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Misophonia: An Investigation of the Lesser-Known Decreased Sound Tolerance  
Condition

A thesis submitted in fulfillment of the requirements for the degree of Master of Science at  
Virginia Commonwealth University

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**Abstract****MISOPHONIA: AN INVESTIGATION OF THE LESSER-KNOWN DECREASED SOUND TOLERANCE CONDITION**

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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University

Virginia Commonwealth University, 2017

Major Director: Scott R. Vrana, Ph.D., Professor, Department of Psychology and Psychiatry

Keywords: decreased sound tolerance, misophonia, obsessive-compulsive disorder, anxiety sensitivity

Misophonia is a decreased sound tolerance condition (DST) that is not yet well-established in the literature. However, the existing research on misophonia shows that it is occurring at substantial levels in the population. The majority of the existing literature has focused on the clinical correlates of misophonia. Although the correlates have been investigated, there is no accepted mechanism behind misophonia etiology or maintenance. The present study examined three hypotheses in order to start to identify potential mechanisms behind misophonia: how emotional predilections are related to the emotional response, how obsessive-compulsive disorder (OCD) symptoms and misophonia are related, and the possibility that the relationship between anxiety sensitivity (AS) and misophonia may be explained in part by the presence of OCD symptoms. Data were collected by Cash (2015) using both undergraduate students ( $N=451$ ) and community participants ( $N = 377$ ) using Amazon's MTurk. Participants completed an online cross-sectional survey assessing for a number of decreased sound tolerance conditions, individual differences variables, and clinical variables. The current study specifically used measures of anxiety sensitivity, OCD, misophonia symptom severity, trait anger, and trait anxiety. Consistent with

the literature on state-trait theory, trait emotion was predictive of state levels, such that trait anger was most predictive of an angry misophonic response and trait anxiety was most predictive of an anxious reaction to misophonic stimuli. Misophonia was more strongly related to obsessive than to compulsive components of OCD, consistent with case reports of obsessive thoughts in misophonia. Lastly, OCD symptoms partially mediated the relationship between AS symptom severity and misophonia symptom severity. These results supported our hypotheses, and align with the theorized role of anxiety sensitivity in OCD and in misophonia. Although the data are cross-sectional in nature, and causality cannot be confirmed, the current study provides a strong basis for future research into the mechanisms of misophonia.



## **Introduction**

Decreased sound tolerance (DST) conditions, such as misophonia and hyperacusis, are novel clinical conditions that are not yet well-established in the literature, nor are they recognized within the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013). Misophonia is defined as “a chronic condition in which specific sounds provoke intense emotional experiences and autonomic arousal within an individual” (Edelstein, Brang, Rouw, & Ramachandran, 2013). These emotional experiences are usually negative in nature and include emotions such as disgust, anger, and distress. The auditory stimuli are typically sounds made by other people, usually someone the person knows, and are often everyday sounds such as smacking of the lips, eating, or chomping of the teeth (Wu, Lewin, Murphy, and Storch, 2014). Wu and colleagues (2014) reported that 20% of a large college student sample reported clinically significant misophonia symptoms; although misophonia is not well-recognized among health care professionals, it appears to be occurring at substantial levels in the population. Given that the research on misophonia is lacking, further investigation into the etiology, symptomology, and treatment effectiveness is warranted.

The majority of misophonia research has focused on its clinical correlates. The symptoms of misophonia have been found to share many features with DSM-V disorders including Specific Phobia, Post-Traumatic Stress Disorder (PTSD), Social Phobia, Obsessive-Compulsive Disorder (OCD), Intermittent Explosive Disorder, Personality Disorders with Impulsive Aggression, Obsessive-Compulsive Personality Disorder (OCPD), Autism Spectrum Disorder, and Sensory Processing Disorder (Schroder et al., 2013). Misophonia has also been found to moderately correlate with symptoms of both anxiety and depression. The occurrence of anxiety and depression with misophonia may be due to the possibility that anxiety and depressive symptoms

are associated with an increased sensitivity to stimuli, such as a trigger sound (Wu et al., 2014). Misophonia symptoms do overlap with a wide range of classified DSM disorders. But, as Schroder et al. (2013) notes, the symptomology of misophonia does not perfectly overlap with any of the DSM-V disorders.

Little is known about the etiology or mechanism behind misophonia. Considering past research, it is likely that misophonia is a learned response rather than an unlearned reflex. For example, Wu and colleagues (2014) found that misophonics have an exaggerated response to sounds made by people they know compared to the same sounds arising from other sources, and Schroder and colleagues (2013) found that misophonia symptoms are highly correlated with many psychological symptoms. Misophonia is more likely psychological than biological in nature, illustrated by the evidence supporting misophonia as a learned response (Dozier, 2015). Further research on misophonia considering learning theory principles is important to elucidate the psychological mechanisms of the condition.

The current study will explore potential mechanisms of action involved in misophonia in order to develop a more comprehensive understanding of the condition as a whole. Specifically, one relationship to be explored is how emotional predilections are related to the emotional response in a misophonic. The individual differences involved in how, if, and why a response is learned in some people and not others are important in elucidating the etiology of misophonia. The primary emotional response (e.g., anger, disgust, anxiety) to sounds in misophonia varies between individuals, but we do not know why. One possibility is that individuals respond to misophonic stimuli in a manner that is consistent with their general emotional predilection. It is possible that trait personality constructs, such as anxiety and anger, are capable of predicting the

type of response a person exhibits to a misophonic stimulus. For example, people with higher trait anger may respond to the stimuli with anger.

A second area to be explored is the relationship between misophonia and OCD, which has been highlighted in case reports of patients with co-morbid OCD and misophonia (Neal & Cavanna, 2013; Webber, Johnson, & Storch, 2014). Misophonia, throughout the literature, has also been found to moderately correlate with obsessive-compulsive symptoms (Zhou, Wu, & Storch, 2017). Past research has focused on using OCD models to create analogies that may help to explain misophonia (Schroder et al., 2013). In this model, an innocuous auditory stimulus (e.g., person chewing) elicits an aggressive impulse. The individual attempts to suppress this impulse through avoidant behaviors, or attempts to neutralize the impulse through compulsive behaviors (e.g., mimicking the sound); this leads to an increase in the obsession and distress surrounding the sound (Schroder et al., 2013).

Both the obsessive and compulsive aspects of OCD can be seen in patients with misophonia. A patient with misophonia may present with an obsessive preoccupation with a certain type of sound, and also may present with compulsive mimicry as a coping mechanism (Edelstein, et al., 2013). When considering contemporary models of obsessional symptoms in OCD, misappraisals of normally occurring intrusive thoughts as highly meaningful are often cited as the cause of corresponding compulsive behavior to control or suppress the thought (Purdon, 2008). Aspects of both the obsessive components and compulsive components of OCD are seen in misophonics. Edelstein and colleagues (2013) explain that misophonics use similar coping strategies to those seen in OCD, such as avoiding certain situations or mimicking the trigger sounds compulsively. Cash (2016) found that the typical emotional and behavioral responses found in misophonics were a compulsive urge to mimic the sound, obsessive thoughts

about the sound, and avoidance of social situations. Given that both obsessive and compulsive aspects of OCD are seen in misophonic individuals, we plan to look at how misophonia relates to the obsessive aspect of OCD compared to the compulsive aspect of OCD.

This study will also explore the possibility that the relationship between anxiety sensitivity and misophonia may be explained in part by the presence of OCD symptomology. Anxiety sensitivity (AS) is defined as “the tendency to fear body sensations associated with anxious arousal because of their perceived physical, psychological, or social consequences” (Wheaton, Mahaffet, Timpano, Berman, & Abramowitz, 2012). Past research has established that AS has multiple dimensions: fear of mental or cognitive dyscontrol, fear of physical catastrophes, and fear that anxiety symptoms will be publicly observable. Wheaton and colleagues (2012) found that the different dimensions of AS play unique roles in the different symptoms seen in OCD. The researchers found that the physical fear dimension was predictive of the contamination OCD symptomology and that both the fear of cognitive dyscontrol dimension and the fear of publically observable anxiety dimension were predictive of difficulties with unacceptable thoughts.

Misophonia has been found to correlate with OCD symptoms (Edelstein et al., 2013), and with higher levels of AS (Wu et al., 2014). However, the relationship between misophonia and both OCD and AS is not well understood. We plan to look at how the cognitive dimension of AS affect misophonia directly and indirectly through OCD symptoms differently. For example, the cognitive dyscontrol aspect of AS may increase the severity of misophonia through obsessive OCD symptoms. Exploring these relationships may help to explain how AS and OCD symptoms impact misophonia severity.

In summary, this study will examine several discrete hypotheses to identify potential pathways involved in the mechanisms behind misophonia. First, we will examine the power of trait personality constructs, such as anger and anxiety, in predicting certain types of misophonic response. Secondly, we will further examine the relationship between OCD and misophonia. We will compare the obsessive symptoms versus the compulsive symptoms of OCD in order to elucidate which are more important in misophonia. Lastly, we will consider OCD in terms of the relationship between AS and misophonia. We plan to examine OCD symptoms, in general, and obsessive symptoms of OCD to see which symptom types may explain the relationship between misophonia severity and AS symptoms using a mediation model. In order to examine whether the proposed hypotheses are specific to misophonia, we will also examine the same relationships in people with hyperacusis, another DST that is hypothesized to have a different etiology (Baguley, 2003; Jastreboff & Jastreboff, 2004).

In order to understand these hypothesized mechanisms, literature in the following areas will be reviewed: misophonia, cognitive and learning models as applied to misophonia, state-trait theories of emotion, OCD, and anxiety sensitivity.

## **Literature Review**

### **Misophonia**

The term misophonia was first proposed by Jastreboff and Jastreboff (2003) to describe the symptoms elicited from an intense adverse emotional reaction to specific sounds. Jastreboff & Jastreboff (2004) differentiated misophonia from another DST condition called hyperacusis. The authors proposed that hyperacusis is the aversion to all sounds above an established loudness level, rather than one particular sound. In contrast, the sounds that are most often cited in cases of misophonia are usually made by other humans, and most often include such sounds as

chewing food, lip smacking, nail picking, and speaking (Edelstein et al., 2013; Neal & Cavanna, 2013; Schroder et al., 2013). These symptoms are often regulated by the social context in which they are presented. Edelstein and colleagues (2013) found that one's misophonic response was more extreme when the sound was produced by close friends, co-workers, or family members. The authors also found that self-produced sounds or sounds made by children and/or animals did not elicit a misophonic response. The sound intolerance in misophonia is thought to be specific to sounds with emotional associations, whereas in hyperacusis, the intolerance is thought to be to certain frequencies and volume ranges of sounds (Baguely, 2003). The etiology of hyperacusis is currently unknown. There are several proposed etiologies of hyperacusis; some etiologies implicate facial nerve dysfunction and some of which implicate a more straightforward conditioning etiology where those with hyperacusis have negative emotional associations with environmental noises generally, leading to the amplification of signals arriving to the cochlea (Baguely, 2003; Jastreboff & Hazell, 1993). Given the differences between misophonia and hyperacusis, the hypothesized processes in misophonia are not expected to occur in hyperacusis.

