Beyond sound irritation: cross-cultural evidence on the robustness of the five aspects of misophonic experience measured by the S-Five in a Polish sample.

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Abstract

Misophonia is commonly associated with negative emotional or physiological responses to specific sounds or stimuli accompanying these sounds. However, the consensus definition emphasizes that misophonia entails much more than that. Even subclinical misophonia, where individuals are significantly affected by misophonia in their lives without meeting the disorder criteria, can have notable impacts on personal and professional lives. The S-Five is a robust psychometric tool that allows for comprehensive research on various aspects of the misophonic experience. It captures five dimensions: internalizing appraisals, externalizing appraisals, impact, threat, and outburst, and includes a section (S-Five-T) to evaluate feelings evoked by triggering sounds and their intensity. We examined whether the five-factor structure initially developed in the UK could be replicated in a Polish sample, including individuals with and without self-identified misophonia.

The Polish version of the S-Five was (forward and backward) translated and tested on 288 Polish-speaking individuals. Comprehensive psychometric evaluation, including factor structure, measurement invariance assessment, test-retest reliability, internal consistency, and concurrent validity evaluations, was conducted on the translated scale. Exploratory factor analysis confirmed the results of the original English study, while bootstrap exploratory graph analysis showed the factor structure to be reproducible in other samples. The scale was found to be bias free with respect to gender, internally consistent and stable in time, and evidence of validity was provided using MisoQuest and Misophonia Questionnaire. These results offer support for the cross-cultural stability of the five factors and confirm the appropriateness of the Polish version for clinical and research purposes.

The study also examined misophonia triggers, emotional responses, cognitive attributions, and their connection to psychopathology symptoms. Mouth sounds, such as eating sounds, elicited the strongest reactions, while repetitive sounds triggered the least intense responses, consistent with other European studies using the S-Five. Anger, panic, and distress were correlated with misophonia symptoms, whereas irritation showed no relationship to the five aspects of misophonia. Disgust was weakly and negatively related to misophonic outbursts and S-Five total score.

Anger was related to externalising appraisal but even more to internalising scale. Anger was the most related to misophonia severity but not to anxiety and depression symptoms, highlighting its distinct role. The study emphasises the core role of anger, distress, and panic in misophonia and confirms eating sounds as predominant triggers.

Introduction

Misophonia is a recently recognised disorder characterized by reduced tolerance to specific sounds or stimuli (Jastreboff & Jastreboff, 2002; Swedo et al., 2022). These sounds, known as 'triggers,' can elicit intense negative emotional, behavioural, and physiological responses unique to each individual (Brout et al., 2018; Edelstein et al., 2013; Kumar et al., 2017) and may include anger, disgust, irritation, and anxiety (Jager et al., 2020; Swedo et al., 2022). Physiological reactions such as increased heart rate, muscular tension, and sweating can also occur (Edelstein et al., 2013; Rouw & Erfanian, 2018; Schröder et al., 2017). Interestingly, misophonia's manifestation can be context-dependent, with reactions being more pronounced or limited to triggers produced by close friends and family (Edelstein et al., 2013). A recent study by Siepsiak et al. (2023) further revealed that the context of mouth sounds can significantly influence affective experiences in adults with misophonia. Misophonia can profoundly impact an individual's life, affecting work, academics, and interpersonal relationships (Brout et al., 2018).

In recent years, the literature on misophonia has seen a surge in interest, with more scientific articles being published between the years 2020 and 2023 than in all the previous years combined. Neacsiu et al. (2022) conducted a literature review on the neurobiological basis of misophonia, concluding that it has unique neurobiological features that distinguish it from other disorders. Consistent with this finding, studies have shown that misophonia frequently co-occurs with various psychiatric disorders and symptoms of psychopathology (Erfanian et al., 2019; Jager et al., 2020; Rosenthal et al., 2022; Siepsiak et al., 2022), even in childhood (Guzick et al., 2023; Rinaldi et al., 2022; Siepsiak, Turek, et al., 2023). However, there is no specific diagnostic entity that can be identified as exclusively characteristic of misophonia or that can fully explain its unique symptoms.

The prevalence of misophonia is currently estimated to vary between 5 to 20% in different populations. Studies based on representative samples of Germany, Turkey and the UK populations reported that 5%, 12.8%, and 18.4% of people experience significant symptoms of misophonia (Jakubovski et al., 2022; Kılıç et al., 2021; Vitoratou et al., 2023) at clinical or subclinical levels. Similar rates (6-20%)

have been mentioned in student populations (Sarigedik & Gulle, 2021; Wu et al., 2014; Zhou et al., 2017) and a clinical sample (9-12%; Siepsiak et al., 2020), while one study on medical students revealed a surprisingly high occurrence of this disorder in almost 50% of participants (Naylor et al., 2021). Although various factors may contribute to the significant differences observed in the outcomes of these studies, it is crucial to employ cross-culturally validated questionnaires with rigorous psychometric properties. This approach ensures a more accurate measurement of misophonia and facilitates meaningful comparisons across different countries and populations. In a systematic review, Kula et al. (2023) examined psychometric measures of misophonia published in English between 2002 and 2020. Notably, these tools were utilized in numerous studies establishing the prevalence of misophonia. However, the measures have shown limitations in meeting the requirements of the Consensus-based Standards for the selection of health status Measurement Instruments (COSMIN; Mokkink, Terwee, Knol, et al., 2010; Mokkink, Terwee, Patrick, et al., 2010). This highlights the necessity for improved and more comprehensive tools to accurately measure and assess misophonia symptoms. More recently, new self-report measurement tools have been developed, including the Duke-Vanderbilt Misophonia Screening Questionnaire (Williams et al., 2022), the Duke Misophonia Questionnaire (Rosenthal et al., 2021), and the S-Five (Vitoratou, Uglik-Marucha, Hayes, & Gregory, 2021), offering promising alternatives for future research and prevalence studies.

