

# Evaluating anxiety sensitivity as a moderator of misophonia and dimensions of aggression

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## ABSTRACT

Misophonia is characterized by increased physiological and emotional reactivity to particular sounds (e.g., chewing), which has been associated with impulsive and aggressive behaviors. To better understand the expression of misophonia, the current study investigated the moderating role of anxiety sensitivity (AS) in the relation between misophonia and facets of aggression (i.e., anger, hostility, verbal aggression, and physical aggression). Participants ( $N = 470$ ;  $M_{age} = 18.68$  years; 74.0% female) included college students who endorsed misophonia symptoms and completed online self-report questionnaires. Four regression analyses were conducted to examine the interaction between misophonia symptoms and AS on each aggression facet. Results revealed that significant variance was accounted for in each facet of aggression, with the association between misophonia and anger, hostility, and verbal aggression (respectively) strengthening as increased. This study provides additional support for the association between misophonia and aggressive behavioral tendencies, suggesting AS may operate as a pivotal factor in the expression of anger and aggressive responses in misophonia. These findings implicate AS a potential treatment target that could enhance outcomes for patients struggling with misophonia.

## 1. Introduction

Misophonia is characterized by the intolerance of certain organic (e.g., chewing, breathing) and non-organic (e.g., pen clicking, writing) noises (Schröder et al., 2013), wherein these triggers elicit intense negative emotions (Dozier, 2015; Dozier & Morrison, 2017; Schröder et al., 2013) and physiological arousal (Cavanna & Seri, 2015; Dozier & Morrison, 2017; Edelstein et al., 2013). Prevalence rates in undergraduate samples suggest as many as 20% of individuals experience misophonia symptoms (Wu et al., 2014; Zhou et al., 2017), ranging from mildly annoying to extremely debilitating symptoms (Edelstein et al., 2013). Misophonia has been linked to a wide range of disorders such as obsessive-compulsive spectrum disorders (Dozier et al., 2017; Schröder et al., 2013), impulse control disorders (Robinson et al., 2018), post-traumatic stress disorder (Schröder et al., 2013), eating disorders (Kluckow et al., 2014), tinnitus, phonophobia, and hyperacusis (Jastreboff & Jastreboff, 2015). Although misophonia has not yet been classified as a specific type of disorder, the heightened auditory sensitivity and emotional distress appear to represent a unique syndrome that is not subsumed or accounted for by the presence of another disorder (Schröder et al., 2013; Taylor, 2017). The underpinnings of misophonia

are not well understood; however, current theoretical and empirical work indicates complex interplay of neurological, physiological, and psychological factors (Brout et al., 2018; Potgieter et al., 2019).

Although disgust, panic, and anxiety are common misophonic responses (Rouw & Erfanian, 2018), reactions to misophonia stimuli tend to emphasize the emotional, physiological, and behavioral signatures of anger (Potgieter et al., 2019). Several studies have shown that trigger stimuli commonly elicit annoyance, irritation, rage, and anger (Dozier & Morrison, 2017; Edelstein et al., 2013; Rouw & Erfanian, 2018; Schröder et al., 2013). These emotional reactions are accompanied by tension, clenched muscles, breathlessness, and increases in body temperature, blood pressure or heart rate (Dozier, 2015; Dozier & Morrison, 2017; Edelstein et al., 2013; Rouw & Erfanian, 2018; Schröder et al., 2013). While most individuals attempt to escape or avoid misophonia triggers (Dozier & Morrison, 2017; Rouw & Erfanian, 2018), approach-oriented behaviors are frequently reported, such as urges to confront others, thoughts of wanting to hurt others, hostility, and impulsive reactions (Edelstein et al., 2013; Rouw & Erfanian, 2018). Further, aggression has been identified as the most prominent dysfunctional response (Rouw & Erfanian, 2018; Wu et al., 2014). For instance, Schröder et al. (2013) found that of 42 patients with misophonia symptoms, 59.5% reported

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misophonia stimuli provoked some form of aggression. Specifically, 28.6% reported verbal aggression, 16.7% engaged in physical aggression toward objects, and 11.9% hit an (ex-) partner. Unfortunately, there is scant research examining the subsequent consequences of anger and aggression in misophonia; yet, aggression is generally associated with poor response to treatment (Cassello-Robbins et al., 2015), workplace violence (Dillon, 2012), and interpersonal difficulties across life domains (e.g., divorce; Cavanna & Seri, 2015; Pasha et al., 2009; Zhou et al., 2017), suggesting additional impairment for those with misophonia.