Though there are not well-established prevalence rates for misophonia, it appears to be a relatively common phenomenon. For example, Wu and colleagues (2014) found that 20% of their college student sample presented with clinically significant misophonia symptoms.

Schröder, Vulink, and Denys (2013) note a relatively large number of patients self-referred to their hospital after reading an online announcement on a Dutch misophonia Internet newsgroup and on their hospital website; 50 patients contacted the researchers in a span of 2.5 years.

Jastreboff & Jastreboff (2003; 2004; 2006) reported that 57% of the patients at tinnitus specialty clinics experienced comorbidity with misophonia or another sound tolerance problem, such as hyperacusis or phonophobia. In the same clinical sample, 28.9% of patients reported

experiencing pure misophonia (Jastreboff, 2004). In an effort to examine the construct in a non-Western population, Zhou, Wu, and Storch (2017) found that 6% of their Chinese college student sample reported clinically significant misophonia symptoms and resulting impairment. The definition of misophonia varies between studies because it is such a nascent construct, fostering some doubt about the reliability of reported prevalence rates. Given the empirical evidence cited above, it is evident that misophonia is not an uncommon problem and continued research to better understand it is an important objective.

Misophonics report a range of negative feelings, thoughts, and physical reactions. To further examine this range, Edelstein and others (2013) conducted interviews with 11 self-identified misophonics. The authors found that the most common negative feelings endorsed by misophonics include intense anxiety, panic, anger, extreme irritation, and rage. There is no empirical support for one emotion that every misophonic feels, but anxiety, anger, and disgust seem to be the most common reactions. Cash (2015) found that, among 503 people that screened positive for misophonia, 29.3% of the sample experienced anger most often in response to a trigger sound, 26.9% reported that they most often experience disgust, and 22.8% reported that they most often experience anxiety. Cash (2015) reported that only 4.5% of her sample reported experiencing fear most often. Other literature has shown anticipatory anxiety is present but without the presence of fear (Edelstein et al., 2013).

The emotional response in misophonia often begins as irritation or disgust, but quickly escalates to extreme emotions such as anger or hatred (Dozier, 2015). While hatred is a common emotion seen in misophonia, it is not directed at the sound, but towards the individual making the sound. This hatred often includes the ideation of harm (Schroder et al., 2013). Edelstein et al. (2013) found that nine out of their 11 subjects reported trigger sounds as being invasive,

intrusive, disgusting, or rude. They also reported feeling offended or violated by the sounds eliciting negative thoughts about the individual making the sound. The types of thoughts often endorsed by individuals with misophonia are thoughts such as “I want to punch this person” and “Don’t you know what you sound like?” (Edelstein et al., 2013).

When examining the relationship between misophonia and existing DSM disorders, Wu et al. (2014) found moderate associations between misophonia symptoms and OCD, general anxiety, and depression symptoms. Schroder and colleagues found that 73% of their sample met criterion for one or more of the obsessive-compulsive spectrum disorders (OCSDs), including attention deficit hyperactivity disorder (ADHD), hypochondria, Tourette syndrome, obsessive-compulsive disorder (OCD), obsessive-compulsive personality disorder (OCPD), skin picking, and trichotillomania, leading to the conclusion that misophonia may potentially be classified as a new OCSD. The similarity between misophonia and other psychopathologies has prompted researchers to consider how the mechanisms of these disorders and misophonia may be similar. In aiming to elucidate the etiology of misophonia, cognitive and learning models of psychopathology have been examined.

### **Cognitive and Learning Models**

Research examining the mechanisms of misophonia is still emerging. The etiology of misophonia is hypothesized to be similar to that described by models of anxiety disorders, such as Panic Disorder, Phobias, and OCSDs (Dozier, 2015). According to Bouton, Mineka, and Barlow (2001), the key aspect of Panic Disorder is unconditioned fear that occurs at the wrong time, otherwise known as a “false alarm.” Panic Disorder, as defined by Barlow (1988), occurs when this “false alarm” triggers more fear, which leads to anticipatory anxiety about the reoccurrence of the panic reaction. A person develops a conditioned response, in this case fear



and anxiety, to a certain cue through emotional learning. The conditioned anxiety potentiates the next panic attack. Learning theory posits that an individual with Panic Disorder will learn to associate fear with the situational context and physical sensations experienced during a panic attack. The internal fear cues will increase due to anxiety and fear, and so the emotional experience will build on itself (Craske, Burton, & Barlow, 1993). Additionally, the authors propose that the strength of the response is dependent on other contextual stimuli in the situation.

Cognitive theories about Panic Disorder have also been proposed. Barlow (1988) explains that catastrophic thoughts about the connotation of a somatic sensation lead to an anxiety response, which leads to additional somatic sensations, which, in turn, elicit more catastrophic thoughts. The catastrophic misinterpretation operates in a cyclical nature. These thoughts may occur during a panic attack because they are a part of the attack or because they are “instrumental acts (operants)” that have been reinforced in similar situations in the past (Bouton et al., 2001). Once the catastrophic thought occurs during a panic attack, it may become a verbal conditioned stimulus (CS) that is associated with the rest of the attack through a verbal conditioning mechanism (Bouton et al., 2001). The authors propose that the effects of CSs are often regulated by other stimuli in the background.

When applying learning theory to misophonia, it may be that the aversion to the sound stimulus arises from an initial association between an innocuous auditory stimulus and an aggressive impulse. The trigger sound can be seen as the stimulus, which is followed by an aggressive impulse, usually towards the person making the sound. Misophonics may try to suppress the impulse through avoiding the stimulus, or neutralizing the stimulus through compulsive behaviors (Schroder et al., 2013). The attempt at suppression results in an increase of the obsessive impulse and distress about the trigger sound (Schroder et al., 2013). In misophonia,

individuals may learn to associate an auditory stimulus with anger or disgust. Learning occurs to allow the stimulus to trigger the same emotional reaction when encountered again. Therefore, a false alarm is present in the form of an intense emotional reaction towards an innocuous sound. In this conceptualization, misophonia can be seen as a learned false alarm occurring in people with certain vulnerabilities. Dozier (2015) presents a series of case studies that provide support for misophonia as a form of conditioned behavior. The emotional response to a trigger stimulus creates a Pavlovian conditioned response that maintains or strengthens the reflex, or response. Dozier (2015) presents a case report where nasal breathing was associated with emotional distress from anxiety, the inability to sleep, and annoyance from hearing the breathing sound. When the sound was heard again later, it elicited the emotional response. If misophonia is a conditioned response, it may be that only certain people learn to pair an intense emotional reaction with an innocuous stimuli due to individual differences underlying vulnerabilities, for example, being high on anxiety sensitivity.

Similar to panic attacks, increased sound sensitivity may be common in the general population. Most people interpret panic attacks as benign, but some interpret them as a sign of a dangerous problem, which results in a fear of panic attacks, and thus, panic disorder (Barlow, 2002). The trigger sounds in cases of misophonia are sounds that are often found annoying by non-misophonics as well. However, non-misophonics do not have an intense emotional reaction when exposed to these sounds. This difference is potentially due to how misophonics are interpreting the sound or their response differently, leading to a stronger response the next time, creating a positive feedback loop. As Webber and Storch (2015) note, though, at this time it is unclear what factors contribute to individual differences in the form of triggers and what vulnerabilities explain the variability in the severity of emotional response to the auditory

triggers. The anxiety response to feared stimuli in anxiety disorders can be explained by the fact that the stimuli either can potentially cause harm, or did have the potential to cause harm in our evolutionary history (e.g., unexplained physiological symptoms, specific phobic objects).

However, it is not clear why the primary response to misophonic sound stimuli is anger, or why different people have different emotional responses to the sounds.

### **Traits as predictive of emotional state**

Past literature has illustrated that one's trait affect level is predictive of their emotional response, or state level, of the same emotion. Nelis and colleagues (2016) examined the predictive power of trait positive affect and trait negative affect in predicting cognitive response style for positive affect. The authors found that higher trait negative affect was predictive of a higher rate of dampening of reactions to positive affect or events. On the other hand, trait positive affect levels predicted more enhancing of responses to positive affect, supporting that trait affect is a predictor of cognitive response style to affect. Additionally, Joo et al. (2012) examined the influence of personality traits on emotional response to interpersonal stress. The results showed that those higher in neuroticism showed more negative emotion and a higher level of reactivity to daily interpersonal conflict. In addition, trait hostility levels increased stress responses, including negative emotional and cardiovascular responses to interpersonal stress, showing that personality may influence individual differences in reactivity to stressful events.

When examining the trait-state relationship, it is important to consider Spielberger's idea that the stronger a particular trait is, the more likely that the emotional state that corresponds to the trait will be experienced (Spielberger, 1972). Spielberger, Jacobs, Russell, and Crane (1983) propose the State-Trait Theory of Anger, which posits that the state of feeling angry is a universal and transitory state. Trait anger, though, is an enduring personality type that acts as a

predisposition for people to experience more frequent anger episodes than those low in trait anger. Deffenbacher et al., (1996) and Quinn, Rollock, and Vrana (2014) tested five hypotheses from Spielberger's State-Trait Theory of Anger. The five hypotheses were: the elicitation hypothesis, which predicts that people high in trait anger will experience state anger with a longer duration and more frequently, the intensity hypothesis, which predicts that individuals high in trait anger will experience their state anger more strongly, the discrimination hypothesis, which proposes that trait anger reflects an increased vulnerability to state anger, the negative expression hypothesis, which proposes that high trait anger individuals will express maladaptive anger expression (e.g., more anger suppression and more anger explosion), and, lastly, the consequence hypothesis, which states that high trait anger individuals experience more severe and frequent anger-related outcomes. Both Quinn and colleagues (2014) and Deffenbacher (1996) found support for the five hypotheses. Quinn et al., (2014) found that those prone to high trait anger reported a higher frequency of anger episodes on an anger inventory and a greater duration of anger episodes. The authors also found that those high on trait anger reported greater anger when compared to those low in trait anger, as measured by an anger inventory magnitude scale. There were no differences in reactions of fear or joy to the anger imagery between the two groups, illustrating that a distinct trait level specifically predicts the same type of reaction. The past research is critical in supporting the idea that trait anger levels are predictive of an anger response.

