogers Memorial Hospital. He is a consultant for Prophase, Inc. and CroNos, Inc., and is on the Speaker's Bureau and Scientific Advisory Board for the International OCD Foundation. Dr. Murphy has received research support in the past 3 years from National Institutes of Health, Ortho McNeil Scientific Affairs, International OCD Foundation, Tourette Syndrome Association, All Children's Hospital Research Foundation, Centers for Disease Control, Shire, Pfizer Pharmaceuticals, Roche Pharmaceuticals, Otsuka, and Transcept Pharmaceuticals, Inc. Dr. Murphy is on the Medical Advisory Board for Tourette Syndrome Association and Scientific Advisory Board for IOCDF. She receives textbook honorarium from Lawrence Erlbaum.

ES, MW, and, AL designed the study and wrote the protocol. MW conducted the statistical analyses and wrote the first draft of the manuscript. ES, AL, and, TK contributed to and have approved the final manuscript.

The authors declare that they have no conflicts of interest.

Please address correspondence to: Monica S. Wu, Department of Pediatrics, Rothman Center for Neuropsychiatry, University of South Florida, 880 6th Street South, Suite 460, Box 7523, St. Petersburg, FL 33701. E-mail: MonicaWu@mail.usf.edu

 © 2014 Wiley Periodicals, Inc.
Published online in Wiley Online Library (wileyonlinelibrary.com/journal/jclp). DOI: 10.1002/jclp.22098

Individuals with misophonia are often faced with significant distress, anger, or discomfort when exposed to specific auditory triggers (Schröder, Vulink & Denys, 2013), which may include common everyday sounds such as smacking of the lips, eating, chomping of the teeth, and breathing (Schwartz, Leyendecker & Conlon, 2011). Additionally, some individuals may feel compelled to mimic or reproduce the sounds upon hearing them (Edelstein, Brang, Rouw & Ramachandran, 2013; Hadjipavlou, Baer, Lau & Howard, 2008). Consequently, those suffering from misophonia may not be able to eat with others, may avoid certain environments or situations where they know the sounds will be present, and often have strained relationships due to their negative emotional reactions to these auditory stimuli (Neal & Cavanna, 2013; Schröder et al., 2013).

The incidence of misophonia in nonclinical samples is currently unknown. Estimates suggest caseness may affect between 10%–60% in patients with tinnitus, a condition where individuals hear sounds without any actual external auditory stimuli (Hadjipavlou et al., 2008; Sztuka, Pospiech, Gawron & Dudek, 2010), with an estimated 10% of the general population affected by tinnitus (Kochkin, Tyler & Born, 2011).

Putative Causes

Unlike other auditory disorders involving sound, misophonia is not dependent on auditory thresholds or impairment or hyperactivation of the auditory pathways. Instead, it is suggested to be associated with enhanced auditory, limbic, and autonomic nervous system neural connections (Jastreboff & Hazell, 2004; Jastreboff & Jastreboff, 2013). Due to the nature of selective sound sensitivity, neurophysiological structures affected by misophonia may be related to components responsible for processing sounds at a higher level (Møller, 2011). It is posited that the context in which the sound is presented, the individual's perception of and previous experience with the sound, and physical characteristics of the sound may coalesce to determine the reaction or distress to a particular sound (Jastreboff & Jastreboff, 2001).

Clinical Correlates

With regards to psychiatric comorbidity in misophonia, clinical observations have suggested the co-occurrence of internalizing disorders and obsessive-compulsive disorder (OCD) and related conditions (e.g., Tourette Disorder; Edelstein et al., 2013; Hadjipavlou et al., 2008; Neal & Cavanna, 2013; Schwartz et al., 2011). Indeed, the shared characteristics between misophonia and OCD and anxiety disorders–namely, the negative reactions triggered by a specific stimuli, associated level of anxiety and distress, and corresponding need to avoid situations or complete compulsions as a result of certain sounds–have prompted speculation that misophonia is closely related to obsessive-compulsive and related disorders and may be treated using similar modalities (Johnson et al., 2013; Schwartz et al., 2011).

Specifically, the negative reinforcement achieved through distress reduction by engaging in avoidant behaviors and related behavioral responses is analogous to similar maladaptive behaviors exhibited in OCD and anxiety disorders (Kircanski, Peris & Piacentini, 2011). As such, exposure-based cognitive-behavioral interventions may similarly help with the management of misophonia symptoms when utilized in conjunction with audiological treatments, such as Tinnitus Retraining Therapy (Jastreboff, 2011). However, there remains limited research on misophonia, and more extensive investigation is necessary to understand its phenomenology to devise effective interventions.

Although there has been a recent rise in interest regarding misophonia, only case studies (Hadjipavlou et al., 2008; Johnson et al., 2013; Schwartz et al., 2011; Veale, 2006) and two clinical studies (Edelstein et al., 2013; Schröder et al., 2013) have been published to date. As such, the present study investigates the incidence, correlates, and impairment associated with misophonia symptoms in a large undergraduate university student sample. Specifically, this study had the following aims: (a) provide descriptive information about misophonia symptoms (e.g., frequency of various misophonia symptoms endorsed); (b) investigate correlations between misophonia symptoms and impairment in various domains of life (e.g., work/school, social, and

Table 1
Demographic Characteristics of the Study Sample (N = 483)

Variable	
Gender (male/female)	79 males (16.4%)/404 females (83.6%)
Age (years)	*M = 21.43*, *SD* = 4.52 Range = 18 to 54 years
Race/ethnicity	
Caucasian	*n* = 277 (57.3%)
African American	*n* = 51 (10.6%)
Latino/Hispanic	*n* = 88 (18.2%)
Asian	*n* = 23 (4.8%)
Middle Eastern	*n* = 10 (2.1%)
Other/mixed	*n* = 34 (7%)
On psychotropic medication	*n* = 30 (6.2%)

Note. M = mean; SD = standard deviation.

family life/home responsibilities); (c) examine the relationship between misophonia symptoms and other clinical constructs (e.g., sensory sensitivities, OCD, anxiety, depression); and (d) determine possible mediating effects of anxiety on misophonia and misophonia-related anger. We expected that as misophonia symptoms increased, anxiety symptoms would increase as well, and anxiety would be directly related to misophonia-related anger. In other words, it was expected that misophonia-related anger would be indirectly affected by misophonia symptoms through anxiety.