Given the potential short- and long-term consequences, further research is needed to understand the connection between misophonia and aggression. Anxiety sensitivity (AS) is a well-established transdiagnostic process that has been implicated in a broad range of clinical syndromes (Smits et al., 2019). Individuals with elevated AS are likely to misinterpret physiological symptoms as aversive and catastrophize consequences of these symptoms as harmful, dangerous, or embarrassing (Reiss & McNally, 1985). In addition to its role in mood and anxiety disorders (Naragon-Gainey, 2010), AS predicts engagement in high risk behaviors, such as non-suicidal self-injury (Dixon et al., 2019), suicide (Stanley et al., 2018) and substance use (Keough et al., 2018; McCaul et al., 2017). Across conditions, AS is theorized to amplify physiological arousal and the experience of distress (Taylor et al., 2007); thus, in the context of misophonia, AS may similarly exacerbate reactions to aversive sounds. To this end, preliminary research has demonstrated AS is significantly correlated with misophonia severity (Cusack et al., 2018; McKay et al., 2018); however, the impact of AS on outcomes relevant to misophonia have not been investigated.

The purpose of the current study is to enhance our understanding of misophonia by examining the moderating role of AS in the relation between misophonia symptoms and facets of aggression, including anger, hostility, verbal aggression, and physical aggression (Buss & Perry, 1992). Moderation analyses evaluate how a third variable effects the relationship between two variables by determining under what circumstances a relationship exists and whether it is strengthened or weakened by the third variable (Hayes & Rockwood, 2017). Existing theoretical models and empirical studies support AS as a moderator across a range of emotional and behavioral outcomes (e.g., Dixon et al., 2014; Stathopoulou et al., 2018); thus, examining the moderating role of AS in misophonia may shed light on the expression of this condition. First, misophonia symptoms were hypothesized to be positively associated with AS and aggression facets. In addition, we hypothesized AS would moderate the association between misophonia and each aggression facet in a sample of undergraduate students. Specifically, it was predicted that AS would strengthen the association between misophonia symptom severity and levels of aggression, after controlling for sex (Archer, 2004, 2009). A college student sample is particularly relevant as high prevalence rates have been reported for both misophonia (Wu et al., 2014; Zhou et al., 2017) and violent behaviors (Schwartz et al., 2015).

## 2. Method

### 2.1. Participants and procedure

Participants included college students ( $N = 655$ ) enrolled at a public southern university. Students were invited to participate in an online questionnaire examining stress for course credit. Upon providing consent, participants completed a battery of questionnaires. Participants who endorsed sensitivity to at least one sound on the Misophonia Questionnaire (Wu et al., 2014) were included in the current study ( $n = 470$  of 655 unselected participants). The final sample ( $N = 470$ ;  $M_{age} = 18.68$ ;  $SD = 1.44$ ) were primarily female (74.0%) and White (82.8%), with the remainder of the sample identifying as Black/African American (14.5%), Hispanic/Latinx (3.0%), and Asian/Pacific Islander (2.3%). All procedures were approved by this university's Institutional Review

Board.