Deffenbacher, Richards, Filetti, & Lynch (2005) examined the relationship between trait driving anger levels and driving anger. The authors found that high trait driving anger was predictive of more frequent angry episodes while driving and more intense anger in day to day

driving. High trait driving anger levels also predicted more physical and verbal aggression tendencies

A similar relationship between trait and state anxiety levels has also been established. Li and Lopez (2005) found that people higher on trait levels of anxiety exhibited state anxiety elevations more frequently. They also found a strong association between trait and state anxiety scores in a stressful context, but only a moderate association in a relaxing context. Trait levels of anxiety made a unique contribution to the prediction of state scores over and above other variables included in the model. Hanton, Cropley, Neil, Mellalieu, and Miles (2007) examined the trait-state relationship in competition anxiety. Studying competitive soccer players, the authors found that high trait anxiety performers responded with more state anxiety than low trait anxiety performers. Similar to anger, trait anxiety levels are predictive of state anxiety levels. The trait-state relationship may be important in relation to misophonia in that the trait levels of a certain emotion, such as anger, may be predictive of the misophonic response experienced by the patient. For example, a misophonic high on trait anger may be more likely to react with anger to the misophonic stimuli. Therefore, it is hypothesized that individual differences in emotional traits will predict the reaction to a misophonic stimuli, the state emotion.

### **Obsessive-Compulsive Disorder**

The second relationship to be explored is the association between OCD and misophonia. OCD, as defined in the DSM-5, is the presence of obsessions, compulsions, or both (American Psychiatric Association, 2013). As Harsanyi et al. (2014) suggest, there are two types of impairments in OCD. Obsessions are unwanted thoughts or images that one is unable to ignore or block. Compulsions are perseverative behaviors or rituals that one is unable to interrupt or stop. The authors propose that obsessions are related to a “failure of cognitive inhibition,” while

compulsions are related to a “failure in behavior inhibition.” The majority of the population experiences unwanted thoughts and images, but can dismiss them as harmless. An unwanted thought becomes an obsession when the thought gives rise to immediate resistance, which, according to Harsanyi et al. (2014), suggests a failure in cognitive inhibition as a possible mechanism in obsessions.

Literature has focused more on compulsions in terms of the role they play relative to obsessions in OCD. Goodman, Grice, Lapidus, and Coffey (2014) propose that the function of compulsions is to neutralize the distress caused by obsessions. The person feels driven to perform these behaviors because of the presence of obsessions. Starcevic et al. (2011) posit that compulsions primarily serve to alleviate anxiety caused by obsessions, and that different types of distress that underlie compulsions may elicit different compulsive behaviors. For example, individuals with sexual, religious, or aggressive obsessions may think that an inability to control their obsessions would lead to a “catastrophic consequence.” Compulsions performed in response to these obsessions will neutralize specific belief-related distress, undoing the obsession and anxiety surrounding it. To support their claims, the authors found that the majority of compulsions were performed to reduce distress and anxiety surrounding an obsession, and that the reason for performing the compulsive behavior was dependent on the type of obsession. The role of compulsions can be presumed to vary in individuals with OCD, but most likely works to reduce distress caused by obsessions.

Investigations of misophonia have revealed a symptomology pattern that is similar to OCD and related disorders. For example, Hadjipavlou and colleagues (2008) found that preoccupation with and compulsive mimicry of the aversive sounds were present in misophonics and in OCD. Research has also established comorbidity of misophonia with OC spectrum

disorders. Taylor and colleagues (2014) found that OC disorder caseness, OC symptom severity, and OCD-related phenomena were elevated among individuals reporting auditory and tactile intolerance. Neal & Cavanna (2013) presented a case report of co-morbid misophonia and OCSDs, and Hadjipavlou et al. (2008) presented a case report of patients with comorbid OC symptoms such as obsession with and compulsive mimicry of the sound trigger. Kircanski, Peris, and Piacentini (2011) describe the avoidance behaviors that are often seen in anxiety disorders in order to reduce the distress caused by obsessions. Similarly, misophonics often try to reduce the stress surrounding a trigger stimulus through avoidance behaviors. The preoccupation with a trigger sound and compulsive efforts to reduce distress surrounding the sound has been supported by much of the past literature (Hadjipavlou et al., 2008; Schroder et al., 2013; Webber & Storch 2015). Misophonics are able to see their symptoms as senseless or excessive, similar to individuals with OCD (Goodman et al., 2014).

When considering the mechanisms of both misophonia and OCD, it is important to note that anxiety mediates the relationship between misophonia symptoms and anger outbursts (Wu et al., 2014), suggesting that OC spectrum disorders and misophonia may have overlapping maintaining factors. Although there are many overlaps between misophonia and OCD, misophonia can be seen as distinct from OCD given that the fundamental response is anger and not anxiety (Schneider & Arch, 2015).

### **Anxiety Sensitivity**

Anxiety sensitivity (AS) is a trait-like tendency to react fearfully to anxiety symptoms, predisposing an individual to the development of panic problems (McNally, 1989; Schmidt, Zvolensky, & Maner 2006; Taylor, 1999). AS is considered an individual difference variable and has proven to be unique from trait anxiety (Rapee & Medoro, 1994). It is considered a multi-

dimensional construct that includes fears of physical, mental, and publicly observable experiences of anxiety (Zinbarg et al., 1997; Schmidt, 2006). Wheaton and colleagues (2012) define the three dimensions of AS as: the social concerns, or the fear of publicly observable anxiety symptoms; the physical concerns, or the fear of personal somatic catastrophe resulting from anxiety symptoms; and the cognitive concerns, or the fear of anxious arousal leading to failures in cognitive or mental control. According to McNally (1989), the fear of anxiety can act as a motive for avoiding any stimulus that is a potential trigger for anxiety symptoms. Schmidt (2006) found that AS may precede the development of clinical anxiety symptoms and that AS predicted the development of panic, anxiety diagnoses, and overall AS-related Axis 1 diagnoses such as anxiety disorders, mood disorders, and alcohol use. Schmidt (2006) also found that for people high on AS, bodily sensations associated with autonomic arousal were seen as a sign of “imminent personal harm” and elevated levels of anxiety. The mechanisms linking AS to clinical conditions is unclear; however, one possible explanation is that AS promotes adverse emotional events, or more intense symptoms, which then leads to a greater level of negative emotional learning (Schmidt, 2006).

AS levels are proven to predict OCD symptoms in past research. Reiss, Peterson, Gursky, and McNally (1986) found moderate elevations on AS in OCD individuals. However, according to Robinson and Fresston (2014), the theoretical explanation for the relationships between AS and anxiety symptoms (e.g., OCD symptoms) within the existing frameworks for different disorders is made unclear by the ambiguity of whether AS is a cognitive distortion, form of interoceptive conditioning, or a “true” sensitivity. Therefore, there is currently no specific rationale for the relationship between AS and OCD aside from the presumed link between sensitivity to anxiety symptoms and enhanced conditionability of fear. Calamari et al. (2008)



further found that specific components of AS, the cognitive and social concerns as discussed in Wheaton et al. (2012), were higher in individuals with OCD. Calamari and colleagues (2008) propose that AS may be an important part of OCD-relevant beliefs due to the fact that AS accounted for significant variance in OCD symptoms that was not accounted for by the belief domains evaluated by the Obsessive Beliefs Questionnaire. Based on this idea, a connection between AS and over importance of thought beliefs may increase the likelihood of anxiety-neutralizing behaviors. The anxiety surrounding an individual's intrusive thoughts, when the individual is high in AS, may foster over-importance of thought through appraisals and mental control efforts.

Wheaton and colleagues (2012) also looked at the relationship between AS and OCD, considering AS as a multi-dimensional construct including fear of physical (somatic) catastrophes, fear of cognitive dyscontrol, and fear of publicly observable anxiety symptoms. The different dimensions of AS are posited to be related differently to various types of anxiety symptoms. Wheaton et al. (2012) hypothesized that the fear of cognitive dyscontrol AS dimension would be especially related to the unacceptable thoughts and responsibility for harm OC symptom dimensions. The results showed that the cognitive dyscontrol factor of AS was uniquely predictive of unacceptable thoughts, illustrating that there is an association between the amount of unacceptable and obsessive thoughts one has and the tendency to perceive that they have lost control over their cognitive abilities. Fear of publicly observable symptoms also predicted the unacceptable thought dimension of OCD. AS also predicted significant variance above and beyond general distress and obsessive beliefs for all OC dimensions, alluding to the fact that AS plays a unique role in OCD symptoms. Lastly, Raines, Oglesby, Capron, and Schmidt (2014) found that the cognitive concern subscale of AS was significantly associated

with the obsessing sub-scale of the OCI-R, but the physical and social concerns subscales were not.

AS may be an important construct to consider when examining misophonia symptom severity, both directly and through OCD symptomology. AS has been shown to be elevated in patients with OCD (Wheaton et al., 2012; Reiss, 1986; Calamari, 2008). OCD and AS levels are also elevated in misophonics (Cash, 2015). Given these relationships, theoretically, it may be that AS will increase misophonia severity directly, and AS would also increase misophonia severity by increasing OCD symptoms, which increase misophonia severity. AS will increase misophonia severity directly, because those who are more sensitive to experiencing anxiety symptoms (high on AS) will engage in avoidance behaviors more often, and may interpret emotional reactions and physiological reactions to auditory stimuli as stronger or as dangerous. Furthermore, AS will indirectly increase misophonia symptom severity through OCD symptomology, since AS is shown to increase OCD symptomology throughout the literature (e.g., Wheaton et al., 2012; Reiss, 1986; Calamari, 2008). It may be that the OCD symptoms seen in misophonics are partly responsible for the relationship between AS and misophonia severity.

OCD cognitive models posit that obsessions arise from intrusive thoughts or images that then motivate the individual to engage in neutralizing compulsive behaviors (Clark 2004; Salovskis, 1985, 1989). Obsessions may work similarly in misophonia, such that people initially experience an obsessive aggressive impulse toward the person making the sound, and compulsive behaviors serve primarily to reduce the distress arising from the obsessions. If so, it follows that misophonia will be more strongly associated with obsessive rather than compulsive OCD symptoms. Carrying this similarity further, it may be that misophonics score highly on the

cognitive dyscontrol dimension of AS, and that the score on this dimension increases symptom severity through OCD obsessive symptoms. Wheaton et al. (2012) found that AS dimensions were associated with general distress and cognitive distortions related to OC symptoms, providing obsessive beliefs as an example. This may allude to the mechanism behind OCD symptoms in misophonia. People with OCD ruminate about hurting other people, more so in patients with OCD and high AS levels. High AS levels could be a characteristic of misophonia influencing the nature of their thoughts about controlling their aggressive impulses towards the person producing the trigger sound.

### **Current Study**

When considering existing literature on misophonia, it is clear that further work is needed to clarify what may be responsible for misophonia symptoms. Taken together, the existing literature suggests that learning theory and models of OCD may be able to explain the mechanisms behind misophonia. The goal of this study is to investigate the mechanisms behind two important aspects of misophonia. First, we will examine why people differ in their specific emotional reaction to misophonia sounds. As prior research suggests that trait levels are predictive of state emotional reactions, further examination of this relationship relative to misophonia may help to better understand tendencies for the extreme emotional reaction seen in misophonics. Additionally, much of the existing research has drawn similarities between OCD and misophonia. Given these similarities, further investigating the relationship between misophonia and OCD may help to clarify what is occurring in misophonics, as it may be similar to the mechanisms of OCD. Anxiety sensitivity, proven to be heightened in those with misophonia and those with OCD, may play an important role in the relationship between OCD and misophonia.