In this work we focus on the S-Five. To assess the complex experience of misophonia and its severity, Vitoratou et al. (2021) developed the Selective Sound Sensitivity Syndrome Scale (S-Five) using the responses of English-speaking population self-identifying with misophonia in four waves of sampling. The S-Five identified five aspects of misophonic experience, namely i) *externalising appraisals*, which represents the feelings of blame and judgement for experiencing negative responses to sounds that are directed towards other people, ii) *internalising appraisals*, when the judgement and blame is directed towards oneself, iii) *impact*, which describes perceived restrictions to functioning due to reactions to sounds, iv) *threat*, feeling of distress (about emotions escalating) around triggering sounds, and v) *outburst*, which include the presence or fear of having physical or verbal explosion in response to some sounds. The questionnaire underwent further psychometric

testing and was shown to have satisfactory psychometric properties with respect to reliability (stability and internal consistency), convergent validity, and measurement invariance. With respect to the responses to triggering sounds, the S-Five comes with a supplementary checklist, the S-Five-T, which allows for investigations of specific reactions and their intensity to certain sounds. For instance, Vitoratou, Uglik-Marucha, Hayes, Erfanian, et al. (2021) reported that people self-identifying with misophonia were more than 40 and 20 times more likely to be triggered by eating sounds and breathing sounds, respectively. The S-Five and the S-Five-T can also be used to investigate mechanisms and response to change to intervention or treatment with respect to the five dimensions of misophonia. Incorporated into research, it can provide insight into understanding the correlates of specific facets of misophonia with other conditions or into longitudinal changes in the severity of symptoms. The five-factor structure of the S-Five was further replicated in a large sample representative of the UK population, demonstrating excellent psychometric properties (Vitoratou et al., 2023). The robustness of the factor structure of the S-Five is further evidenced through its replications across different languages and cultures, namely in German (Remmert et al., 2022) and Chinese (Vitoratou et al., 2022) populations.

There have been only two measures of misophonia available in the Polish language, namely MisoQuest (Siepsiak, Śliwerski, et al., 2020) and Misophonia Questionnaire (MQ; Wu et al., 2014). MisoQuest was the first scale in misophonia literature with published full psychometric evaluation in a peer-reviewed journal, whose properties were assessed in the Polish population. MisoQuest is a unidimensional measure for identifying the presence of misophonia defined according to a very specific and narrow criteria, developed by Schröder et al. (2013) (which were later revised by Jager et al., 2020), with minor modifications applied by authors. For instance, the diagnostic criteria for misophonia by Schroder et al. include the presence of spontaneous and aversive reaction to sounds produced by humans only, while MisoQuest assesses for the presence of all ranges of sounds, both human and non-human. The scale has demonstrated good validity and reliability (Siepsiak, Śliwerski, et al., 2020), very high specificity but limited sensitivity (Enzler et al., 2021; Siepsiak, Sobczak, et al., 2020). Importantly, it was neither developed to measure the severity of misophonia symptoms nor developed using a multidimensional reflective latent variables model. Furthermore, the MisoQuest

detects the presence of misophonia when the aversive emotional response is immediate. Individuals who only react negatively to a prolonged exposure to external stimuli would not be identified; however, those diagnosed would constitute a more homogenous group. MisoQuest is thus a useful tool for screening for misophonia when Schröder et al. (2013) criteria are applied.

MQ was developed to assess misophonia symptoms in three sections, investigating the symptoms sensitivity (MSYS), person's behaviours and emotions (MEBS), and the severity of the symptoms (MEBS). MQ has been translated to Polish and its psychometric properties are currently evaluated as a part of an unpublished study. The original English version has shown satisfactory internal consistency (Wu et al., 2014). Although the full psychometric properties of the English scale have not been published, it has been recently validated for use in Norway (Larsen et al., 2022), Turkey (Sakarya & Çakmak, 2022) and Iran (Mehrabizadeh Honarmand & Roushani, 2019). Despite this, MQ has been the most widely used questionnaire for the assessment of misophonia (Cusack et al., 2018; Janik McErlean & Banissy, 2018; McKay et al., 2018; Zhou et al., 2017). Notably, the MSES, which is frequently used as a cut-off score to create groups with and without misophonia, was developed on the basis of items assessing obsessive-compulsive disorder severity and, to our knowledge, has not been validated as a tool to discriminate between those with and without misophonia.

In Poland, the notable barrier in misophonia research has been a limited possibility to compare the data collected in the Polish population with the data collected by other researchers across the world. Furthermore, to our knowledge, there has been no measurement tool available in the Polish language for a multidimensional assessment of the severity of the misophonic experience. In light of this, the aim of this study was to translate the S-Five into Polish language and validate it in the population of Polish-speaking individuals, both those who self-identify with having the condition and those who do not. The Polish version of the S-Five would supplement the assessment of misophonia in Polish-speaking populations in both therapeutic and research context and address the barriers in cross-cultural research of misophonia by allowing for international investigations.