### 2.2. Measures

The Buss-Perry Aggression Questionnaire (Buss & Perry, 1992) is a 29-item questionnaire measuring anger, hostility, verbal aggression, and physical aggression. Statements are rated on a five-point scale ranging from 1 ("extremely uncharacteristic of me") to 5 ("extremely characteristic of me"). Emotional and physiological preparation to express aggression are assessed by the Anger subscale ("I sometimes feel like a powder keg ready to explode"). The Hostility subscale emphasizes cognitive components of anger, such as thoughts of ill will towards another ("I wonder why sometimes I feel so bitter about things"). The tendency to engage in aggressive behaviors is evaluated by the verbal aggression ("I can't help getting into arguments when people disagree with me") and physical aggression ("There are people who pushed me so far that we came to blows") subscales. The Aggression Questionnaire has been corroborated with behavioral tasks of aggression in experimental laboratory studies (e.g., Chester, 2019; Saleem et al., 2017), and modest to strong evidence for construct validity has been demonstrated for all four subscales (Buss & Perry, 1992). Acceptable internal consistency for the subscale and total scores has been established in undergraduate samples (Clements et al., 2018; Tremblay & Ewart, 2005). Internal consistency coefficients in the current study were acceptable (Anger  $\alpha = 0.83$ , Hostility  $\alpha = 0.91$ , Verbal Aggression  $\alpha = 0.84$ , Physical Aggression  $\alpha = 0.79$ ).

The Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007) is an 18-item measure of anxiety about arousal-related sensations and their physical, social, and cognitive implications (e.g., "It scares me when my heart beats rapidly"). Items are rated on a five-point scale, ranging from 0 ("very little") to 4 ("very much"). Items are summed to calculate a total score ranging from 0 to 72, with higher scores indicating greater AS. The ASI-3 has demonstrated good internal consistency across subscales (Taylor et al., 2007; Wheaton et al., 2012). Cronbach's alpha in the current study was excellent ( $\alpha = 0.94$ ).

The Misophonia Questionnaire (Wu et al., 2014) is a three-part questionnaire that assesses sensitivity to certain sounds (e.g., people eating), emotional and behavioral reactions (e.g., anxious, distressed), and overall misophonia severity, respectively. This study used the total score, which is derived from the first two parts of the questionnaire. Items are rated on a scale from 0 ("not at all true") to 4 ("always true"), and summed to calculate the total score, which ranges from 0 to 68. The final section of the questionnaire evaluates the severity and impairment of misophonia symptoms on a scale from 1 ("minimal") to 15 ("very severe"), with a suggested clinical cutoff of 7 (Wu et al., 2014). In the current study, 0 was incidentally included as an option to indicate no sound sensitivity; thus, participants rated misophonia impairment on a 0 to 15 scale. The Misophonia Questionnaire has demonstrated good internal consistency for the total score and subscales (Wu et al., 2014). Internal consistent in the current study was excellent ( $\alpha = 0.93$ ).

## 3. Results

### 3.1. Preliminary analyses

Data were initially screened and supported the testing of current models. Means, standard deviations, ranges, and bivariate correlations for the study variables are presented in Table 1. The results indicated that 24.1% of the sample was above the clinical cutoff for sensitivity to sound ( $M = 5.26$ ;  $SD = 3.08$ ) and 6.2% reported severe/very severe impact ( $\geq 10$ ; Wu et al., 2014). As expected, the bivariate correlations revealed significant, positive associations between the variables ( $r_s = 0.29 - 0.36$ ).

**Table 1**

Means, standard deviations, and bivariate correlations among primary study variables.

	1	2	3	4	5	6
1. Misophonia	–	.337	.332	.275	.339	.294
2. Anxiety Sensitivity		–	.342	.259	.325	.302
3. Anger			–	.758	.728	.715
4. Hostility				–	.794	.836
5. Verbal Aggression					–	.840
6. Physical Aggression						–
Mean	22.29	15.62	21.14	22.52	11.13	24.80
SD	11.53	13.26	5.30	8.00	5.72	7.87
Observed Range	1–56	0–60	8–35	8–40	5–25	9–45

Note. All correlations significant at  $p < .001$ ;  $r$ s between 0.10 and 0.29 = small effect;  $r$ s between 0.30 and 0.49 = moderate effect; and  $r$ s  $\geq 0.50$  = large (Cohen, 1988). Misophonia = Misophonia Questionnaire; Anxiety sensitivity = Anxiety Sensitivity Index-3; Anger = Buss-Perry Aggression Questionnaire-Anger subscale; Hostility = Buss-Perry Aggression Questionnaire-Hostility subscale; Physical aggression = Buss-Perry Aggression Questionnaire-Physical Aggression subscale; Verbal Aggression = Buss-Perry Aggression Questionnaire-Verbal Aggression subscale.