Methods

Participants and Procedures

Participants were 483 undergraduate university students at the University of South Florida (USF) in Tampa, Florida. Details regarding the demographic characteristics of the study sample are presented in Table 1. The majority of participants were female (83.6%), ranging from 18 to 54 years of age (mean [*M*] = 21.43, standard deviation [*SD*] = 4.52). Of the 483 participants, 277 (57.3%) were Caucasian/White, 51 (10.6%) were African American, 23 (4.8%) were Asian, 88 (18.2%) were Latino/Hispanic, 10 (2.1%) were Middle Eastern, and 34 (7%) were reported as other/mixed. The most commonly reported combined gross annual income for the participant's family was over $100,000 (17.2%), with the total sample ranging between under $10,000 to over $100,000 a year.

All data were collected via online administration of questionnaires through a secure online participant pool. The online participant pool is utilized for undergraduate students taking psychology course(s) that wish to receive extra credit for the psychology course(s) they are currently enrolled in (e.g., clinical, experimental, social, cognitive psychology courses). All participants must have been 18 years of age or older to qualify for the study. Participants who were registered through the online participant pool were able to read through an online institutional review board approved informed consent document to learn more about the study. All participants must have electronically acknowledged reading the informed consent and agreed to participate before proceeding with the study. Thereafter, all questionnaires were administered remotely via the online database. Anonymous responses coded with subject numbers could be retrieved through the online participant pool by the study investigators.

Measures

Misophonia Questionnaire. The Misophonia Questionnaire (MQ) is a three-part self-report questionnaire developed by the study authors that assesses misophonia symptom

Table 2
Geomin Rotated Factor Loadings and Eigenvalues for the Misophonia Questionnaire (MQ) Based on a Three-Factor Solution Through Exploratory Factor Analysis

MQ Item	Factor 1	Factor 2	Factor 3
Misophonia Symptom Scale			
1. People eating	**.52**	.12	−.12
2. Repetitive tapping	**.61**	.11	−.11
3. Rustling	**.80**	.04	.07
4. Nasal sounds	**.71**	.01	−.13
5. Throat sounds	**.80**	−.07	−.01
6. Consonants/vowels	**.67**	−.001	.39
7. Environmental sounds	**.75**	−.06	.16
Misophonia Emotions and Behaviors Scale			
1. Leave environment	.04	**.57**	−.25
2. Avoid	.16	**.55**	−.01
3. Cover ears	.004	**.57**	.004
4. Anxious/distressed	−.02	**.67**	−.24
5. Sad/depressed	.004	**.59**	.41
6. Annoyed	.06	**.54**	−.48
7. Violent thoughts	−.05	**.78**	.31
8. Angry	−.01	**.75**	−.13
9. Physically aggressive	.01	**.71**	.65
10. Verbally aggressive	.001	**.78**	.36
Eigenvalues	6.46	2.46	1.44

Note. The highest loadings for each item are bolded.

presence, resulting emotions and behaviors, and the overall severity of sound sensitivities. In preparation for developing this measure, a comprehensive literature search was conducted to ensure the items would be carefully derived from the extant research. Currently published articles containing other measures that assess misophonia symptoms (e.g., Schröder et al., 2013) were not available until after enrollment had commenced for the present study–hence the development of the current measure.

Items were reviewed by psychologists and psychiatrists clinically experienced with misophonia and knowledgeable about the literature, and were piloted on two patients with misophonia in an OCD-specialty outpatient clinic for readability and clarity. Revisions to the items (e.g., rewording items, removing items that did not fit conceptually with the others) were made based on this process. Subsequently, the revised questionnaire was analyzed with exploratory factor analysis through the default settings (e.g., geomin rotation, maximum likelihood estimates) in Mplus (Muthén & Muthén, 1998–2012). Based on the recommendations of Henson and Roberts (2006), a final three-factor solution was determined using multiple methods, specifically derived from parallel analysis and eigenvalues greater than 1 (Table 2).

The first section, named Misophonia Symptom Scale, examines the presence of specific sound sensitivities (e.g., eating, tapping, throat sounds). The second part, named Misophonia Emotions and Behaviors Scale, examines emotional and behavioral reactions associated with misophonia symptoms. Example items include "leaving the environment to a place where the sound(s) cannot be heard anymore" and "become anxious or distressed." The first two parts are rated on a 0 to 4 scale, ranging from 0 (*not at all true*), to 4 (*always true*). The first two sections are summed to form the Total score, with possible values ranging from 0 to 68.

The last section of the questionnaire, named the Misophonia Severity Scale, was adapted from the NIMH Global Obsessive-Compulsive Scale (NIMH GOCS; Murphy, Pickar & Alterman, 1982) to be applicable for misophonia. It allows the respondent to provide a rating of their sound sensitivity on a scale from 1 to 15, ranging from "minimal" to "very severe," respectively, with a score greater than or equal to 7 indicating clinically significant symptoms. Reports of 7

or above indicate at least "moderate sound sensitivities" that cause "significant interference," which mirrors the clinical cutoff that is used for the NIMH GOCS in populations with OCD (St. Clare, 2003).