In accordance with the findings by Vitoratou, Uglik-Marucha, Hayes, & Gregory (2021) in English-speaking population, it was hypothesised that:

1. The five-factor structure of S-Five will be replicated in the Polish sample,
2. The S-Five will demonstrate satisfactory psychometric properties with respect to internal consistency, test-retest reliability, measurement invariance with respect to gender adjusted for age, and convergent validity with MisoQuest and MQ and its subscales (except for MSYS),
3. The S-Five will emerge weakly to moderately correlated with depression and anxiety.

Methods

Study overview

Participants were recruited between December 2021 and March 2022 through groups on social media sites relating to misophonia, namely Facebook ('Mizofonicy' group), Reddit (r/misophonia), and Twitter (#misophonia, #mizofonia). The survey was administered via Qualtrics. Before proceeding with the study, participants were provided with a participants' information sheet and consent of participation was established (ethics approval reference RESCM-19/20–11,826). Inclusion criteria for participation included being aged 18 years and over and Polish fluency. Participants who indicated the presence of severe intellectual and/or learning disability at the beginning of the survey were automatically excluded from continuing with the study. At the end of the survey, participants were asked about the participation in a retest study, which involved entering their e-mail addresses in a separate survey to avoid linking their responses with their contact information. Those who agreed to participate in the retest survey were contacted again three weeks after the initial assessment. An Amazon voucher of £20 pounds was offered for one in twenty participants as a lucky draw to encourage participation.

The online survey included the S-Five and other measures for validity and hypothesis testing purposes (please see below for details on the battery used). The items of S-Five and the blocks of the remaining questionnaires were presented to the participants in random order. Throughout the survey, attention check questions were administered allowing for screening of the data for low-quality responses. Demographic characteristics were collected, such as age, gender, occupation, education level, and country of birth and residence. Participants were asked to report any formal diagnoses they may have received of mental health conditions (affective, anxiety, personality, trauma, psychotic, substance abuse and eating disorders), neurodevelopmental conditions (autism, dyslexia, ADHD), and audiological conditions (hyperacusis, tinnitus, auditory processing disorder).

Translation process

The translation process followed a framework outlined by the Oxford University Innovation (Wild et al., 2005). This process took the following steps:

1. Forward translation of the English version of the S-Five into Polish was performed simultaneously by two independent researchers (NUM & JZ) to produce two translations. Both NUM and JZ are bilingual with Polish as their mother tongue. One of the translators (NUM) acted as a subject expert due to being a co-author of the original S-Five, thus ensuring that misophonia intricacies were not missed.
2. Reconciliation of forward translations was achieved by comparing and merging the two Polish versions by NUM and JZ. The discrepancies in translations were discussed and resolved with an independent bilingual translator with Polish as their native language (AT). This step resulted in a preliminary Polish version of the S-Five.
3. Back-translation of the Polish version of the S-Five to English was performed independently by two bilingual researchers (MS & WD) with Polish as their mother tongue, who were not involved in the previous exercise. The two researchers were subject experts on misophonia.
4. Reconciliation of back-translation was conducted by SV and JG, original developers of the S-Five, by comparing the two back-translated versions with the source text. In this step, minor discrepancies were identified with respect to 4 items, which were discussed between NUM, JZ, and MS to reach a consensus on a final version of items. This led to minor revisions, which were reported back to SV and JG for the approval, and thus resulting in the final translated Polish version of the S-Five.
5. Testing of the translated questionnaire was performed on the Polish population self-identifying with having misophonia. In the survey, a space was provided for the participants to provide feedback on the translated items.

Measures

The **S-Five** (Vitoratou, Uglik-Marucha, Hayes, & Gregory, 2021) is a self-report scale which consists of 25 items, are rated on an 11-point scale ranging from 0 (not at all true) to 10 (completely true), with a total score range of 0–250. There are

five factors with five items each, with a score range of 0–50 for each of the following domains: *externalising* appraisals, *internalising* appraisals, perceived emotional *threat*, *outbursts*, and *impact* on functioning. Please see Table A1 in Appendix for both English and Polish items and Additional File for fillable form with automatic scoring in a pdf format.

A supplementary S-Five trigger checklist (S-Five-T) consists of 37 trigger sounds. Respondents select their main response to each sound from the following options: *no feeling*, *irritation*, *distress*, *disgust*, *anger*, *panic*, other feeling: *negative*, other feeling: *positive*, and *physiological* reaction. The latter option was recently added in the German validation of the S-Five (Remmert et al., 2022), and was also used in the present study. The intensity of the selected reaction is then rated on an 11-point scale from 0 (does not bother me at all) to 10 (unbearable/causes suffering). The checklist results in four summary indices: trigger count (TC; the number of triggers endorsed), reaction count (RC; the number of times each reaction is endorsed across all triggers), frequency/intensity of reactions score (FIRS; the total score for the intensity items across all endorsed triggers), and relative intensity of reactions score (RIRS; intensity of reactions relative to the number of triggers). The original and Polish items are presented in Table A2 in the Appendix.

Other measures

The **MisoQuest** (Siepsiak, Śliwerski, et al., 2020) is a self-report measure of misophonia validated in a sample of Polish-speaking participants that was developed around the diagnostic criteria proposed by Schröder et al. (2013). The questionnaire is a unidimensional tool consisting of 14 items, which are rated on a 1 to 5 agreement scale. In this study, MisoQuest had both Cronbach's alpha (α) and McDonald's omega (ω) of 0.91.