Therefore, the purpose of the current study is to extend prior research to better clarify misophonia through investigating trait anger and anxiety's influence on a misophonic response type, and through investigating the OCD-misophonia relationship using AS, specifically the cognitive dyscontrol dimension of AS. Examining cognitive dyscontrol in misophonics may help to clarify why one type of OCD symptom (e.g., obsessive symptoms) are more prevalent in misophonia than other OCD symptom types (e.g., compulsive symptoms).

### **Research Hypotheses:**

**Hypothesis 1.** Trait emotion levels will predict the emotional response in misophonics. People with higher trait anger will be more likely to exhibit primarily anger responses to sounds. People with higher anxiety levels will be more likely to exhibit primarily anxious responses to sounds.

**Hypothesis 2:** The obsessive symptoms of OCD will be more strongly related to misophonia than the compulsive symptoms.

**Hypothesis 3a.** Misophonia will be more strongly related to the cognitive dyscontrol scale of the ASI than the other two sub-scales.

**Hypothesis 3b.** OCD will mediate the relationship between AS symptom severity and misophonia symptoms severity.

**Hypothesis 3c.** The obsessive OCD symptom sub-scale will mediate the relationship between the cognitive dyscontrol scale of the ASI-3 and misophonia symptom severity.

## **Methods**

### **Participants**

The current study will use data originally collected by Cash (2015). Participants were recruited from two different sources. One sample was recruited from the Virginia Commonwealth University undergraduate population using an online system for students to

participate in research for extra credit in their psychology courses. The second sample was recruited from community based adults in the United States participating in research through Amazon's Mechanical Turk (MTurk) program. Cash (2015) defines MTurk as an "online marketplace" where researchers can post human intelligence tasks or jobs and participants can choose jobs to complete for which they will receive compensation. Past research has discussed the benefits for conducting research using MTurk. For example, Mason and Suri (2012) claim that participants recruited through MTurk provide a more diverse background than a sample of undergraduate students. MTurk has proven to be useful in broadening sample size, sample diversity, and external validity of survey research.

A total of 828 people were included in the current study. However, due to missing data, the sample size for each analysis varies (see Table 1). The eliminated participants were those who made too many errors on distraction questions, and those who did not complete the survey. The two populations varied in terms of demographics. The mean age for the student sample ( $N=451$ ) was 19.58 ( $SD = 3.60$ ), the mean age for the community sample ( $N=377$ ) was 37.04 ( $SD = 12.54$ ), and the mean age for the combined sample was 27.49 ( $SD = 12.41$ ). The combined sample was 63.6% female and 35.7% male. The majority of the combined sample identified as White-Non-Hispanic at 51.1%. Given that the current study is examining misophonia, a disorder with a potentially low base rate in the population, we used the combined sample. Furthermore, Cash (2015) found that the rates of tinnitus, hyperacusis, misophonia, and general sensory and auditory intolerance based on screening items were equivalent across the two samples

### **Design**

This is a cross-sectional survey study. The self-report measures were presented using a secure online survey.

## **Procedure**

The survey was distributed to the undergraduate participant pool and the community sample with a link to the survey at an external, secure, electronic data management system (REDCap). Responses from the student sample were collected between July and December 2014. Responses from the community sample were collected on one day in April 2015. Participants were instructed to complete a series of screening questions regarding tinnitus, sound intolerance, and hearing problems. Based on their responses, participants were then asked to answer additional questions about the reported problems. The questionnaires were administered to each participant in the same order, which was established to keep group related constructs together for ease of comprehension.

**Measures.** Cash (2015) selected measures to evaluate the following: tinnitus, DST symptoms, mental health symptoms, physical health problems, quality of life, and individual differences and mechanisms of action. However, the current study will only be investigating a subset of measures from Cash (2015). Measures used in the current study are presented in the Appendix.

**Misophonia.** Screening items were developed based on existing screening questions used in audiology research and clinical practice (Moller et al., 2011). These screening items were presented first. Only participants who responded affirmatively to questions about tinnitus, DST in general, or misophonia were asked to complete the rest of the questions about these conditions, given that the questions assume some level of decreased sound tolerance (DST) symptoms.

The Misophonia Questionnaire (MQ) is a three-part self-report questionnaire that assesses for the presence of misophonia (Misophonia Symptom Scale), associated emotions and

behaviors (Misophonia Emotions and Behaviors Scale), and the severity of sound intolerance (Misophonia Severity Scale) (Wu et al., 2014). For the Misophonia Severity Scale (range=0-15), individuals that reported a 7 or higher on the MQ Misophonia Severity Scale were considered to have clinically significant misophonia symptoms (Wu et al., 2014). The Misophonia Severity Scale, items from the Misophonia Emotions and Behaviors scale, and the MQ Total Score were used for analyses in the current study.

***Hyperacusis.*** The Hyperacusis Questionnaire (HQ) is a 14-item self-report scale (range=14-56) designed to quantify the behavioral/adaptive consequences and cognitive and emotional aspects of hyperacusis (Khalifa, Dubal, Veuillet, Perez-Diaz, Jouvent, & Collet, 2002). It has good psychometric properties, and provides information about hyperacusis symptoms within attentional, social, and emotional domains (Khalifa et al., 2002). A mean score of 15 has been reported in the general population, with a score greater than 28 indicating likely clinical-level hyperacusis symptoms (Khalifa et al., 2002).

***Obsessive Compulsive Inventory-Revised.*** The Obsessive Compulsive Inventory-Revised (OCI-R; Foa et al., 2002) is an 18-item abridged version of the OCI (Foa, Kozak, Salkovskis, Coles, & Amir, 1998) used to measure OCD symptoms in both clinical and non-clinical samples. Individuals use a 5-point Likert scale to rate the degree of distress and impairment caused by obsessive-compulsive symptoms in the past month. According to Foa et al. (2002), 21 is the cutoff score suggesting the presence of OCD. The current study will use the subscales of the OCI-R validated in a clinical sample of patients with OCD by (Huppert et al., 2007). Huppert and colleagues (2007) validated six subscales measuring six different OCD symptom types. The six subscales are as follows: washing, checking, ordering, obsessing, hoarding, and neutralizing. The researchers found high internal consistency for the six subscales,

supporting the idea that the six subtypes of OCD are well measured by the OCI-R. Additionally, each subscale score was the highest in patients who identified as having primary concerns with that subscale symptom type and lowest in patients who denied those symptoms, and patients with a GAD diagnosis.

***Anxiety Sensitivity Inventory.*** The Anxiety Sensitivity Inventory-3 (ASI-3; Taylor et al., 2007) is an 18-item self-report instrument that asks individuals to rate their degree of anxiety in response to various social, cognitive, and physiological situations. Example of items included in the ASI are: “It scares me when my heart beats rapidly” and “When I feel "spacey" or spaced out I worry that I may be mentally ill.” Anxiety sensitivity is measured by a total score. The ASI also provides three domain scores: Cognitive concerns, Social concerns, and Physical concerns. Factorial validity was supported by Taylor et al., (2007) through confirmatory factor analyses of six replication samples, both clinical and non-clinical samples. The developers found strong convergent and discriminant validity of these subscales in that the correlations between similar subscales from the ASI–3 and ASI were significantly larger than the correlations between dissimilar subscales. Lastly, Taylor and colleagues looked at the internal consistency to gauge the reliability of the subscales and found that the internal consistency of the ASI-3 subscales is strong.

***Multidimensional Anger Inventory.*** The Multidimensional Anger Inventory (MAI; Siegel, 1986) is a 30-item self-report questionnaire that captures trait-level anger along a variety of dimensions. It was validated within a sample of adult factory workers and found to have adequate reliability and validity. The current study will use the total MAI score.

***Hospital Anxiety and Depression Scale.*** The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) is a 14-item self-report scale that assesses common symptoms



of anxiety and depression. It was developed to avoid conflation of the somatic symptoms of anxiety and depressive disorders with those of physical illness. As such, it is commonly used in medical settings to screen for anxiety and depression. Interpretative ranges are available for overall and separate anxiety (HADS-A) and depression (HADS-D) levels. Spinhoven and colleagues (1997) extensively examined the reliability of the HADS and found that the test-retest reliability of the measure and the subscales was good and that the dimensional structure and reliability of the HADS was stable across medical settings and age groups. The current study will only use the anxiety scale of the HADS.

## Results

### Descriptive Statistics:

Descriptive statistics for all independent and dependent variables are presented in the tables below.

Table 1.

*Descriptive statistics of all independent and dependent variables.*

	N	Mean	SD
ASI Sum	826	18.36	13.53
OCI-R Sum	826	12.53	11.13
MQ Severity	817	2.94	2.62
Hyperacusis	822	23.83	6.89
MAI Sum	826	71.84	19.24
MQ Sum	826	16.66	11.48
HADS-A	826	6.74	4.22
MQ Reaction #4	694	1.51	1.11
MQ Reaction #8	691	1.36	1.03

Table 2.

*Descriptive statistics of obsessive compulsive (OCI-R) subscales.*

	N	Mean	SD
Obsessive	817	2.14	2.64
Checking	811	1.99	2.35
Hoarding	811	2.25	2.33
Neutralizing	815	1.39	2.12
Washing	813	1.62	2.25
Ordering	813	3.17	2.82

Table 3.

*Descriptive statistics of anxiety sensitivity (ASI-3) subscales.*

	N	Mean	SD
Cognitive	789	4.37	5.15
Physical	794	5.42	5.29
Social	802	8.69	5.29

### **Hypothesis 1:**

The relationship between trait emotion levels and the emotional response in misophonia was examined using linear regression in which an anger reaction to a trigger sound was predicted based on trait anger levels and trait anxiety levels (see Table 4). The regression showed that trait anger, as measured by the MAI total score, and trait anxiety levels, as measured by the HADS-A, explain a significant amount of the variance in one's anger reaction to a trigger sound, ( $F(2,690) = 99.89, p < .001, R^2 = .23, R^2_{adjusted} = .22$ ). Both trait anger levels ( $\beta = .36, t(689) = 8.98, p < .001$ ) and trait anxiety levels ( $\beta = .17, t(689) = 4.31, p < .001$ ) were significant predictors of an angry reaction in misophonics, as measured by the "anger reaction" question from the MQ Emotions and Behaviors scale; 10.5% of the variance in a misophonic's anger reaction is attributable to trait anger levels, but is not attributable to trait anxiety levels ( $pr^2 = .105$ ); 2.6% of

the variance in a misophonic's anger reaction is attributable to trait anxiety levels, but is not attributable to trait anger levels ( $pr^2 = .026$ ).