For the present study, the internal consistency was $\alpha = .86$ for the Misophonia Symptom Scale, $\alpha = .86$ for the Misophonia Emotions and Behaviors Scale, and $\alpha = .89$ for the Total score (i.e., the combination of the first two sections). To preliminarily test convergent validity, a Pearson's product-moment correlation revealed a strong correlation ($r = .50$, $p < .001$) between the total score and the unique question on the Adult Sensory Questionnaire (ASQ; Kinnealey & Oliver, 2002) that assesses the presence of sound sensitivities. To test discriminant validity, a Pearson's product-moment correlation between the MQ Total score was calculated with other sensory sensitivities. The MQ Total score possessed small to moderate correlations with the questions on the ASQ unique to visual ($r = .33$, $p < .001$), olfactory ($r = .28$, $p < .001$), and tactile sensitivities ($r = .34$, $p < .001$), which were all notably smaller than the aforementioned correlation with sound sensitivities.

Furthermore, using the Hotelling-Williams test (Bobko, 1995), the correlation between the MQ Total score and the ASQ sound sensitivities item was confirmed to be statistically significantly different from the correlations between the MQ Total score and the other sensory sensitivities, providing further support for its ability to discriminate between other types of sensory defensiveness.

ASQ. The ASQ (Kinnealey & Oliver, 2002) is a 26-item self-reported measure of sensory defensiveness on which respondents rate items true or false. Sensory defensiveness is defined as a condition where individuals display oversensitivity and aversive reactions to certain sensory stimuli (e.g., tactile, auditory, olfactory) that are typically innocuous (Kinnealey, Oliver & Willbarger, 1995). Based on the number of items endorsed as "true," respondents fall on a continuum of scores that suggests "definite sensory defensiveness," "moderate sensory defensiveness," or "not sensory defensive." Items cover sensitivities in different sensory modalities (e.g., olfactory, auditory, tactile, visual, gustatory) and describe different situations that suggest sensory sensitivity. Cutoff scores from the ASQ were drawn from adults between the ages of 18 and 48 years, and the test-retest reliability for the measure was reported as 0.92 (Kinnealey & Oliver, 2002). Internal consistency for the present study was $\alpha = .79$.

Sheehan Disability Scale (SDS). The SDS (Sheehan, 1983) is a three-item self-reported questionnaire that measures the level of impairment in work/school, social, and family life/home responsibilities due to the symptoms of interest. For this study, ratings were garnered for impairment specifically related to sound sensitivities. Responses are recorded on a 10-point Likert scale, ranging from 0 (*not at all*) to 10 (*extremely*) interfering. The internal consistency is reportedly high ($\alpha = .89$) for the three-item scale and was adequate in identifying clinically impaired patients (Sheehan, 2000). Internal consistency was $\alpha = .78$ for the present sample.

Obsessive Compulsive Inventory-Revised (OCI-R). The OCI-R (Foa et al., 2002) is an 18-item measure that assesses the presence and distress associated with varied obsessive-compulsive symptoms. Answers are recorded on a 5-point Likert scale, ranging from 0 (*not at all*) to 4 (*extremely*), in which responders choose how much each symptom has bothered or distressed them in the past month. The OCI-R is a psychometrically sound instrument, demonstrating high internal consistency, excellent test-retest reliability, and good convergent and divergent validity (Abramowitz & Deacon, 2006; Foa et al., 2002; Storch et al., 2009). Internal consistency for the present study was $\alpha = 0.90$.

Depression Anxiety Stress Scale-21 (DASS-21). The DASS-21 (Lovibond & Lovibond, 1995) is a 21-item questionnaire that assesses symptoms of depression, anxiety, and stress in the past week. Answers are given on a Likert scale, ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). Separate subscale scores for anxiety, depression, and stress can be garnered. The DASS-21 possesses good psychometric properties, showing excellent internal consistency, as well as good convergent and discriminant validity when compared

to other validated measures of depression, anxiety, and overall functioning (Antony, Bieling, Cox, Enns & Swinson, 1998; Henry & Crawford, 2005; Ng et al., 2007). Internal consistency for the present study was $\alpha = .95$.

Rage Outbursts and Anger Rating Scale (ROARS). The ROARS (Budman et al., 2008) is a three-item questionnaire that assesses the frequency, intensity, and duration of rage attack(s) in the past week. Answers are provided on 4-point scale (from 0 to 3). Scoring for the questionnaire is garnered by the sum of all responses, resulting in values ranging from 0 to 9; respondents with a total score between 0 and 3 are "mild," between 4 and 6 "moderate," and between 7 and 9 "severe." Initial findings by Storch et al. (2012) demonstrate the measure's good construct validity in youth with OCD exhibiting anger outbursts. Internal consistency for the present sample was $\alpha = .83$.

Data Analytic Plan

All statistical analyses were conducted using IBM SPSS Statistics 21 (IBM Corp, 2012). Mahalanobis distance was utilized to detect the presence of outliers based on all predictor variables (Mahalanobis, 1936). Fifteen potential outliers were detected, so all analyses were run with and without the outliers to detect any significant changes in results. Ultimately, all correlational and mediating outcomes remained the same, so all subsequent results reported were based on the dataset excluding the outliers ($n = 483$). Descriptive statistics were calculated for demographics variables (e.g., age, gender) and misophonia symptoms endorsed. Investigation of potential gender differences when considering specific misophonia symptoms were conducted through multivariate analyses of variance. Pearson product-moment correlations were conducted to assess the relationship between misophonia symptoms and the severity of sound sensitivities, general sensory sensitivities, impairment, obsessive-compulsive symptoms, anxiety, and depressive symptomology. Independent t tests were conducted to detect potential differences in these variables between individuals with clinical and subclinical levels of misophonia symptoms.

For mediation analyses, the INDIRECT macro in SPSS was utilized as presented by Preacher and Hayes (2008). The bootstrapping technique was employed to detect significant mediators, with the number of bootstrap resamples set at 5,000. Statistically significant mediators were detected if the 95% confidence interval (CI) did not include 0. The bootstrapping technique calculates the same basic information provided by Baron and Kenny (1986), but allows for testing of the specific mediated effect and increased statistical power through its bootstrapped resampling (Hayes, 2009).