The **Misophonia Questionnaire** (MQ; Wu et al., 2014) is a self-report questionnaire consisting of 34 items that form three parts. The Misophonia Symptoms Scale (MSYS) measures the sensitivity to a specific trigger when compared to others, and

the Misophonia Emotions and Behaviours Scale (MEBS) assesses for emotional and behavioural responses to trigger sounds. Both parts are rated on a 5-point ordinal scale, which are combined to form the MQ total score. The third part, the Misophonia Severity Scale (MSES) is a single-item question that measures the severity of sound sensitivity on a 15-point scale, where 1 indicates minimal and 15 suggests very severe sensitivity. A score of 7 or above on the MSES is proposed to indicate clinical levels of misophonia. The MQ was translated by MS as a part of another, yet unpublished study. In the present study, the subscales of MQ had both α and ω of 0.74 and 0.85 for MSYS and MEBS, respectively. Cronbach's α for the total scale was 0.84 and ω was 0.83.

The **Patient Health Questionnaire-9** (PHQ-9; Kroenke et al., 2001) is a brief measure of the severity of depression. The tool includes 9 items that are rated on a 4-point ordinal scale that form a total score ranging from 0 to 27. PHQ-9 has been validated for the use in Polish, and such a version was used in this study (Kokoszka et al., 2016). In this study, the measure had an α and ω of 0.84.

The **Generalized Anxiety Disorder-7** (GAD-7; Spitzer et al., 2006) screens and measures the severity of generalised anxiety disorder. GAD-7 has 7 items and uses a 4-point ordinal scale, which are summed to create a total score for all items (0 to 21). The Polish version of GAD-7 has not been psychometrically validated. In this study, the GAD-7 demonstrated satisfactory internal consistency, with both α and ω of 0.83, respectively.

The **Anxiety Sensitivity Index-3** (ASI-3; Taylor et al., 2007) is a self-report measure of anxiety sensitivity, that is, concerns regarding anxiety symptoms. ASI-3 consists of 18 items forming 3 subscales, with responses rated on a 5-point scale ranging from 0 (very little) to 4 (very much). The three subscales measure the physical, cognitive, and social concerns about anxiety. All items are summed to create ASI-3 total (0 to 72) and the sum of items consisting of each subscale provides a subscale score (0 to 24). A Polish version that was validated in the Polish population was used in this study (Michałowski et al., 2014). The cognitive and physical subscales had both α and ω of 0.90 and 0.87, respectively and social subscale had an α and ω of 0.83 and 0.82, respectively. The entire measure demonstrated α and ω of 0.92.

Statistical analysis

Dimensionality

The psychometric analysis followed the Exploratory factor analysis (EFA) was used for evaluation of the structure of the scale. The amenability of a correlation matrix to factoring was evaluated using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (KMO of ≥0.90 suggests suitability; Kaiser, 1960; Kaiser & Rice, 1974) and the Bartlett's test of sphericity (significant difference between the correlation matrix and the identity matrix indicates amenability to factoring; Bartlett, 1951). To account for skewed continuous data, the maximum likelihood estimator with robust standard errors MLR was used (Muthén & Muthén, 1998-2017). Two common factor selection procedures were employed, the Kaiser-Guttman criterion (Guttman, 1954; Kaiser, 1960) and parallel analysis (Horn, 1965). The first suggests retaining the number of factors that correspond to the number of eigenvalues of the sample correlation matrix that are greater than one. Parallel analysis compares the number of sample eigenvalues with the mean of eigenvalues generated from 50 random samples of the same size and number of variables. The number of factors to be retained corresponds to the number of eigenvalues larger than the average eigenvalues from the random data.

The solutions suggested by the Kaiser-Guttman criterion and parallel analysis were compared with plus minus one factor solutions to evaluate which solution is most interpretable (Lim & Jahng, 2019). Several goodness of fit indices were used to evaluate proposed solutions. The absolute fit of the model was assessed using relative χ^2, the root mean square error of approximation (RMSEA; Browne & Cudeck, 1992; Steiger & Lind, 1980 cited in Steiger, 1990) and its 90% confidence interval (90% CI), and the standardized root mean square residual (SRMR). Fit relative to a null model was evaluated using the comparative fit index (CFI; Bentler, 1990) and the Tucker–Lewis index (TLI; Tucker & Lewis, 1973). Guidelines for close fit provided in Hu & Bentler (1999) and Ullman (2006) were followed with the following criteria: relative χ^2 (≤ 2), RMSEA (≤ .05, 90% CI ≤ .06), SRMR (≤ .08), CFI (≥ .95), and TLI (≥ .95).

Item selection was based on the items' factor loadings, with loadings of at least 0.30 on the main factor identified as a meaningful indicator of a latent construct and to be retained (Brown, 2015). Items with loadings below 0.3 and/or cross-loadings on other factors ($\lambda \geq 0.25$) were considered redundant.

To obtain accurate estimates for factor solutions, the ratio of the participants to the number of measured indicators was considered (Kyriazos, 2018). For this study, 25 items were used in dimensionality investigations, which requires 250 cases for EFA alone. The study's sample (N=288) was sufficient for EFA but did not allow for further dimensionality explorations using confirmatory factor analysis.