A second multiple linear regression was used to predict an anxious reaction to a trigger sound based on trait anger levels and trait anxiety levels (see Table 5). The regression showed that trait anger and trait anxiety levels explain a significant amount of the variance in one's anxiety reaction to a trigger sound ( $F(2,693) = 101.85, p < .001, R^2 = .228, R^2_{adjusted} = .225$ ). Both trait anxiety levels ( $\beta = .369, t(692) = 9.26, p < .001$ ) and trait anger levels ( $\beta = .162, t(692) = 4.05, p < .001$ ) were significant predictors of an anxious reaction to a trigger sound. 11.0% of the variance in a misophonic's anxiety reaction is attributable to trait anxiety levels, but is not attributable to trait anger levels ( $pr^2 = .110$ ). 2.3% of the variance in a misophonic's anxiety reaction is attributable to trait anger levels, but is not attributable to trait anxiety levels ( $pr^2 = .023$ ).

Table 4.

*Summary of Simple Regression Analyses for Variables Predicting Emotional Reaction in Misophonia*

Variable	Anger Reaction (N = 694)			Anxiety Reaction (N = 691)		
	B	SE B	$\beta$	B	SE B	$\beta$
Trait Anger	.02	.00	.36***	.01	.00	.16***
Trait Anxiety	.04	.01	.17***	.10	.01	.37***
$R^2$	.23			.23		
F	101.85***			99.89***		

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\*\*\* $p < .001$

### **Hypothesis 2:**

To examine the relationship between OCD symptoms and misophonia, Pearson product moment correlations were conducted. A significant association was found between misophonia (MQ Total) and OCD symptoms as measured by the OCI-R total score ( $r = .44, p < .001$ ). Additional analyses were conducted to see which OCD subscale was most strongly related to misophonia. Pearson product moment correlations revealed significant associations between misophonia and the OCI-R obsessive subscale, neutralizing subscale, ordering subscale, washing subscale, and the hoarding subscale, (see Table 5). Fisher's z-transformation were used to change the  $r$ s to Z-scores. The Z-scores were then used as standardized scores in the significance testing formula. The Z-scores represent the standardized version of the comparison between the correlation of MQ Total and the OCI-obsessive sub-scale versus the correlation of the MQ Total and every other OCI sub-scale. The p-values provide information regarding the significance of the difference between these two correlations. The positive z-scores and significant p-values provide support for hypothesis 2: that misophonia was most strongly correlated with the obsessive symptom sub-type of the OCI-R.

The same analyses were conducted with hyperacusis in order to examine whether these relationships are unique to misophonia and OCD. There was a significant association between hyperacusis (Hyperacusis Questionnaire) and OCD symptoms as measured by the OCI-R total score ( $r = .19, p < .001$ ). Pearson product moment correlations revealed significant associations between hyperacusis and all of the OCI-R subscales (see Table 5a). Although all OCI-R subscales were significantly related to hyperacusis, there were no significant differences between the

correlation of the hyperacusis questionnaire and the OCI-obsessive sub-scale versus the correlation of the hyperacusis questionnaire tool and every other OCI sub-scale (see table 5a). Based on these insignificant results, hyperacusis is not more strongly related to the obsessive symptoms of OCD, more so than the other OCI sub-scales.

Table 5.

*Misophonia (MQ Total) and OCD Symptom Subscale Correlations and Z-scores*

	MQ Total	Z score	p value
OCI Obsessive	.42		
OCI Neutralizing	.27	4.61	<.001
OCI Ordering	.36	2.06	.04
OCI Washing	.40	2.73	<.001
OCI Hoarding	.27	4.56	<.001
OCI Checking	.32	3.18	<.001

*Notes.* All correlations are significant at  $p < .001$ .

$N = 811$ , except for the following: OCI Obsessive ( $n = 817$ ), OCI Neutralizing ( $n = 815$ ), OCI Washing ( $n = 813$ ), and OCI Ordering ( $n = 813$ ).

Table 5a.

*Hyperacusis and OCD Symptom Subscale Correlations and Z-scores.*

	Hyperacusis Questionnaire	Z score	p value
OCI Obsessive	.43		
OCI Neutralizing	.27	1.85	.06
OCI Ordering	.38	1.08	.28
OCI Washing	.31	1.28	.20
OCI Hoarding	.30	0.56	.58
OCI Checking	.33	0.94	.35

*Notes.* All correlations between OCI sub-scales and the Hyperacusis Questionnaire are significant at  $p < .001$ .

$N = 811$ , except for the following: OCI Obsessive ( $n = 817$ ), OCI Neutralizing ( $n = 815$ ), OCI Washing ( $n = 813$ ), and OCI Ordering ( $n = 813$ ).

**Hypothesis 3a: Relationship between misophonia severity and anxiety sensitivity levels**

The relationship between misophonia severity and anxiety sensitivity was examined using Pearson product moment correlations. There was a significant association between anxiety sensitivity total score and misophonia severity,  $r = .40$ ,  $p < .001$ , as well as misophonia severity and each ASI subscale: ASI Cognitive,  $r = .40$ , ASI Social,  $r = .35$ , ASI Physical,  $r = .33$ , all significant at  $p < .001$ . Fisher's Z-transformations were used to test the hypothesis that the cognitive dyscontrol scale of the ASI would be more associated with misophonia than the other two subscales. This hypothesis was not supported. There were no significant differences in the associations between misophonia and each subscale.

Results support a significant relationship between hyperacusis and anxiety sensitivity,  $r = .17, p < .001$ , as well as hyperacusis and each ASI subscale: ASI Cognitive,  $r = .16, p < .001$ , ASI Social,  $r = .11, p = .002$ , and ASI Physical,  $r = .17, p < .001$ . Fisher's Z-transformations were again used to test the strength of the relationship between hyperacusis and the cognitive dyscontrol scale of the ASI in comparison to the other two sub-scales. This hypothesis was not supported for hyperacusis either.

**Hypothesis 3b: Relationship between misophonia severity and anxiety sensitivity levels mediated by OCD symptoms.**

To assess hypothesis 3b, the mediation of the relationship between misophonia severity (MQ severity) and anxiety sensitivity (ASI-3 total score) was assessed using a simple mediation model with OCD symptoms as the mediator. The total effect model was significant,  $R^2 = .31, F(1,815) = 363.31, p < .001$ , indicating that OCD symptoms and anxiety sensitivity account for 9.5% of the variance in misophonia severity. Further examination found that misophonia severity was directly explained by the presence of anxiety sensitivity, as well as indirectly explained by the presence of anxiety sensitivity through a pathway of OCD symptomology (see Figure 1). Greater anxiety sensitivity was associated with greater OCD symptomology ( $a = .46$ ), and OCD symptomology was associated with higher levels of misophonia severity ( $b = .08$ ). A bias-corrected bootstrap confidence interval (CI) for the indirect effect ( $ab = .04$ ) based on 5,000 bootstrap samples was entirely above zero (.0263-.0472). Because this CI does not include zero, the null hypothesis that  $ab_1 = 0$  can be rejected, meaning that OCD symptomology did mediate between anxiety sensitivity and misophonia severity. However, the direct effect of AS on misophonia symptom severity was also maintained, independent of its mediation by OCD symptomology ( $c' = .06, p < .001$ ), indicating partial mediation.

The same mediation model was used to test the relationship between anxiety sensitivity symptoms and hyperacusis mediated by OCD symptoms. The total effect model was significant  $R^2 = .37$ ,  $F(1,824) = 129.12$ ,  $p < .001$ , indicating that OCD symptoms and anxiety sensitivity account for 13.5% of the variance in hyperacusis. Hyperacusis was directly explained by the presence of anxiety sensitivity, and indirectly explained by the presence of anxiety sensitivity through a pathway of OCD symptomology. Greater anxiety sensitivity was associated with greater OCD symptomology ( $a = .46$ ), and OCD symptomology was associated with higher levels of hyperacusis ( $b = .21$ ). A bias-corrected bootstrap confidence interval (CI) for the indirect effect ( $ab = .10$ ) based on 5,000 bootstrap samples was entirely above zero (.0731-.1268). Because this CI does not include zero, the null hypothesis that  $ab_1 = 0$  can be rejected, meaning that OCD symptomology did mediate between anxiety sensitivity and hyperacusis. However, the direct effect of AS on hyperacusis was also maintained, independent of its mediation by OCD symptomology ( $c' = .09$ ,  $p < .001$ ), indicating partial mediation.

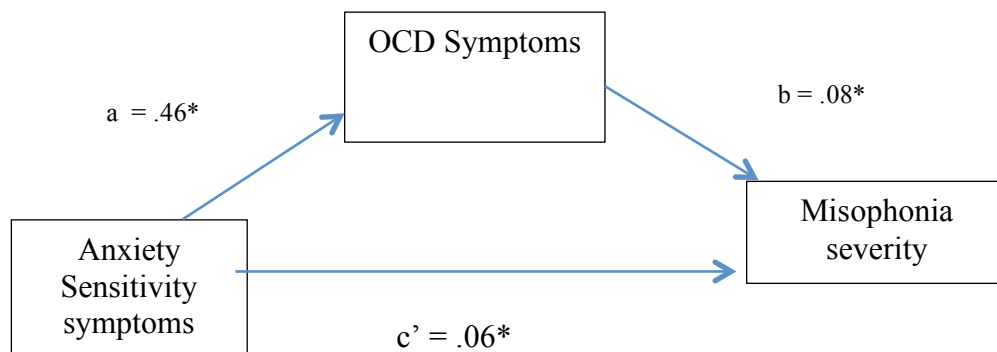


Figure 1. Simple Mediation of Misophonia Symptoms by Anxiety Sensitivity

\* $p < .001$



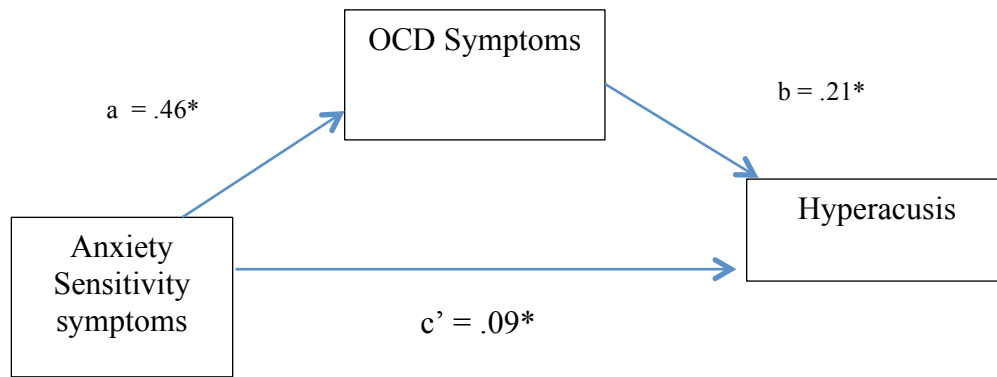


Figure 2. Simple Mediation of Hyperacusis by Anxiety Sensitivity

\* $p < .001$

**Hypothesis 3c: Relationship between misophonia severity and cognitive anxiety sensitivity symptoms mediated by OCD obsessive symptoms.**

To test hypothesis 3c, the mediation of the relationship between misophonia severity (MQ Severity Score) and the cognitive subscale (ASI cognitive) of the Anxiety Sensitivity Inventory by obsessive OCD symptoms (OCI-R obsessive subscale) was assessed using a simple mediation model. The total effect model was significant,  $R^2 = .08$ ,  $F(1,771) = 70.71$ ,  $p < .001$ , indicating that OCD obsessive symptoms and anxiety sensitivity cognitive symptoms account for 8% of the variance in misophonia severity. Further analysis found that misophonia severity was directly explained by the presence of cognitive anxiety sensitivity symptoms as well as indirectly explained through a pathway of obsessive OCD symptoms (see Figure 3). The presence of cognitive anxiety symptoms was associated with greater obsessive OCD symptoms ( $a = .30$ ), and obsessive OCD symptoms were associated with higher levels of misophonia severity ( $b = .27$ ). A bias-corrected bootstrap confidence interval (CI) for the indirect effect ( $ab = .08$ ) based on 5,000 bootstrap samples was entirely above zero (.0564-.1119), meaning that the null hypothesis that  $ab_1 = 0$  can be rejected and obsessive OCD symptoms did mediate between cognitive anxiety sensitivity symptoms and misophonia severity. The direct effect of cognitive AS symptoms on

misophonia severity was maintained independent of its relationship with OCD symptoms ( $c' = .06, p = .002$ ).