Results

Descriptive Statistics

The mean, standard deviation, range, and frequency of each misophonia symptom endorsed are presented in Table 3. The means of the responses for each symptom item on the MQ Misophonia Symptom Scale ranged between 0.52 (consonants and/or vowels) and 1.60 (repetitive tapping). Collectively, 23.4% of the study sample reported being "sometimes" sensitive to certain sounds on average; this portion of the sample scored greater than or equal to a score of "2," on average, for all seven of the misophonia symptom questions, garnering a score of 14 or higher. Additionally, 19.9% of the participants (inclusive of the 23.4% of the study sample) reported having clinically significant misophonia symptoms that cause interference in their lives, as indicated by a score of 7 or higher on their ratings of sound sensitivities on the MQ Misophonia Severity Scale.

Individual misophonia symptom frequencies were investigated to assess the portion of participants that were either "often" or "always" sensitive to the respective sounds. Specifically, 22.8% were often/always sensitive to the sound of people eating (e.g., chewing, swallowing, slurping), 22.8% were often/always sensitive to repetitive tapping (e.g., pen on table, foot on floor), 16.1% were often/always sensitive to the sound of rustling (e.g., paper, plastic), 21.7% were often/always sensitive to nasal sounds (e.g., sniffing, inhale), 19.5% were often/always

Table 3
Individual Symptoms Endorsed on the Misophonia Questionnaire

				Frequency of endorsement				
Misophonia Questionnaire Item	Mean	*SD*	Range	0	1	2	3	4
People eating	1.47	1.29	0–4	147	115	111	67	43
Repetitive tapping	1.60	1.17	0–4	106	121	146	81	29
Rustling	1.19	1.15	0–4	167	151	87	61	17
Nasal sounds	1.51	1.21	0–4	129	115	134	76	29
Throat sounds	1.39	1.19	0–4	143	127	119	71	23
Consonants and/or vowels	0.52	0.87	0–4	317	109	37	12	8
Environmental sounds	1.17	1.14	0–4	180	125	107	57	14

Note. SD = standard deviation.

sensitive to throat sounds (e.g., coughing, throat-clearing), 4.1% were often/always sensitive to certain consonants and/or vowels (e.g., "k" sounds), and 14.7% were often/always sensitive to environmental sounds (e.g., clock ticking, refrigerator humming). There were no significant gender differences with regards to the individual misophonia symptoms endorsed (quantified as the MQ Total score). Furthermore, no statistically significant relationships were found between misophonia symptoms and age or ethnicity.

To investigate the levels of functional impairment due to misophonia symptoms, percentages were calculated for individuals reporting a moderate or higher range (i.e., 4 or above) of impairment on each SDS subscale. Moderate or higher levels of functional impairment were reported at 14.9% for work and school-related functioning, 6.4% for social functioning, and 5.6% for family and home functioning. When investigating individuals that met the cutoff for clinically significant misophonia symptoms, the percentages for moderate or higher levels of functional impairment were 52.1% for work and school functioning, 22.9% for social functioning, and 18.8% for family and home functioning. The notably higher percentages within this group corroborate the heightened impairment experienced by individuals meeting the clinical cutoff for misophonia symptoms.

Correlations

The correlation matrix, as well as the means, standard deviations, and ranges for all study measures are in Table 4. All study variables exhibited positive and statistically significant associations. With regards to the relationship with misophonia symptoms (as measured by the Misophonia Questionnaire), a strong association was demonstrated with the severity of sound sensitivity ($r = .67$, $p < .001$), general sensory sensitivities ($r = .53$, $p < .001$), misophonia-related work and school impairment ($r = .57$, $p < .001$), misophonia-related social impairment ($r = .51$, $p < .001$), and misophonia-related overall impairment ($r = .60$, $p < .001$). Misophonia symptoms exhibited a moderate relationship with impairment in misophonia-related family life/home responsibilities ($r = .40$, $p < .001$), obsessive-compulsive symptoms ($r = .47$, $p < .001$), anxiety symptoms ($r = .39$, $p < .001$), and depressive symptoms ($r = .30$, $p < .001$).

Mean Differences in Study Variables for Clinical and Subclinical Misophonia Symptoms

Individuals that reported a 7 or higher on the MQ Misophonia Severity Scale were considered to have clinically significant misophonia symptoms for the purposes of this study, which is analogous to the clinical cutoff on the NIMH GOCS (Murphy et al., 1982). Means, standard deviations, *t*-test results, and Cohen's *d* values are displayed in Table 5 for individuals that were reportedly affected by at least some sound sensitivities (i.e., individuals not reporting any sound sensitivities did not complete the MQ Misophonia Severity Scale, and were thus not

Table 4
Correlation Coefficients, Means, Standard Deviations, and Ranges for Study Variables

	1	2	3	4	5	6	7	8	9	10
1. MQ Total Score		.67***	.53***	.57***	.51***	.40***	.60***	.47***	.39***	.30***
2. Severity of Sound Sensitivity			.42***	.57***	.45***	.38***	.57***	.41***	.30***	.23***
3. ASQ Total				.41***	.33***	.24***	.40***	.55***	.45***	.38***
4. SDS—work and school					.53***	.55***	.86***	.42***	.30***	.26***
5. SDS—social						.63***	.84***	.43***	.36***	.34***
6. SDS—family and home							.83***	.33***	.30***	.27***
7. SDS Total								.47***	.38***	.34***
8. OCI-R Total									.53***	.46***
9. Anxiety (DASS-21)										.73***
10. Depressive symptoms (DASS-21)										
Mean	19.76	4.53	7.71	1.64	0.82	0.73	3.19	11.71	7.15	6.47
SD	10.78	2.74	4.47	2.04	1.59	1.48	4.32	10.34	5.41	8.55
Range	0–53	1–13	0–21	0–10	0–10	0–9	0–21	0–49	0–34	0–40

Note. MQ = Misophonia Questionnaire; ASQ = Adult Sensory Questionnaire; SDS = Sheehan Disability Scale; OCI-R = Obsessive Compulsive Inventory-Revised; DASS-21 = Depression Anxiety Stress Scale-21; SD = standard deviation.
***$p < .001$.