Exploratory Graph Analysis

In addition to those traditional factor reduction methods, a new method derived from the network psychometrics framework was conducted to assess the dimensionality underlying the data and to evaluate the stability of the established factor structure. Exploratory Graph Analysis (EGA; Golino & Epskamp, 2017) was used to generate a visual guide-network plot that depicts relations between the items and factors. In these network models, nodes (circles) correspond to items, and the edges (lines) represent correlations between two items. The basis of the network structure is derived from a Gaussian Graphical Model (GGM; Lauritzen, 1996), which estimates an undirected network of partial correlation coefficients (Epskamp et al., 2018). GGM was obtained using a Graphical Least Absolute Shrinkage and Selection Operator (glasso; Friedman et al., 2008; Friedman et al., 2014) method, which directly penalizes and shrinks the partial correlation coefficients of the matrix, and thus protects against overfitting. Glasso employs the extended Bayesian information criterion to retrieve model with best fit to the data. The number of factors in the network model is estimated using the walktrap algorithm (Pons & Latapy, 2006), which detects the number and content of distinct subcomponents of uniquely related nodes through the process of "random walks" over the network.

The stability of number of factors and the robustness of each item's placement within their assigned factors identified using EGA was investigated using bootstrap exploratory graph analysis (bootEGA; Christensen & Golino, 2021). bootEGA assesses the factorial stability using structural consistency measure, which is the proportion of times each factor initially derived from EGA was replicated from the bootstrap samples. The non-parametric approach of bootEGA was used, which is recommended for skewed data, applies resampling with replacement technique to generate 1000 samples from the original dataset with the same number of cases. For each generated sample, a network is estimated and walktrap algorithm is employed to create a sampling distribution of networks. Descriptive statistics (median, standard error, 95% confidence intervals) on the number of identified factors, and the proportion of times a specific number of factors was estimated were computed across the replica of networks. Additionally, a median network plot of a sampling distribution of 1000 networks was generated, which depicts the most likely and stable factor structure identified in the data. The median network plot was compared with the initial EGA plot.

An additional measure to structural consistency is item stability, which calculates a proportion of times each item was present in each factor specified through EGA across the replica of networks. Items identified to replicate in their confirmatory factors ≥80% of the time were considered stable and contributing to structural consistency, while the items with low proportions of replications (< .80) were labelled as possibly problematic due to their multidimensional nature and leading to structural inconsistency.

Measurement invariance

Measurement invariance investigations were employed to evaluate whether the S-Five can measure the underlying construct of misophonia equivalently across different genders. This procedure ensures that any observed score differences between groups are genuine reflections of actual differences in the construct being measured, rather than being influenced by biases in the measurement tool itself. The measurement invariance of the tool was assessed using multiple indicators, multiple

causes model (MIMIC; Joreskog & Goldberger, 1975; Muthén, 1979), which involves regressing the latent factors and indicators (items) onto a gender covariate. The direct effects of gender on the items were estimated. A significant direct effect signifies measurement-noninvariance (bias) of that item; that is, when the levels of misophonia are held constant, gender alone influences the probability of endorsing a particular item. The analysis was adjusted for age.

Reliability

The internal consistency of the S-Five was assessed using Cronbach's alpha (α; Cronbach, 1951) and McDonald's omega (ω; McDonald, 1999) within each factor. While α is the most used measure of reliability, Cronbach's α produces incorrect estimates of internal consistency except in scarce conditions when all factor loadings are of equal magnitude within a scale and no correlated residuals are present (Sijtsma, 2009). Thus, ω coefficient is additionally computed as model-based estimates of internal consistency are favoured (Revelle & Condon, 2019). Guidelines for internal consistency coefficients vary and range from 0.70 to 0.95 (DeVellis, 2003; Nunnally & Bernstein, 1994) but in this study we follow the guidelines outlined by Nunnally (1978) that recommend a value of ≥0.80 for research scales. As a part of internal consistency investigations, additional indices were investigated for each item, namely corrected item-total correlations (ITC), average inter-item correlations (IIC), and alpha/omega if item deleted (AID/OID). For ITC and IIC, the acceptable range of correlation considered was 0.2 to 0.8. Items with values of AID/OID higher than alpha/omega for the total subscale are decreasing the reliability of the scale and were thus labelled as problematic.

The stability of the items and scales across time (test-retest reliability) was assessed using the mixed effects, absolute agreement intraclass correlation coefficient (ICC; Shrout & Fleiss, 1977) and the Psi Non-Parametric Concordance Coefficient (Psi; Kuiper & Hoogenboezem, 2019). Landis & Koch (1977) guidelines were followed for interpreting the results, where evidence towards very good agreement was granted with values >0.81, good agreement was indicated by values ranging between 0.61 to 0.80, moderate agreement was demonstrated for values of

0.41 to 0.60, fair agreement was evidenced with values of 0.21-0.40, and values indicating poor agreement were <0.20.

Validity

The concurrent convergent validity of the S-Five was tested by assessing correlations with pre-existing measures of misophonia, namely MisoQuest and MQ. In comparison, discriminant validity was evaluated through associations with a subscale of MQ (MSYS, sensitivity to specific triggers in comparison to other people), which although related to misophonia, is not measured by the S-Five. To establish convergent validity, the S-Five and its subscales should be at least modestly correlated with MisoQuest and MQ. Discriminant validity should be determined through weak correlations with MSYS subscale of MQ.