A mediation model was used to test the same proposed relationship in hyperacusis. The total effect model was significant,  $R^2 = .35, F(1,780) = 107.64, p < .001$ , indicating that OCD obsessive symptoms and anxiety sensitivity cognitive symptoms account for 12% of the variance in hyperacusis. Further analysis found that hyperacusis was directly explained by the presence of cognitive anxiety sensitivity symptoms, as well as indirectly explained through a pathway obsessive OCD symptoms (see Figure 4). The presence of cognitive anxiety symptoms was associated with greater obsessive OCD symptoms ( $a = .30$ ), and obsessive OCD symptoms were associated with higher levels of misophonia severity ( $b = .84$ ). A bias-corrected bootstrap confidence interval (CI) for the indirect effect ( $ab = .25$ ) based on 5,000 bootstrap samples was entirely above zero (.1822-.3248), meaning that the null hypothesis that  $ab_1 = 0$  can be rejected and obsessive OCD symptoms did mediate between cognitive anxiety sensitivity symptoms and hyperacusis. The direct effect of cognitive AS symptoms on hyperacusis was maintained independent of its relationship with OCD symptoms ( $c' = .21, p = <.001$ ).

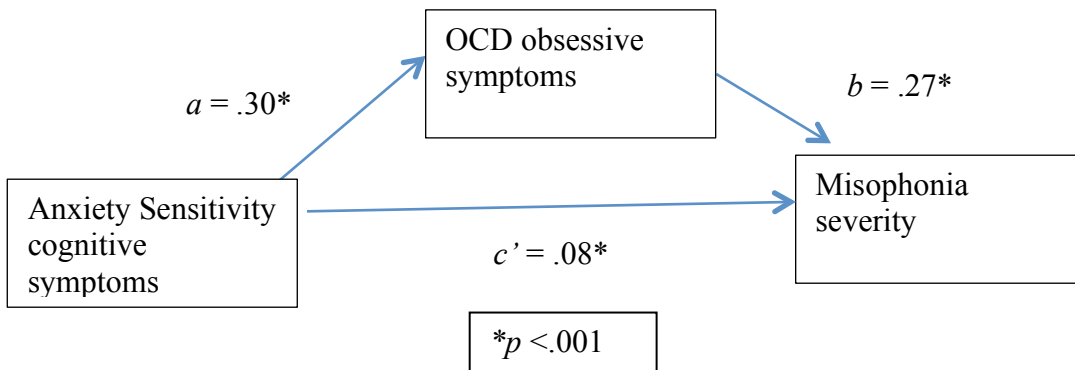


Figure 3. Simple Mediation of Misophonia Severity by Anxiety Sensitivity Cognitive Symptoms

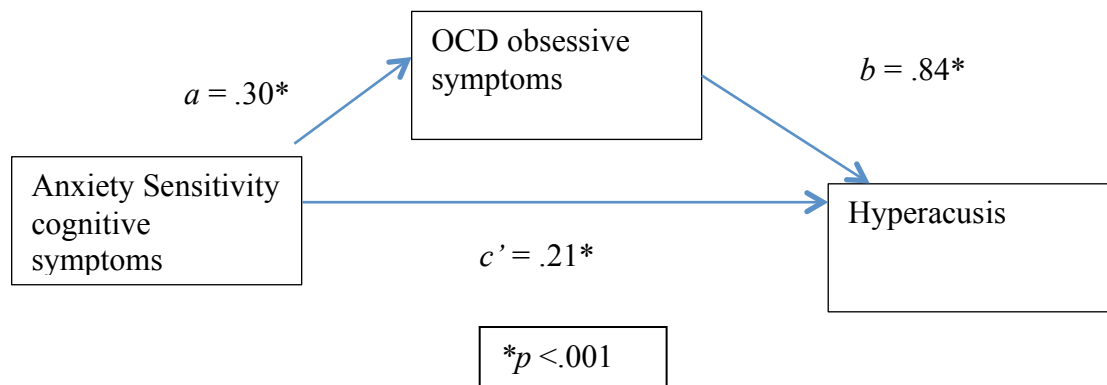


Figure 4. Simple Mediation of Hyperacusis by Anxiety Sensitivity Cognitive Symptoms

### Discussion

The primary aim of the study was to test three discrete hypotheses about misophonia. First, this study sought to examine the power of trait anxiety and anger levels in predicting the emotional reaction reported by a misophonic. Second, the study examined the relationship between misophonia and various symptom types of OCD in order to clarify the relationship between misophonia and OCD. To further understand the relationship between OCD and misophonia, and the role of AS in that relationship, an exploratory aim was to examine the potential mediating effect of OCD symptomology on the relationship between AS levels and misophonia severity.

#### Trait Anger and Anxiety as Predictive of Emotional State

The first aim of the present study was to determine the relationship between trait emotion levels and the emotional response in misophonia. The linear regression in which an anger reaction to a trigger sound was predicted based on trait anger levels and trait anxiety levels showed that trait anger and trait anxiety levels explain a significant amount of the variance in one's anger reaction to a trigger sound. 10.5% of the variance in a misophonic's anger reaction is attributable to anger levels but is not attributable to anxiety levels. In comparison, 2.6% of the

variance in an anger reaction is attributable to trait anxiety levels but not to trait anger levels. Although there is no extant research on emotional traits and misophonia reaction, these results are consistent with Speilberger's trait-state theory, which proposes that the stronger a particular trait is, the more likely that the emotional state that corresponds will be experienced (Speilberger, 1972). More specifically, these results are consistent with the State-Trait Theory of Anger, which posits that trait anger acts as a predisposition for people to experience more frequency and more intense anger episodes than those low in trait anger (Speilberger, Jacobs, Russell, & Crane, 1983). Past literature has also supported the State-Trait Theory of Anger (e.g., Quinn, Rollock, & Vrana, 2014; Deffenbacher, Richards, Filette, & Lynch, 2005). Although the results show that trait levels were predictive of states inconsistent with that emotion (e.g., trait anxiety predicted an anger response), the results also support that the emotion trait consistent with the reaction account for more of the variance in one's reported reaction. The current findings add to the literature supporting trait anger levels as predictive of states. While the majority of the literature on trait anger and anxiety levels focuses on one trait level predicting one consistent state level, the results of the current study elude to the fact that this may not be the case. Multiple trait levels should be considered when examining what trait emotions predict what state reactions. Furthermore, the results add to the lacking literature on misophonia. Specifically, the results from the regression tell us that trait anger levels are an important consideration in identifying factors that are contributing to one's angry response to a trigger sound.

In a second linear regression, both trait anger and trait anxiety levels were significant predictors of an anxiety misophonic reaction. 11.0% of the variance in this reaction is attributable to trait anxiety levels, but not trait anger levels. 2.3% of the variance in this reaction is attributable to trait anger levels, but not trait anxiety levels. These findings support the notion

that trait emotion levels do predict the emotional response in misophonia, where the trait level that is consistent with this reaction explains more variance in one's reaction. The relationship between state and trait anxiety levels is well established in the literature (e.g., Li and Lopez, 2005; Hanton et al., 2007). Trait anxiety levels are predictive of state anxiety elevations more frequently, or one's inherent, seemingly stable, level of anxiety is predictive of how often one experiences a heightened state, or temporary, feeling of anxiety. Higher trait anxiety levels are predictive of a stronger state anxiety, where those with high trait anxiety levels report feeling a more intense state anxiety reaction. Consistent with this literature, trait anxiety predicted state anxiety reaction in the presence of a misophonia trigger sound.

Literature on misophonia has found that those who endorse experiencing misophonia report feeling a wide range of emotions. For example, Edelstein and colleagues (2013) found that the most common negative feelings endorsed by misophonics include anxiety, panic, anger, irritation and rage. Additionally, Cash (2015) found that those who endorsed misophonia in her sample reported experiencing anger, disgust, and anxiety most often. Given that the response to auditory triggers varies on a case-by-case basis, to help understand mechanisms involved in the development and maintenance of misophonia, it is important to consider what underlying factors may be causing individual differences in response to misophonic stimuli. The current findings provide support for trait emotion levels as a potential explanation for these individual differences.

Although one emotion did account for more of the variance, both emotions were significant predictors of one's state reaction. Zhou, Wu, and Storch (2017) examined misophonia in a Chinese college student sample and found that anxiety significantly mediated the relationship between misophonia and anger outbursts. The current findings coupled with the

findings from Zhou et al. (2017) provide rationale for considering how multiple trait emotion levels may influence one's reaction. The current results provide insight into personal characteristics that may have a role in producing one's misophonic reaction.

In addition to this insight, the results provide treatment implications that should be considered. Clinicians providing treatment for misophonia should evaluate for both anger and anxiety levels whether or not the client is experiencing an anger versus an anxiety response. Because either trait level could be responsible for the emotional state, the clinician cannot solely focus on just anger or just anxiety because they may miss an important underlying emotional factor. The literature does provide a number of case studies using cognitive behavioral therapy (CBT) to treat misophonia, but given the variation in emotion levels from person-to-person and the potential interaction of multiple emotions as causing a misophonic reaction, other treatment protocols should also be explored. For example, Schneider and Arch (2017) found that their client exhibited declines in symptomology after sessions based on mindfulness- and acceptance-based components drawn from dialectical behavior therapy and acceptance and commitment therapy. With the further examination of a wide range of therapeutic approaches for misophonia, various combinations of emotions can be targeted in treatment.