Table 5
Results of t Tests Comparing Clinical and Subclinical Misophonia Symptoms on Study Variables in Individuals Affected by Sound Sensitivities

	Clinical		Subclinical				
	M	*SD*	*M*	*SD*	*t*	*df*	Cohen's *d*
MQ Total	31.21	7.64	17.81	9.17	−13.85***	170.37	2.12
ASQ Total	10.51	4.88	7.42	4.07	−5.64***	136.59	0.69
SDS—work and school	3.46	2.39	1.21	1.62	−8.51***	121.98	1.10
SDS—social life	2.02	2.33	0.53	1.12	−5.99***	107.39	0.82
SDS—family and home	1.72	2.09	0.49	1.16	−5.42***	110.69	0.73
SDS Total	7.20	5.27	2.22	3.28	−8.59***	115.85	1.13
OCI-R Total	18.50	12.09	10.82	9.38	−5.73***	130.77	0.71
Anxiety (DASS-21)	8.98	8.75	4.89	6.63	−4.24***	129.06	0.53
Depressive Symptoms (DASS-21)	9.98	9.55	6.10	8.28	−3.60***	140.15	0.43

Note. M = mean; SD = standard deviation; df = degree of freedom.
***$p < .001$.

included in the table). Statistically significant mean differences were found between individuals with clinical and subclinical levels on all study variables. Specifically, individuals with clinical levels of misophonia symptoms displayed higher scores across all variables, demonstrating a large effect size for misophonia symptoms, misophonia-related work and school impairment, misophonia-related social impairment, and total misophonia-related impairment, a medium effect size for general sensory defensiveness, misophonia-related family and home impairment, obsessive-compulsive symptoms, and anxiety, and a small effect size for depressive symptoms.

Mediation

Anxiety was tested as a potential mediator between misophonia symptoms (as measured by the MQ Misophonia Symptom Scale) and anger attacks (ROARS). The *a* path (misophonia symptoms to anxiety) was found to be statistically significant, $\beta = 0.30$, $t(483) = 5.76$, $p < .0001$.

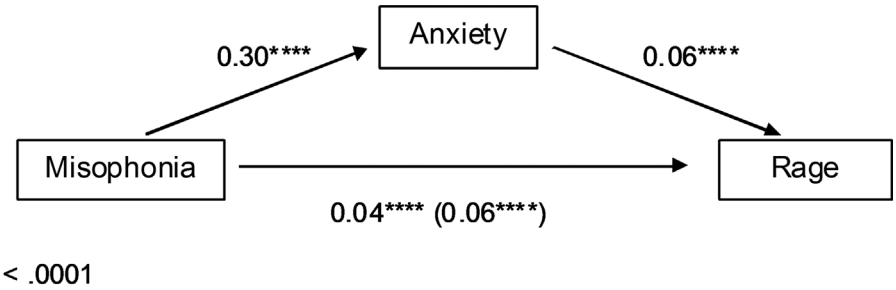

Figure 1. Mediating effect of anxiety symptoms on misophonia symptoms and rage.

The *b* path (direct effect of anxiety on rage) was also found to be significant, $\beta = 0.06$, $t(483) = 7.38$, $p < .0001$. The *c* path (total effect of misophonia symptoms on rage) was significant, $\beta = 0.06$, $t(483) = 6.44$, $p < .0001$. Finally, the *c*' path (direct effect of misophonia symptoms on rage) was statistically significant, $\beta = 0.04$, $t(483) = 4.69$, $p < .0001$. Anxiety was ultimately found to be a statistically significant mediator (see Figure 1) for the relationship between misophonia symptoms and rage ($\beta = 0.02$, 95% CI [0.01, 0.03]).

Discussion

This initial study examined the incidence, phenomenology, correlates, and impairment of misophonia in a large university undergraduate sample. When investigating the frequency of misophonia symptoms, nearly a quarter of the sample stated being "sometimes" sensitive to selective sounds, on average. Of the most bothersome were sounds of people eating and/or repetitive tapping, with close to a quarter of the sample noting that they are "often" or "always" sensitive to those auditory stimuli, which is consistent with previous findings (Edelstein et al., 2013). Collectively, misophonia symptoms appear to be relatively common in a nonclinical sample and may not be limited to patients presenting at otolaryngology clinics, which has been the previous focus (Hadjipavlou et al., 2008; Sztuka et al., 2010).

Furthermore, much research has been devoted to other auditory conditions, such as tinnitus, which have received relatively more attention in audiology (Jastreboff, 2011; Jastreboff, Hazell & Graham, 1994; Nyenhuis, Golm & Kroner-Herwig, 2013; Smith, Romanelli-Gobbi, Gray-Karagrigoriou & Artz, 2013). In comparison to previously reported rates of tinnitus in the community (10%; Kochkin et al., 2011), clinically significant misophonia symptoms were reported in close to 20% of the sample. Thus, while a quarter of the study sample reported being "sometimes" sensitive to certain sounds, closer to 20% of the entire study sample (inclusive of the aforementioned quarter of the sample) noted that these sound sensitivities were causing significant interference.