### 3.2. Primary analyses

PROCESS 3.2.01 (Hayes, 2018) model 1 for SPSS was used to test four moderation models to evaluate the interaction of misophonia severity (predictor variable) and AS level (moderator variable) in predicting facets of aggression (outcomes = anger, hostility, verbal aggression, and physical aggression) while controlling for sex (0 = Female, 1 = Male). All variables were mean-centered for the analyses and then converted back to the original scale values for the plots. Significant interactions were probed using the Johnson-Neyman technique to identify points of significance and the pick-a-point technique was used to visualize the interaction at the 16th, 50th, and 84th percentiles (Hayes, 2018).

Unstandardized conditional betas ( $B$ ), standard error,  $F$ -test values, and  $p$ -values are reported in Table 2. The models evaluating anger, hostility, and verbal aggression revealed a similar pattern of results, whereas a different pattern of results emerged for physical aggression. The overall model was significant for anger ( $R^2 = 0.19$ ,  $p < .001$ ), hostility ( $R^2 = 0.14$ ,  $p < .001$ ), and verbal aggression ( $R^2 = 0.23$ ,  $p < .001$ ). In each of these models, male sex was a significant predictor and there were significant conditional effects of misophonia symptoms and AS on aggression propensity for these facets. The interaction term between misophonia and AS was a significant predictor of anger ( $\Delta R^2 = 0.01$ ,  $p = .008$ ), hostility ( $\Delta R^2 = 0.01$ ,  $p = .016$ ), and verbal aggression ( $\Delta R^2 = 0.02$ ,  $p < .001$ ). That is, results supported the moderating role of AS in the relation between misophonia and each outcome (anger, hostility, verbal aggression), wherein the effect strengthened as AS scores increased. The Johnson-Newman analysis indicated misophonia was a significant predictor of anger and verbal aggression at all levels of AS observed in this sample, indicating that AS consistently amplified the association between these variables. For hostility, misophonia was a significant predictor at scores of AS  $\geq 0.77$ , indicating significance for

approximately 92.1% of scores in this sample. The interaction estimates predicting aggression scores at the 16th (3.00), 50th (12.00), and 84th percentiles (32.00) of AS are depicted in Fig. 1.

With regard to physical aggression, the overall model was significant ( $R^2 = 0.19$ ,  $p < .001$ ). Significant conditional effects of male sex, misophonia, and AS on physical aggression were observed; however, the interaction term was not significant ( $\Delta R^2 = 0.00$ ,  $p = .102$ ).

## 4. Discussion

The current study investigated AS and aggression to further understand processes contributing to the experience and expression of misophonia. As hypothesized, misophonia symptoms were found to be positively associated with AS and each of the four facets of aggression. These results are consistent with previous findings that have demonstrated increased AS in misophonia samples (McKay et al., 2018) and positive associations of misophonia with aggressive behaviors (Wu et al., 2014; Zhou et al., 2017) and AS (Cusack et al., 2018; McKay et al., 2018).

Consistent with hypothesis, AS moderated the association between misophonia and three of the dimensions of aggression – anger, hostility, and verbal aggression. In addition, significant conditional effects were observed, wherein male sex, greater misophonia symptoms, and higher levels of AS contributed to increases in aggressive tendencies. Specifically, the association between misophonia and each of these aggression facets strengthened as levels of AS increased, and this interactive effect accounted for 1.2% unique variance in anger, 1.1% unique variance in hostility, and 2.0% unique variance in verbal aggression. For an individual with misophonia, this suggests that AS may amplify the experience of and reaction to aversive sounds and increase the likelihood that they may engage in these forms of aggression. These results highlight AS a relevant cognitive-emotional process in misophonia, which extends the characterization of misophonia and informs future studies investigating key psychological mechanisms in misophonia. Furthermore, as individuals with misophonia commonly describe anger and aggressive reactions as uncontrollable and impulsive (Edelstein et al., 2013; Rouw & Erfanian, 2018; Schröder et al., 2013), results suggest that targeting AS may help ameliorate these and other adverse outcomes associated with misophonia.