### **Obsessive-Compulsive Disorder and Misophonia**

The second aim of the current study was to determine the relationship between misophonia and the symptom types of OCD. The research on misophonia has established the relationship between misophonia and OCD symptomology (e.g., Wu et al., 2014; Cash, 2015). The relationship of misophonia to specific types of OCD symptomology, to the best of our knowledge, has not yet been examined.

The function of compulsions in OCD is to reduce the distress caused by obsessions (Goodman et al., 2014), where the person feels drive to perform the behavior because of the presence obsessions. Both the obsessive and the compulsive aspects of OCD have been present in cases of misophonia. For example, Hadjipavlou and colleagues (2008) found that preoccupation with and compulsive mimicry of the aversive sound was a symptom of misophonia. Other examinations into misophonia symptomology have also shown the intrusive thought component but instead of the engagement in compulsive behaviors, the research has shown that misophonics engage in avoidance behaviors instead (Schroder et al., 2013; Webber & Storch, 2015). Therefore, from the information that the developing literature on misophonia provides thus far, the preoccupation is present in misophonia consistently, while compulsive behaviors may be replaced by avoidant behaviors in some cases.

Consistent with the established relationship between misophonia and OCD, the Pearson product moment correlations between misophonia and all OCD symptom types (i.e., obsessing, neutralizing, ordering, washing, hoarding, and checking) revealed significant associations. However, the z-scores used to compare the relationship between misophonia and the obsessing subscale with the relationships between misophonia and the compulsive subscales showed that misophonia is most strongly associated with the obsessive symptom subtype of the OCI-R. Hyperacusis, another decreased sound tolerance disorder, was also significantly associated with OCD symptomology. However, the obsessive symptoms of OCD were not more strongly related to hyperacusis than to any other OCD symptom type. The stronger relationship between misophonia and the obsessive symptom type of OCD, then, may be unique to misophonia, suggesting that obsessions may be an important part of misophonia.

The finding from the current study, that misophonia is more strongly related to the obsessive subscale rather than any of the compulsive symptom subscales, is consistent with early examinations into misophonia and OCD symptomology overlaps; the preoccupation tends to be seen across cases of misophonia and OCD. The results of the Pearson product moment correlations and Fisher's *Z* transformations support hypothesis two: misophonia will be most strongly correlated with the obsessive symptom subtype of the OCI-R.

### **Anxiety Sensitivity and Misophonia.**

The third aim of the current study was to examine the relationship between misophonia severity and anxiety sensitivity. A relationship between misophonia and AS was expected given that misophonia involves an exaggerated emotional response to typically innocuous stimuli. A significant moderate association between misophonia severity and AS was supported by the results of a Pearson product moment correlation. The relationships between misophonia severity and the three ASI sub-scales: Cognitive concerns, Social concerns, and Physical concerns were explored as well. Again, there was a significant moderate relationship between each ASI subscale and misophonia severity. Fisher's *Z*-transformations revealed no significant differences in the associations between misophonia severity and each ASI-3 subscale.

The literature has established the relationship between OCD and AS in that AS levels are proven to predict OCD symptoms (Wheaton et al., 2012; Calamari, 2008; Reiss et al., 1986). To date, there is no specific conceptual rationale for the relationship between AS and OCD aside from the link between sensitivity to anxiety symptoms and an enhanced vulnerability to fear conditioning (Robinson & Freeston, 2014). It may be that those high in AS with OCD have negative beliefs about the meaning of their symptoms (e.g., intrusive thoughts) and, thus, are



more likely to engage in avoidance strategies to reduce the symptoms and the anxiety and fear the symptoms are causing.

Misophonia is associated with higher AS levels and OCD symptomology (Cash, 2015). The literature on OCD has proposed that obsessions arise from intrusive thoughts that then motivate an individual to engage in neutralizing, compulsive behaviors (Clark, 2004). In misophonia, an individual may experience an obsessive aggressive impulse, and engage in compulsive or avoidance behaviors to reduce the distress from this impulse or thought. Given that obsessions are consistently present in cases of misophonia, whereas compulsive behaviors are not, it follows that obsessive thoughts may be more prominent in misophonia symptomology. As discussed above, the OCI-R obsessive sub-scale is related specifically to the cognitive dyscontrol subscale of AS. This relationship may be present in misophonia as well, where the individual experiences a mental preoccupation with the trigger sound and/or person making the sound. Those high on the cognitive dyscontrol subscale of the AS may interpret this preoccupation as more meaningful than it is and may be more sensitive to a lack of cognitive control; leading them to engage in avoidance behaviors often seen in misophonia. If this is the case, misophonia should be more strongly related to the cognitive dyscontrol subscale of the ASI-3, our third hypothesis. However, this hypothesis was not supported.

In continuing with the third aim of the current study, the relationship between AS, OCD, and misophonia was examined using a mediation model. AS is shown to increase OCD symptoms (Calamari 2008; Reiss et al., 1986) and is related to misophonia in the literature (Cash, 2015). Thus, we hypothesized that AS will increase misophonia severity directly, because those who are more sensitive to experiencing anxiety symptoms (high on AS) will engage in avoidance behaviors more often, and may interpret emotional reactions and physiological

reactions to auditory stimuli as stronger. Furthermore, AS will indirectly increase misophonia symptom severity through OCD symptomology, since AS is shown to increase OCD symptomology. It may be that the OCD symptoms seen in misophonics are partly responsible for the relationship between AS and misophonia severity. The total effect model was significant, indicating that OCD symptoms and AS account for 9.5% of the variance in misophonia severity. Misophonia severity was directly explained by AS, and indirectly explained by the presence of AS through a pathway of OCD symptoms. The direct effect of AS on misophonia symptom severity was maintained with the addition of the mediator, indicating partial mediation.

Notably, this is one of the first studies to examine the relationship between misophonia, OCD, and a potential risk factor for the development of both OCD and misophonia. While other studies have looked at the associations between misophonia and existing DSM disorders (e.g., Wu et al., 2014), the interplay of how these constructs are related in misophonia has not been studied. The current findings are consistent with the theory in the literature about how AS works relative to OCD, and based on the present findings, misophonia.

Lastly, a mediation model was used to test the mediating effects of the obsessive symptom type of OCD on the relationship between the ASI-3 cognitive dyscontrol subscale and misophonia severity. Given that obsessions are more prominent in the symptomology of misophonia, we hypothesized that the cognitive dyscontrol subscale would increase misophonia severity directly and indirectly through OCD obsessions. Calamari and colleagues (2008) found that the cognitive dyscontrol component of AS was higher in individuals with OCD; this makes sense given the overestimation of the importance of one's thoughts as a cardinal feature of OCD (Rachman, 1998). Additionally, Raines, Oglesby, Capron, and Schmidt (2014) found that the cognitive concern subscale of AS was significantly associated with the obsessing sub-scale of the

OCI-R, but the physical and social concerns subscales were not. Sensitivity to failures in cognitive control is higher in those with OCD considering how important obsessions are to the disorder. Similarly, then, the importance of obsessions in misophonia should predict a higher sensitivity to failures in cognitive control. Consistent with this idea, results showed that the total effect model was significant and that OCD obsessive symptoms and anxiety sensitivity cognitive symptoms account for 8% of the variance in misophonia severity. Furthermore, misophonia severity was directly explained by the presence of cognitive anxiety symptoms as well as indirectly explained through a pathway of obsessive OCD symptoms.

Unexpectedly, the mediation models tested for misophonia symptom severity were also significant for hyperacusis. The two decreased sound tolerance disorders are hypothesized to have different etiologies and trigger sounds. It may be that one's levels of OCD symptomology and anxiety sensitivity are contributors to decreased sound tolerance conditions generally, rather than to misophonia specifically. Higher levels of AS and OCD symptomology may predispose someone to be more sensitive to sounds, whether specific or general, and thus these levels may account for variance in many decreased sound tolerance disorders.

### **Future Directions**

Very little is known about the development and maintenance of misophonia. The major limitation of the current study is the cross-sectional nature of the data, and so causal relationships cannot be inferred. The current study tested theorized causal relationships through mediation analyses between potential mechanisms of action (e.g., anxiety sensitivity and OCD) and outcomes (e.g., misophonia symptom severity). The assumed temporal order of the tested relationship cannot be confirmed and may potentially operate in a different directional order given the use of cross-sectional data. Specifically, it may be that more severe misophonia

symptoms lead to higher levels of anxiety directly, or through OCD symptomology. The lack of experimental manipulation in the current study is a second limiting factor in inferring causality from the results. Future research should focus on using longitudinal designs, as opposed to cross-sectional, so that causal and temporal relationships can be adequately assessed. Longitudinal and/or experimentally manipulated data will allow for the confirmation of the causal relationships and the direction of the relationships examined in the current study. Elucidating the causal relationships behind misophonia symptoms will help to clarify how it may, or may not, be similar in terms of etiology to OCD.

To examine individual differences in misophonia reaction more comprehensively, experimental manipulations should be used. For example, researchers could use a misophonia trigger stimuli in order to provoke a reaction from the participant. The researcher could measure trait anger and anxiety levels pre-exposure, to see if the trait levels were predictive of the reaction in real time. Future research into the influence of trait level emotions on state level reactions should also focus on examining a larger number of relevant trait emotion levels that may underlie one's state reaction. This may provide insight into how trait emotion levels are interacting to produce one's state reaction.

The current study provides additional insight into the relationship between misophonia and OCD. Without further examination into the causal factors of misophonia, it is hard to say that the thoughts are, in fact, obsessive in nature and those avoidance behaviors, then, are reducing distress from the preoccupation. Future research on misophonia and OCD should more specifically focus on the role symptoms are playing for the misophonic, to expand upon the associations found in the current study. A potential research design to measure the role of these symptoms is for the researcher to first assess if the misophonic is having thoughts that are

obsessive in nature after being exposed to a misophonia stimulus and to obtain a subjective distress rating from the participant. After establishing the presence of obsessional thoughts following the exposure, the researcher should measure overt avoidance behaviors, or the participant's self-reported rating on their desire to engage in avoidance behaviors. A post-avoidance behavior subjective distress rating should be taken to see if the avoidance behavior was successful in decreasing reported distress. Free-response, open-ended items would also be useful here in gathering information about why the participant engaged in, or felt the need to engage in, avoidance behaviors.

Because misophonia was not significantly more strongly related to any one dimension of the ASI-3, future investigations of misophonia should further explore the relationship between the dimensions of the ASI-3. It may be that misophonics are afraid of publicly observable anxiety symptoms (the social concern), as triggered by the sound, given that they are able to realize their emotions and thoughts about the sound as excessive (Goodman et al., 2014). Again, open-ended, free-response items may be useful here in gathering more comprehensive data on why misophonics fear anxiety symptoms. The results of the current study do not support the idea that misophonia is more strongly related to one dimension of the ASI-3 than any other. Thus, it may be that misophonics are generally high on AS, but there is not one reason (e.g., fear of cognitive dyscontrol) that explains increased AS levels across misophonics. Further exploring the role of each anxiety sensitivity symptom type in misophonia may help to explain why certain symptoms occur in misophonia (e.g., avoidance behaviors, preoccupations, compulsive mimicry, etc.).