When investigating the relationship between misophonia and associated clinical characteristics, various positive, significant correlations were found. Misophonia was strongly associated with general sensory sensitivities, indicating that selective sound sensitivities may be linked to higher occurrences of other types of sensory defensiveness as well (Baguley & McFerran, 2011; Stansfeld, Clark, Jenkins & Tarnopolsky, 1985). Recognizing other types of sensory sensitivities in individuals, such as tactile sensitivity, may help in the detection of concurrent increased sound sensitivities. When investigating its relationship with specific domains of impairment, strong correlations were exhibited for work/school and social life, as well as total impairment, while family and home life possessed a moderate correlation. This discrepancy may be attributed to family accommodation or avoidance of distressing auditory stimuli, including the ability to leave the situations involving the distressing sounds with relatively less resistance. At home, individuals with misophonia may be permitted to engage in safety behaviors without significant repercussions, while the converse would be expected from social and work and school situations if responsibilities were not carried out, resulting in higher impairment.

Furthermore, individuals that reported having clinically significant misophonia symptoms displayed significant differences across study variables when compared to individuals with subclinical misophonia symptoms. As such, it is suggested that misophonia is related to elevated levels of several related constructs, such as impairment, anxiety, general sensory defensiveness, and obsessive-compulsive symptoms.

Misophonia symptoms demonstrated significant, moderate correlations with obsessive-compulsive symptoms, anxiety, and depressive symptoms. For obsessive-compulsive and misophonia symptoms, both may contain obsessive preoccupations with specific types of sounds, resulting in anxiety and distress. This may ultimately lead to much avoidance and/or rituals associated with the sounds, resulting in impairment in various domains of life. However, Schröder et al. (2013) suggested that misophonia should contain its own diagnostic criteria, as their sample exhibited only reactions of anger (rather than anxiety), and not everyone with misophonia engaged in compulsions as a result of their sound sensitivities, although they likely displayed active avoidance, a feature common in OCD and anxiety disorders (McGuire et al., 2012). As such, further investigation into the nature of emotional and behavioral reactions to selective sounds, as well as the neurobiology of misophonia, can shed light on information that can aid in diagnosis.

Misophonia demonstrated moderate correlations with anxiety and depressive symptoms, suggesting a moderately increased likelihood of displaying anxiety and/or depressive symptoms, which may link back to their sound sensitivities. It is possible that the sound sensitivities can lead to increased anxiety and depressive symptoms, with the auditory triggers directly eliciting internal distress upon hearing the sounds. However, it is also plausible that anxiety and depressive symptoms are associated with an increased sensitivity to certain things, such as specific sounds. For instance, commonly shared irritability between depressive and/or anxiety symptoms may decrease their threshold for tolerating mild or otherwise innocuous stimuli.

Collectively, obsessive-compulsive symptoms, anxiety, and depressive symptoms all shared similarly robust correlations with misophonia symptoms. These modest correlations indicate that misophonia may possess phenomenological similarities, such as anxiety, obsessional thinking, irritability, and/or avoidance (Schröder et al., 2013). However, commonalities do not necessarily equate to the suggestion that all of these symptoms are rooted in one common disorder. Indeed, the comparable correlations across each construct suggest that misophonia is related to all of these disorders and cannot be uniquely linked to one diagnosis at this time. As such, further research and data are needed on clinical cases to help inform accurate diagnostic classification.

Examining factors that may influence the relationship between misophonia symptoms and subsequent impairment is pertinent, as the emotional distress and behaviors due to misophonia symptoms commonly lead to interference in various domains of life (Edelstein et al., 2013; Schröder et al., 2013). Anxiety symptomology mediated the relationship between misophonia symptoms and anger outbursts, such that higher levels of misophonia symptoms were associated with higher anxiety, and higher anxiety was related to higher levels of anger. While misophonia has been linked to a variety of negative emotions, anger has been commonly reported upon hearing the selective sounds (Schröder et al., 2013; Schwartz et al., 2011).

Additionally, anxiety has been increasingly reported within patients with misophonia as well, suggesting the importance of further investigation into emotional states beyond anger (Edelstein et al., 2013; Johnson et al., 2013). This finding has potential implications for interventions, as it reveals an underlying mechanism that indirectly affects the consequences of misophonia. As such, it may be beneficial to target anxiety symptomology in cognitive-behavioral treatment to increase the individual's ability to manage their reactions to triggering sounds and employ a more adaptive behavior that does not lead to anger outbursts. Indeed, clinical presentations of misophonia allude to the temporal precedence of negative emotional states (inclusive of anxiety), leading to maladaptive behaviors and anger (Johnson et al., 2013), consistent with other cognitive-behavioral models of related constructs such as OCD and anxiety. However, as the investigation into misophonia is in its nascent stages, further empirical support for the theoretical basis of the relationship between anxiety, misophonia symptoms, and anger is warranted.

Additionally, due to the cross-sectional nature of the present study, interpretations of the meditational analysis should be interpreted with caution due to the limited ability to draw inferences of causality; for example, it may be possible to interpret the converse relationship as rage episodes leading to mounting anxiety, resulting in elevated misophonia symptoms.

Limitations

Several limitations to the study should be noted. First, the study sample primarily comprised female undergraduate university students, limiting the generalizability. Importantly, future studies should seek to examine misophonia symptoms in pediatric populations, as clinical experience and case reports (Schwartz et al., 2011) dictate their prevalence. Second, all answers were obtained through self-report methods; future studies should obtain multi-informant reports and clinician-rated data. Third, all data were collected at a single time point; future research should collect data across multiple time points and investigate potential changes over time. Fourth, though the clinical cutoff for misophonia symptoms was utilized in a manner analogous to an established measure (St. Clare, 2003), the cutoff has not been validated in individuals with misophonia.

This study also utilized a pilot measure (MQ) to test relationships. The exploratory factor analysis converged into a three-factor solution with some secondary loadings; this indicates a need for further validation of the measure in other populations, and a bifactor model may help in determining the potential role of a general factor explaining the variance in the items. However, it is noted that other support for strong psychometric properties was evidenced by high internal consistency, high correlations with converging constructs, and statistically significantly smaller correlations with divergent constructs.