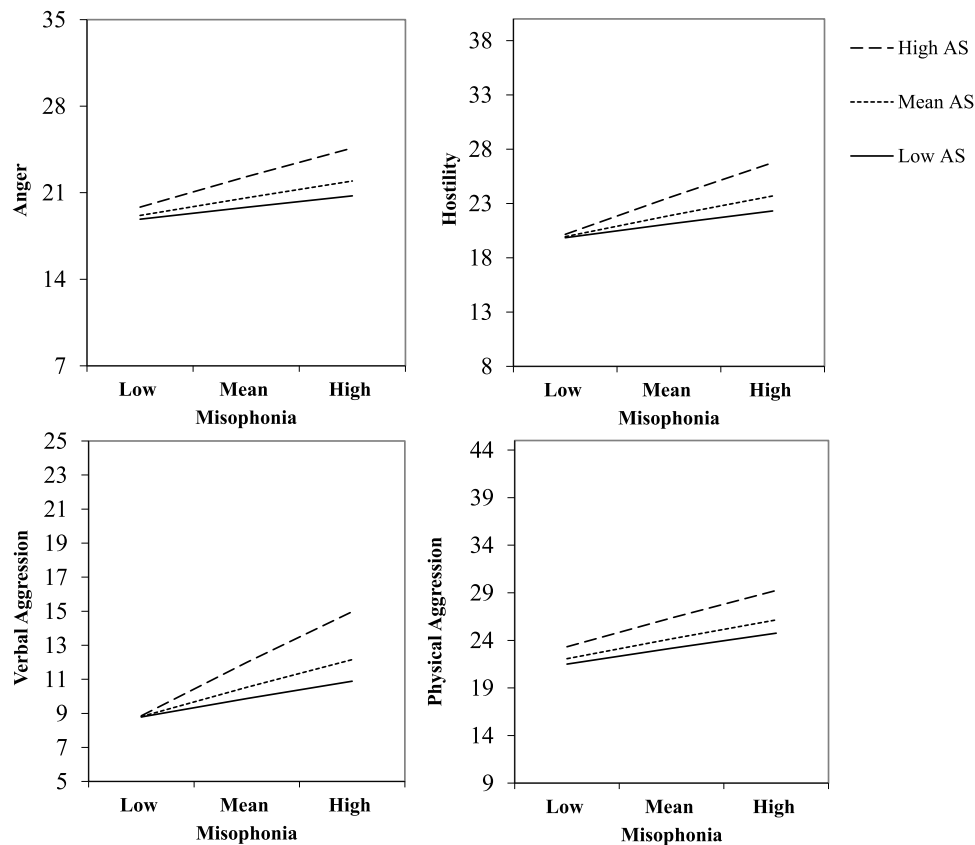
Unexpectedly, while physical aggression was predicted by the conditional effects of male sex, misophonia, and AS, findings did not support AS as a factor contributing to physical aggression by magnifying misophonia reactivity. Although anger and aggressive urges are frequently endorsed in misophonia, the incidence of physical aggression appears to be less common among adults with misophonia (Jager et al., 2020; Schröder et al., 2013). Consequently, the occurrence of these behaviors may be explained by other factors. To further understand these behaviors, future work is needed to explicate various forms of aggressive responses to misophonia cues (e.g., relational aggression; proactive/reactive aggression) and explore additional factors that may modulate physical aggression in response to misophonia triggers, such as gender, context, or irrational beliefs (Archer, 2004; Burton et al., 2007; Eagly & Steffen, 1986; Fives et al., 2011).