All statistical analyses were performed using R version 1.31093 (R Core Team, 2020), M*plus* 8 (Muthén & Muthén, 1998-2017) and SPSS version 28.0 (IBM Corp, 2021) Exploratory factor analysis was run in M*plus* via *MplusAutomation* package (Hallquist & Wiley, 2018) in R and the results of parallel analysis were depicted using *ggplot2* (Wickham, 2016). EGA and bootEGA were conducted using the R package *EGAnet* (Golino et al., 2020), which makes use of the *qgraph* (Epskamp et al., 2012) to visualise the network models. Test-retest reliability analysis was run in the R package *nopaco* (Kuiper & Hoogenboezem, 2019) and internal consistency analysis was conducted in SPSS.

Results

Demographic characteristics of the sample

The study included 288 participants from the Polish population (99% were born in Poland), of which 81.3% (*n*=234) self-identified as having misophonia, 13.1% (*n*=13) did not and 8.7% (*n*=25) was not sure (5.6%, *n*=16 missing). Among the participants, 231 (80.2%) were women, including 2 (0.7%) who identified as trans women; 38 (13.2%) were men, including 17 (6.3%) who identified as trans men; and 19 (6.6%) identified as non-binary/other. The participants' ages ranged from 18 to 59 years old, with a mean age of 30.15 (standard deviation, SD=8.39). The characteristics of the participants' highest level of education was as follows: lower secondary education (*n*=5, 1.7%), secondary education (*n*=87, 30.2%), vocational education (*n*=4, 1.4%), post-secondary non-tertiary education (*n*=20, 6.9%), Bachelor's degree (*n*=66, 22.9%), Master's degree (*n*=99, 34.4%), and Doctoral degree (*n*=7, 2.4%).

The most frequently self-reported mental health diagnoses were depression (*n*=64, 22.2%) and generalized anxiety disorder (*n*=44, 15.3%). In terms of audiological diagnoses, 18 (6.3%) participants reported having a diagnosis of tinnitus, 16 (5.6%) of hyperacusis, and 2 (0.7%) of auditory processing disorder.

For test-retest purposes, a subset of 68 participants was re-administered the S-Five three weeks after the initial assessment. This subsample had a mean age of 29 (SD=7.5), with 56 (82.4%) identifying as women. Missingness in the trigger sections of the S-Five ranged from 2.1% to 4.2%, and listwise deletion was used, resulting in 47 participants for the test-retest analysis of S-Five-T.

S-Five: Statements

a) Dimensionality

The data were first evaluated with respect to their suitability for factor analysis, which revealed amenability to factoring (KMO=0.91; Bartlett's test χ^2 = 3748.40, df=300, p<0.001). Oblimin-rotated EFA was conducted on all twenty-five

items. Five eigenvalues were above 1 (9.014, 2.453, 1.721, 1.619, 1.417) in the sample correlation matrix, suggesting up to five factors to be retained according to the Kaiser-Guttman criterion, explaining the 64.9% of the total variance. Parallel analysis also indicated that the five-factor structure was suitable to the data (see Figure 1). The intercorrelations among the five factors ranged from 0.20 (externalising-internalising) to 0.49 (impact-threat). The-five factor structure had close fit to the data (relative χ^2 = 1.70, RMSEA [90% CI] = 0.05 [0.04, 0.06], CFI = 0.96, TLI = 0.93, SRMR = 0.03). The factor loading estimates indicated that all items were strongly related to their corresponding factors (λ range =0.34-0.84; please see Table 1 for loadings). Salient cross-loadings (λ >0.25) were not present for any item. The intercorrelations among the five factors ranged from 0.20 (externalising-internalising) to 0.49 (impact-threat). Each factor consisted of five items that conceptually corresponded to the original model identified by Vitoratou, Uglik-Marucha, Hayes, & Gregory (2021). Solutions with fewer factors did not emerge close fit to the data and increasing the number of factors resulted in factors whose items had non-salient loadings.