Furthermore, more detailed assessment of other auditory conditions (e.g., tinnitus, hyperacusis, phonophobia) could have provided additional important information regarding the comorbidity and clinical presentation of misophonia; future studies should formally assess for the presence of other forms of decreased sound tolerance. Given the presence of general sensory defensiveness and specifically sound sensitivities in autism spectrum disorders (Stiegler & Davis, 2010), future studies should also seek to evaluate misophonia within that population to garner a better clinical picture. Last, all statistical analyses utilized correlations or regressions, limiting the ability to establish causality and directionality.

Conclusion

Within these limitations, this study conducted an investigation into misophonia and garnered important information about its phenomenology and associations with related clinical characteristics. With the rate of significantly interfering misophonia symptoms falling around 20% for the study sample, rates of clinically significant misophonia may be higher than previously expected. Furthermore, individuals with clinical levels of misophonia symptoms demonstrated elevated levels of related constructs, indicating potentially increased difficulties with general sensory sensitivities, impairment, obsessive-compulsive symptoms, anxiety, and depressive symptoms; these augmented issues have implications for the prediction of misophonia, as well as the potential benefit of incorporating these clinical constructs into treatments for misophonia. Misophonia symptoms also generally exhibited strong correlations with measures of impairment, and a moderate association with obsessive-compulsive symptoms, anxiety, and depressive symptoms. While misophonia symptoms, OCD, anxiety, and depression share some commonalities in presentation, the moderate relationships across all constructs demonstrate that misophonia may be related to multiple forms of psychopathology, through either direct or associative relationships.

Last, anxiety mediated the relationship between misophonia symptoms and anger outbursts, suggesting the role of anxiety in misophonia-induced anger outbursts. As such, addressing anxiety through targeted interventions may have important implications for the maintenance and exacerbation of misophonia. Ultimately, with a current paucity of research on misophonia, this study sought to garner data that provide a better understanding of the incidence, phenomenology, and clinical correlates of misophonia.

References

Abramowitz, J. S., & Deacon, B. J. (2006). Psychometric properties and construct validity of the Obsessive-Compulsive Inventory-Revised: Replication and extension with a clinical sample. Journal of Anxiety Disorders, 20(8), 1016–1035. doi:10.1016/j.janxdis.2006.03.001.

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. Psychological Assessment, 10(2), 176–181.

Baguley, D. M., & McFerran, D. J. (2011). Hyperacusis and disorders of loudness perception. In A. R. Møller, B. Langguth, D. DeRidder & T. Kleinjung (Eds.), Textbook of tinnitus (pp. 13–23). New York, NY: Springer.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology, 51(6), 1173–1182.

Bobko, P. (1995). Correlation and regression: Principles and applications for industrial/organizational psychology and management. New York, NY: McGraw-Hill.

Budman, C., Coffey, B. J., Shechter, R., Schrock, M., Wieland, N., Spirgel, A., & Simon, E. (2008). Aripiprazole in children and adolescents with Tourette disorder with and without explosive outbursts. Journal of Child and Adolescent Psychopharmacology, 18(5), 509–515. doi:10.1089/cap.2007.061.

Edelstein, M., Brang, D., Rouw, R., & Ramachandran, V. S. (2013). Misophonia: Physiological investigations and case descriptions. Frontiers in Human Neuroscience, 7, 296. doi:10.3389/fnhum.2013.00296.

Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., & Salkovskis, P. M. (2002). The Obsessive-Complusive Inventory: Development and validation of a short version. Psychological Assessment, 14(4), 485–495. doi:10.1037//1040-3590.14.4.485.

Hadjipavlou, G., Baer, S., Lau, A., & Howard, A. (2008). Selective sound intolerance and emotional distress: What every clinician should hear. Psychosomatic Medicine, 70(6), 739–740.

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. Communication Monographs, 76(4), 408–420. doi:10.1080/03637750903310360.

Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. The British Journal of Clinical Psychology, 44(Pt 2), 227–239. doi:10.1348/014466505X29657.

Henson, R. K., & Roberts, J. K. (2006). Use of exploratory factor analysis in published research: Common errors and some comment on improved practice. Educational and Psychological Measurement, 66(3), 393–416. doi:10.1177/0013164405282485.

IBM Corp. (2012). IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.

Jastreboff, M. M., & Jastreboff, P. J. (2001). Components of decreased sound tolerance: Hyperacusis, misophonia, phonophobia. ITHS Newsletter, 2, 5–7.

Jastreboff, M. M., & Jastreboff, P. J. (2002). Decreased sound tolerance and Tinnitus Retraining Therapy (TRT). Australian and New Zealand Journal of Audiology, 24(2), 74–81.

Jastreboff, P. J. (2011). Chapter 73: Tinnitus retraining therapy. In A. R. Møller, B. Langguth, D. DeRidder & T. Kleinjung (Eds.), Textbook of tinnitus. New York, NY: Springer.

Jastreboff, P. J., & Hazell, J. P. (2004). Tinnitus retraining therapy: Implementing the neurophysiological model. Cambridge, UK: Cambridge University Press.

Jastreboff, P. J., Hazell, J. W., & Graham, R. L. (1994). Neurophysiological model of tinnitus: Dependence of the minimal masking level on treatment outcome. Hearing Research, 80(2), 216–232.

Jastreboff, P. J., & Jastreboff, M. M. (2013). Using TRT to treat hyperacusis, misophonia and phonophobia. ENT & Audiology News, 21(6), 88–90.

Johnson, P. L., Webber, T. A., Wu, M. S., Lewin, A. B., Murphy, T. K., & Storch, E. A. (2013). When selective audiovisual stimuli become unbearable: A case series on pediatric misophonia. Neuropsychiatry, 3(6), 569–575.

Kinnealey, M., & Oliver, B. (2002). Adult Sensory Questionnaire. Philadelphia, PA: Temple University, College of Allied Health Professionals.

Kinnealey, M., Oliver, B., & Willbarger, P. (1995). A phenomenological study of sensory defensiveness in adults. American Journal of Occupational Therapy, 49(5), 444–451.