**Table 2**

Overall model, conditional, and moderation effects on facets of aggression.

	Anger			Hostility			Verbal aggression			Physical aggression		
	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Intercept	20.599	.269	<.001	21.523	.419	<.001	10.076	.283	<.001	23.518	.400	<.001
Sex	1.299	.508	.011	2.689	.793	<.001	2.928	.535	<.001	4.218	.756	<.001
Misophonia	0.128	.021	<.001	0.173	.032	<.001	0.156	.022	<.001	0.179	.031	<.001
AS	0.086	.019	<.001	0.086	.029	.003	0.075	.019	<.001	0.111	.028	<.001
AS $\times$ Misophonia	0.004	.002	.008	0.006	.002	.016	0.006	.002	<.001	0.004	.002	.102
Total model $F(4, 465)$	27.87, $p < .001$ , $R^2 = .19$			18.73, $p < .001$ , $R^2 = .14$			35.63, $p < .001$ , $R^2 = .23$			27.57, $p < .001$ , $R^2 = .19$		

Note. B = conditional unstandardized beta coefficients; SE = standard error; Sex coded 0 = Female, 1 = Male; AS = Anxiety Sensitivity.



Note. Predicted severity of aggression dimensions (i.e., Anger, Hostility, Verbal Aggression, and Physical Aggression), as a function of scores falling at 16 (low), 50 (mean), and 84 (high) percentiles on the Anxiety Sensitivity Index-3 (AS) and Misophonia Questionnaire (Misophonia).

Fig. 1. Anxiety sensitivity as moderator of the association between misophonia and facets of aggression.

Given the few number of studies investigating rates and psychological correlates of misophonia, the secondary findings contribute to knowledge on misophonia in a college sample. Of the initial sample of unselected undergraduate students ( $N = 655$ ), over 70% of individuals endorsed some degree of sound intolerance. Consistent with previous studies, approximately 24% of participants reported clinical levels of misophonia symptoms and 6% reported severe impact (Wu et al., 2014; Zhou et al., 2017). These results illustrate the prevalence and continuum of misophonia symptoms. In addition, levels of AS (Chowdhury et al., 2016; Wheaton et al., 2012), as well as anger, hostility, verbal aggression, and physical aggression (Buss & Perry, 1992; D'Zurilla et al., 2003; Mathes et al., 2018) were comparable with previous studies investigating these factors among undergraduate and community samples, which supports the generalizability of these results to other nonclinical populations.

Several limitations should be noted and addressed in future research. First, the generalizability of the results is limited by the predominantly White, female sample of undergraduate students. Second, the cross-sectional study design precludes causal determinations. Third, aggressive responses may have been underreported due to social desirability response biases (Tourangeau & Yan, 2007). Accordingly, a critical next step is the use of experimental designs to explicate the role of AS on aggressive responses to misophonia sounds. If supported, such findings have the potential to inform investigations aimed at improving outcomes for individuals with misophonia. For instance, the potential utility of brief AS reduction interventions is supported by research demonstrating the positive impact of reducing AS on improving outcomes for related conditions, such as obsessive-compulsive spectrum symptoms (Timpano et al., 2016) and tinnitus (Andersson et al., 2005); however, it is unclear if similar effects would be expected for aggression.

Accordingly, interventions focused on increasing distress tolerance warrant consideration (e.g., dialectical behavior therapy; Frazier & Vela, 2014). Controlled case studies and clinical feasibility trials are needed to evaluate the efficacy of such techniques among those with clinical misophonia.

#### Contributors

M. J. Schadegg and L. J. Dixon developed the study concept, designed the study, and analyzed the results. L. J. Dixon collected the data. M. J. Schadegg, H. L. Clark, and L. J. Dixon drafted the manuscript, and L. J. Dixon provided critical revisions. All authors contributed to and approved the final manuscript for submission.

#### Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Conflicts of interest

All authors declare that they have no conflicts of interest.

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