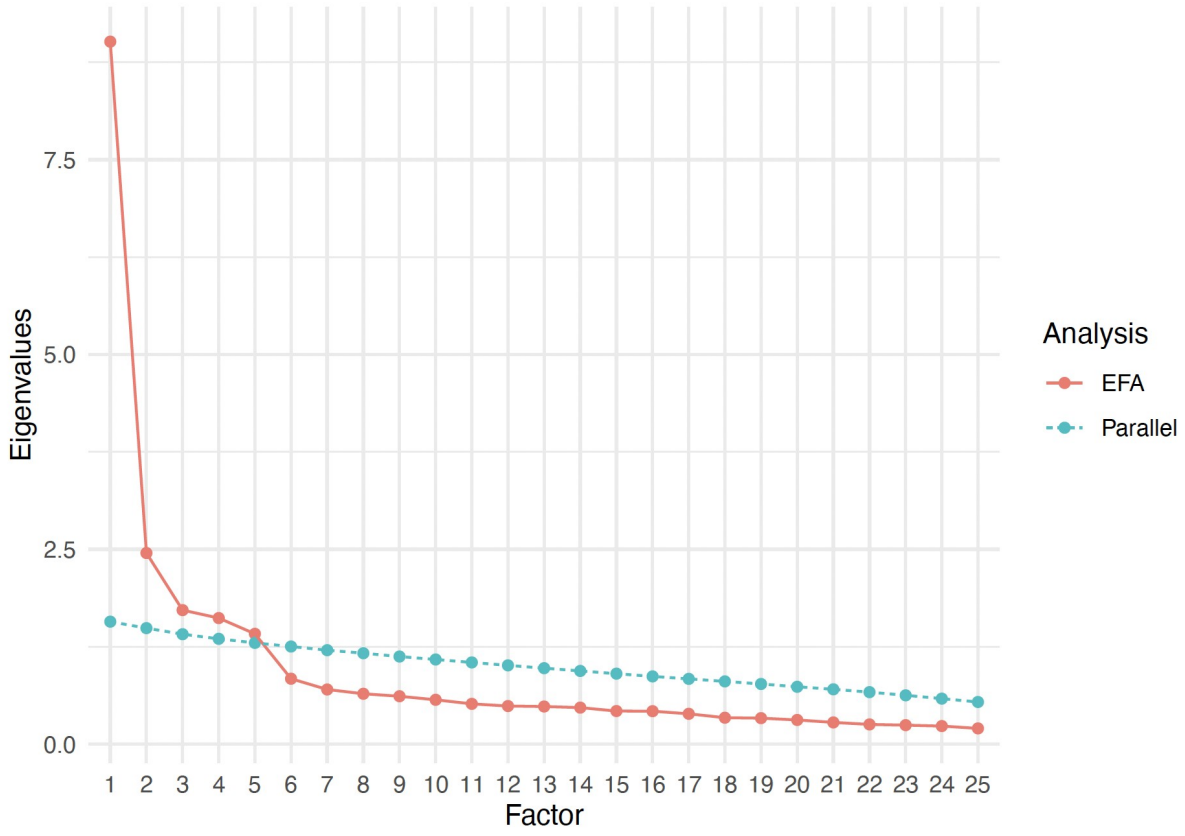


Figure 1. Scree plot showing parallel analysis results.

Table 1. Descriptive indices, associations with age and gender, factor analysis loadings to factors, and reliability indices of the 25 S-Five items (N=288).

S-Five-E statements per factor	Mean (SD)	Median (Q1-Q3)	Mode (min-max)	Age rho	λ	Psi (95% CI)	ICC
Externalising							
I06 Others avoid making noises	7.22 (3.06)	8 (5-10)	10 (0-10)	**0.15	0.73	0.83 (0.79, 1)	0.87
I13 Others should not make sounds	7.24 (3.41)	9 (5-10)	10 (0-10)	0.09	0.65	0.83 (0.79, 1)	0.87
I16 Others selfish	5.73 (3.44)	6 (3-9)	10 (0-10)	0.04	0.66	0.83 (0.79, 1)	0.87
I21 Others bad manners	6.88 (3.15)	8 (5-10)	10 (0-10)	0.04	0.81	0.78 (0.73, 1)	0.85
I25 Others disrespectful	7.59 (2.99)	9 (6-10)	10 (0-10)	0.09	0.71	0.80 (0.76, 1)	0.86
Internalising							
I05 Respect myself less	3.98 (3.58)	3 (1-7)	0 (0-10)	*-0.13	0.79	0.86 (0.82, 1)	0.88
I08 Unlikeable person	5.69 (3.41)	6 (3-9)	10 (0-10)	-0.11	0.51	0.84 (0.81, 1)	0.87
I12 Angry person inside	6.76 (3.43)	8 (5-10)	10 (0-10)	0.01	0.41	0.84 (0.81, 1)	0.87
I18 Bad person inside	4.69 (3.74)	5 (1-8)	0 (0-10)	**-0.159	0.79	0.82 (0.77, 1)	0.86
I19 Dislike self	7.09 (3.32)	8 (5-10)	10 (0-10)	-0.06	0.75	0.84 (0.80, 1)	0.87
Impact							
I01 Do not meet friends	3.59 (3.21)	3 (1-6)	0 (0-10)	0.04	0.63	0.85 (0.82, 1)	0.88
I09 Eventually isolated	4.59 (3.37)	5 (2-8)	0 (0-10)	-0.09	0.64	0.85 (0.81, 1)	0.87
I14 Avoid places	5.17 (3.61)	5 (2-9)	10 (0-10)	0.07	0.71	0.83 (0.79, 1)	0.87
I15 Cannot do everyday things	4.17 (3.6)	3 (1-7)	0 (0-10)	-0.08	0.84	0.82 (0.77, 1)	0.86
I20 Limited job opportunities	3.45 (3.41)	2 (0-6)	0 (0-10)	-0.08	0.68	0.82 (0.79, 1)	0.86
Outburst							
I04 Verbally aggressive	7.32 (2.85)	8 (5-10)	10 (0-10)	-0.02	0.48	0.81 (0.77, 1)	0.86
I17 Physically aggressive	4.23 (3.63)	4 (1-7)	0 (0-10)	0.06	0.75	0.82 (0.78, 1)	0.86
I22 Violence	3.07 (3.22)	2 (0-5)	0 (0-10)	-0.08	0.60	0.82 (0.78, 1)	0.86
I23 Shout at people	6.42 (3.62)	8 (3-10)	10 (0-10)	-0.1	0.67	0.82 (0.79, 1)	0.87
I24 Afraid of outburst	7.34 (2.97)	8 (6-10)	10 (0-10)	-0.01	0.34	0.80 (0.76, 1)	0.86
Threat							
I02 Panic or explode	8.16 (2.5)	9 (7-10)	10 (0-10)	*-0.12	0.52	0.82 (0.78, 1)	0.86
I03 Feel helpless	8.48 (2.53)	10 (8-10)	10 (0-10)	-0.05	0.60	0.76 (0.72, 1)	0.84
I07 Feel anxious	8.55 (2.36)	10 (8-10)	10 (0-10)	0.04	0.82	0.77 (0.73, 1)	0.85
I10 Experience distress	7.92 (3.01)	10 (7-10)	10 (0-10)	-0.08	0.71	0.82 (0.78, 1)	0.86
I11 Feel trapped	8.76 (2.11)	10 (8-10)	10 (0-10)	-0.02	0.80	0.78 (0.74, 1)	0.85

Note. SD: standard deviation; Q1-Q3: first and third quartile; rho: Spearman's correlation coefficient; λ: EFA loadings; Psi coefficient and 95% confidence intervals; ICC: intraclass correlation coefficient (two-way mixed effects, absolute agreement); *p<0.05; **p<0.01. All EFA loadings are significant, p<0.001.