Kircanski, K., Peris, T. S., & Piacentini, J. C. (2011). Cognitive-behavioral therapy for obsessive-compulsive disorder in children and adolescents. Child and Adolescent Psychiatric Clinics of North America, 20(2), 239–254. doi:10.1016/j.chc.2011.01.014.

Kochkin, S., Tyler, R., & Born, J. (2011). MarkeTrak VIII: The prevalence of tinnitus in the United States and the self-reported efficacy of various treatments. Hearing Review, 18(12), 10–26.

Lovibond, S. H., & Lovibond, P. F. (1995). Manual for the Depression Anxiety Stress Scales. Sydney: Psychology Foundation.

Mahalanobis, P. C. (1936). On the generalised distance in statistics. Proceedings of the National Institute of Sciences of India, 2(1), 49–55.

McGuire, J. F., Storch, E. A., Lewin, A. B., Price, L. H., Rasmussen, S. A., & Goodman, W. K. (2012). The role of avoidance in the phenomenology of obsessive-compulsive disorder. Comprehensive Psychiatry, 53(2), 187–194. doi:10.1016/j.comppsych.2011.03.002.

Møller, A. R. (2011). Chapter 4: Misophonia, phonophobia, and "exploding head" syndrome. In A. R. Møller, B. Langguth, D. DeRidder & T. Kleinjung (Eds.), Textbook of tinnitus. New York, NY: Springer.

Murphy, D. L., Pickar, D., & Alterman, I. S. (1982). Methods for the quantitative assessment of depressive and manic behavior. In E. I. Burdock, A. Sudilovsku & S. Gershon (Eds.), The behaviour of psychiatric patients: Quantitative techniques for evaluation (pp. 335–392). New York, NY: Marcel Dekker.

Muthén, L. K., & Muthén, B. O. (1998–2012). Mplus user's guide (7th ed.). Los Angeles, CA: Muthén & Muthén.

Neal, M., & Cavanna, A. E. (2013). Selective sound sensitivity syndrome (misophonia) in a patient with Tourette syndrome. The Journal of Neuropsychiatry & Clinical Neurosciences, 25(1).

Ng, F., Trauer, T., Dodd, S., Callaly, T., Campbell, S., & Berk, M. (2007). The Validity of the 21-Item Version of the Depression Anxiety Stress Scales as a Routine Clinical Outcome Measure. Acta Neuropsychiatrica, 19(5), 304–310. doi:10.1111/j.1601-5215.2007.00217.x.

Nyenhuis, N., Golm, D., & Kroner-Herwig, B. (2013). A systematic review and meta-analysis on the efficacy of self-help interventions in tinnitus. Cognitive Behaviour Therapy, 42(2), 159–169. doi:10.1080/16506073.2013.803496.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879–891.

Schröder, A., Vulink, N., & Denys, D. (2013). Misophonia: Diagnostic criteria for a new psychiatric disorder. PLoS ONE, 8(1), e54706. doi:10.1371/journal.pone.0054706.t001.

Schwartz, P., Leyendecker, J., & Conlon, M. (2011). Hyperacusis and misophonia: The lesser-known siblings of tinnitus. Minnesota Medicine, 94, 42–43.

Sheehan, D. V. (1983) The anxiety disease (pp. 151). New York, NY: Charles Scribner & Sons.

Sheehan, D. V. (2000). Sheehan Disability Scale. In A. J. Rush, H. A. Pincus & M. B. First (Eds.), Handbook of psychiatric measures (pp. 113–115). Washington, DC: American Psychiatric Association.

Smith, G. S., Romanelli-Gobbi, M., Gray-Karagrigoriou, E., & Artz, G. J. (2013). Complementary and integrative treatments: Tinnitus. Otolaryngologic Clinics of North America, 46(3), 389–408. doi:10.1016/j.otc.2013.02.005.

Stansfeld, S. A., Clark, C. R., Jenkins, L. M., & Tarnopolsky, A. (1985). Sensitivity to noise in a community sample: I. Measurement of psychiatric disorder and personality. Psychological Medicine, 15(02), 243–254. doi:10.1017/S0033291700023527.

St. Clare, T. (2003). Chapter 14: Assessment procedures Obsessive Compulsive Disorder: Theory, research, and treatment (pp. 239–258). West Sussex, UK: John Wiley & Sons Ltd.

Stiegler, L. N., & Davis, R. (2010). Understanding sound sensitivity in individuals with autism spectrum disorders. Focus on Autism and Other Developmental Disabilities, 25(2), 67–75. doi:10.1177/1088357610364530.

Storch, E. A., Jones, A. M., Lack, C. W., Ale, C. M., Sulkowski, M. L., Lewin, A. B., ... Murphy, T. K. (2012). Rage attacks in pediatric obsessive-compulsive disorder: Phenomenology and clinical correlates. Journal of the American Academy of Child & Adolescent Psychiatry, 51(6), 582–592.

Storch, E. A., Khanna, M., Merlo, L. J., Loew, B. A., Franklin, M., Reid, J. M., ... Murphy, T. K. (2009). Children's Florida Obsessive Compulsive Inventory: Psychometric properties and feasibility of a self-report measure of obsessive-compulsive symptoms in youth. Child Psychiatry and Human Development, 40(3), 467–483. doi:10.1007/s10578-009-0138-9.

Sztuka, A., Pospiech, L., Gawron, W., & Dudek, K. (2010). DPOAE in estimation of the function of the cochlea in tinnitus patients with normal hearing. Auris, Nasus, Larynx, 37(1), 55–60. doi:10.1016/j.anl.2009.05.001.

Veale, D. (2006). A compelling desire for deafness. Journal of Deaf Studies and Deaf Education, 11(3), 369–372. doi:10.1093/deafed/enj043.

Copyright of Journal of Clinical Psychology is the property of John Wiley & Sons, Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.