## **Summary and Conclusions**

This examination of multiple discrete hypotheses regarding misophonia provides preliminary insight into factors (i.e., trait emotion levels, AS, and OCD) that potentially influence misophonia. Trait emotion levels were predictive of one's state experience in response to misophonia stimuli. These findings are consistent with the majority of the current literature examining trait-state emotion relationships, specifically trait and state anxiety and anger relationships. However, more than one trait emotion level was responsible for this reaction. Therefore, as future research works to uncover what produces individual differences in presentations of misophonia, and thus potential treatment targets, trait emotion levels should be considered.

The current study provides a more comprehensive look into the relationship between OCD and misophonia than the existing literature to date does. Misophonia was more related to the obsessive symptom type of OCD. Again, as future research tries to determine how to classify misophonia (e.g., anxiety disorders versus OCSDs), and how to successfully treat it, the symptoms that are seen in existing disorders and misophonia should be further examined together. In considering the established role these symptoms play in current DSM disorders, researchers may be able to clarify the role of misophonia symptoms.

Lastly, the relationship between AS and misophonia was further explored. While misophonia was related to AS generally, it was not related to a subscale of AS more so than any other subscale. This provides an additional potential target for the clarification of who develops misophonia. The examination of AS as a mechanism of action on misophonia symptom severity, both directly and through OCD, provide a preliminary look into what factors are potentially causing misophonia symptoms. In sum, the current study furthers the research agenda focused on

the nascent construct of misophonia through the investigation of individual difference factors and potential mechanisms of action.

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Appendix

Misophonia Questionnaire (MQ)

Directions: Please rate how much the following statements describe you on a scale from 0 to 4, 0 being "Not at all true" and 4 being "Always true."

0-----1-----2-----3-----4
Not at all True Rarely True Sometimes True Often True 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: \_\_\_\_\_

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-----1-----2-----3-----4
Never Rarely Sometimes Often 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: \_\_\_\_\_

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. \_\_\_\_\_

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.

**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.

**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.

**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.

**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.

## Hyperacusis Questionnaire (HQ)

In the following questionnaire, put a cross in the box corresponding to the answer which best applies to you:

	<b>No</b>	<b>Yes, a little</b>	<b>Yes, quite a lot</b>	<b>Yes, a lot</b>
1) Do you ever use earplugs or earmuffs to reduce your noise perception (Do not consider the use of hearing protection during abnormally high noise exposure situations)?				
2) Do you find it harder to ignore sounds around you in everyday situations?				
3) Do you have trouble reading in a noisy or loud environment?				
4) Do you have trouble concentrating in noisy surroundings?				
5) Do you have difficulty listening to conversations in noisy places?				
6) Has anyone you know ever told you that you tolerate noise or certain kinds of sound badly?				
7) Are you particularly sensitive to or bothered by street noise?				
8) Do you find the noise unpleasant in certain social situations (e.g. night clubs, pubs or bars, concerts, firework displays, cocktail receptions)?				
9) When someone suggests doing something (going out, to the cinema, to a concert, etc.), do you immediately think about the noise you are going to have to put up with?				
10) Do you ever turn down an invitation or not go out because of the noise you would have to face?				
11) Do noises or particular sounds bother you more in a quiet place than in a slightly noisy room?				



	<b>No</b>	<b>Yes, a little</b>	<b>Yes, quite a lot</b>	<b>Yes, a lot</b>
12) Do stress and tiredness reduce your ability to concentrate in noise?				
13) Are you less able to concentrate in noise towards the end of the day?				
14) Do noise and certain sounds cause you stress and irritation?				

## Obsessive Compulsive Inventory-Revised (OCI-R)

The following statements refer to experiences that many people have in their everyday lives. Circle the number that best describes **HOW MUCH** that experience has **DISTRESSED or BOTHERED you during the PAST MONTH**. The numbers refer to the following verbal labels:

0	1	2	3	4
Not at all	A little	Moderately	A lot	Extremely

1. I have saved up so many things that they get in the way.
2. I check things more often than necessary.
3. I get upset if objects are not arranged properly.
4. I feel compelled to count while I am doing things.
5. I find it difficult to touch an object when I know it has been touched by strangers or certain people.
6. I find it difficult to control my own thoughts.
7. I collect things I don't need.
8. I repeatedly check doors, windows, drawers, etc.
9. I get upset if others change the way I have arranged things.
10. I feel I have to repeat certain numbers.
11. I sometimes have to wash or clean myself simply because I feel contaminated.
12. I am upset by unpleasant thoughts that come into my mind against my will.
13. I avoid throwing things away because I am afraid I might need them later.
14. I repeatedly check gas and water taps and light switches after turning them off.
15. I need things to be arranged in a particular way.
16. I feel that there are good and bad numbers.
17. I wash my hands more often and longer than necessary.
18. I frequently get nasty thoughts and have difficulty in getting rid of them.

### Sub-scales:

Checking: 2, 8, 14

Hoarding: 1, 7, 13

Neutralizing: 4, 10, 16

Obsessing: 6, 12, 18

Ordering: 3, 9, 15

Washing: 5, 11, 17

## **Hospital Anxiety and Depression Scale (HADS)**

Choose one response from the four given for each question. Do not think too much about your answers. Answer based on how it currently describes your feelings.

I feel tense or 'wound up'.

Most of the time

A lot of the time

From time to time, occasionally

Not at all

I still enjoy the things I used to enjoy.

Definitely as much

Not quite so much

Only a little

Hardly at all

I get a sort of frightened feeling as if something awful is about to happen.

Very definitely and quite badly

Yes, but not too badly

A little, but it doesn't worry me

Not at all

I can laugh and see the funny side of things.

As much as I always could

Not quite so much now

Definitely not so much now

Not at all

Worrying thoughts go through my mind.

A great deal of the time

A lot of the time

From time to time, but not too often

Only occasionally

I feel cheerful.

Not at all

Not often

Sometimes

Most of the time

I can sit at ease and feel relaxed.

Definitely

Usually

Not often

Not at all

I feel as if I am slowed down.

Nearly all the time

Very often

Sometimes

Not at all

I get a sort of frightened feeling like 'butterflies' in the stomach.

Not at all

Occasionally

Quite often

Very often

I have lost interest in my appearance.

Definitely

I don't take as much care as I should

I may not take quite as much care

I take just as much care as ever

I feel restless as if I have to be on the move.

Very much indeed

Quite a lot

Not very much

Not at all

I look forward with enjoyment to things.

As much as I ever did

Rather less than I used to

Definitely less than I used to

Hardly at all

I get sudden feelings of panic

Very often indeed

Quite often

Not very often

Not at all

I can enjoy a good book or radio or TV program.

Often

Sometimes

Not often

Very seldom

## Multidimensional Anger Inventory (MAI)

Instructions: Everybody gets angry from time to time. A number of statements that people have used to describe the times that they get angry are included below. Read each statement and select the number to the left of the statement that best describes you. There are no right or wrong answers.

- 1, The statement is completely un-descriptive of you.
  - 2, The statement is mostly un-descriptive of you.
  - 3, The statement is partly un-descriptive and partly descriptive of you.
  - 4, The statement is mostly descriptive of you.
  - 5, The statement is completely descriptive of you.
- 
1. I tend to get angry more frequently than most people.
  2. Other people seem to get angrier than I do in similar circumstances.
  3. I harbor grudges that I don't tell anyone about.
  4. I try to get even when I'm angry with someone.
  5. I am secretly quite critical of others.
  6. It is easy to make me angry.
  7. When I am angry with someone, I let that person know.
  8. I have met many people who are supposed to be experts who are no better than I am.
  9. Something makes me angry almost every day.
  10. I often feel angrier than I think I should.
  11. I feel guilty about expressing my anger.
  12. When I am angry with someone, I take it out on whoever is around.
  13. Some of my friends have habits that annoy and bother me very much.
  14. I am surprised at how often I feel angry.
  15. Once I let people know I'm angry, I can put it out of my mind.
  16. People talk about me behind my back.
  17. At times, I feel angry for no specific reason.
  18. I can make myself angry about something in the past just by thinking about it.
  19. Even after I have expressed my anger, I have trouble forgetting about it.
  20. When I hide my anger from others, I think about it for a long time.
  21. People can bother me just by being around.
  22. When I get angry, I stay angry for hours.
  23. When I hide my anger from others, I forget about it pretty quickly.
  24. I try to talk over problems with people without letting them know I'm angry.
  25. When I get angry, I calm down faster than most people.
  26. I get so angry. I feel like I might lose control.
  27. If I let people see the way I feel, I'd be considered a hard person to get along with.
  28. I am on my guard with people who are friendlier than I expected.
  29. It's difficult for me to let people know I'm angry.
  - 30a. I get angry when someone lets me down.
  - 30b. I get angry when people are unfair.
  - 30c. I get angry when something blocks my plans.
  - 30d. I get angry when I am delayed.

- 30e. I get angry when someone embarrasses me.
- 30f. I get angry when I have to take orders from someone less capable than I.
- 30g. I get angry when I have to work with incompetent people.
- 30h. I get angry when I do something stupid..
- 30i. I get angry when I am not given credit for something I have done.



### Anxiety Sensitivity Inventory-3 (ASI-3)

Enter the number from the scale below that best describes how typical or characteristic each of the 16 items is of you, putting the number next to the item. You should make your ratings in terms of how much you agree or disagree with the statement as a general description of yourself.

0	1	2	3	4
very little	a little	some	much	very much

1. It is important for me not to appear nervous.
2. When I cannot keep my mind on a task, I worry that I might be going crazy.
3. It scares me when my heart beats rapidly.
4. When my stomach is upset, I worry that I might be seriously ill.
5. It scares me when I am unable to keep my mind on a task.
6. When I tremble in the presence of others, I fear what people might think of me.
7. When my chest feels tight, I get scared that I won't be able to breathe properly.
8. When I feel pain in my chest, I worry that I'm going to have a heart attack.
9. I worry that other people will notice my anxiety.
10. When I feel "spacey" or spaced out I worry that I may be mentally ill.
11. It scares me when I blush in front of people.
12. When I notice my heart skipping a beat, I worry that there is something seriously wrong with me.
13. When I begin to sweat in a social situation, I fear people will think negatively of me.
14. When my thoughts seem to speed up, I worry that I might be going crazy.
15. When my throat feels tight, I worry that I could choke to death.
16. When I have trouble thinking clearly, I worry that there is something wrong with me.

17. I think it would be horrible for me to faint in public.

18. When my mind goes blank, I worry there is something terribly wrong with me.

Sub-scales:

Physical sub-scale: 3, 4, 7, 8, 12, 15

Cognitive sub-scale: 2, 5, 10, 14, 16, 18

Social sub-scale: 1, 6, 9, 11, 13, 17