The dimensionality of the S-Five was further investigated using EGA, which also concluded to 5 dimensions (Figure 2) whose items correspond to the theoretical factors identified by Vitoratou, Uglik-Marucha, Hayes, & Gregory (2021).

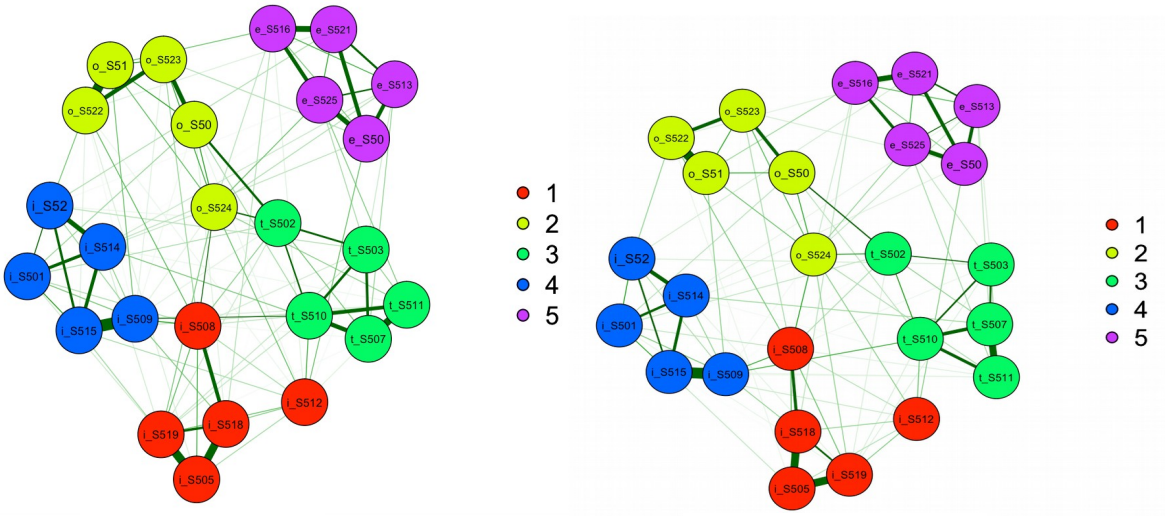


Figure 2. EGA (left) and bootstrap EGA's median network (right) for the S-Five model. Dimension 1 (red) relates to internalising appraisals, dimension 2 (light green) relates to outburst, dimension 3 (dark green) corresponds to threat, dimension 4 (blue) relates to impact on life, and dimension 5 (violet) indicates externalising appraisals.

The stability and reproducibility of this factor structure was evaluated using the dimension stability function of bootstrap EGA (bootEGA) for 1000 iterations. The median network structure (Figure 2) consisted of 5 dimensions and was identical to the empirical EGA. 5-factor structure was stable across 1000 bootstrapped samples (median=5, SE=0.29, and 95% CI [4.43, 5.57]). The frequency of factorial solutions derived from bootEGA across all replica of networks was computed, which showed that the five factor structure was replicated the most (919 times out of 1000 samples). While bootEGA identified 4, 6, and 7 factors to be present across all 1000 bootstrap replicate samples, these were only replicated 25, 56, and 1 time respectively. Further stability checks were conducted by assessing stability of each dimension individually to see how frequently each of the initial EGA factors (identical item allocation) is reproduced across replica of networks. Dimensions 4 and 5 were the most stable, with 94% and 100% proportion of times when identical item arrangement was replicated, respectively. Dimensions 1, 2, and 3 were less stable and were reproduced 59%, 62% and 66% times, respectively.

Items were assessed for their stability of placement in each designated factor in the bootstrapped samples (please see Figure 3). All but three items (thr_S502, out_S524, int_S512) had high proportion of times (≥ .80) they were replicated in 1000 bootstrap samples in the confirmatory dimensions, indicating that these items are stable and consistently identified in their theoretical factors. Items thr_S502, out_S524, and int_S512 had relatively low proportions (< .80) of replications, indicating that these items could be considered unstable. These unstable items were further investigated to evaluate which additional dimensions they were replicating on (please see Table 2 for item stability values for all items). Item int_S512 from the Internalising dimension was replicated in its corresponding dimension in 614 out of 1000 bootstrapped samples, but also 213 times on Outburst factor and 122 times on Threat factor. With respect to out_S524, it replicated on its theoretical dimension in 621 samples and 198 times on Internalising and 128 times on Threat factors. Item from the Threat factor (thr_S502) replicated on its own confirmatory dimension 662 times. However, it was also replicated in the Internalising dimension (91 times) and Outburst (219 times). Although these items do correspond to their theoretical factors, they overlap conceptually with other factors, which is an indication of their complexity.

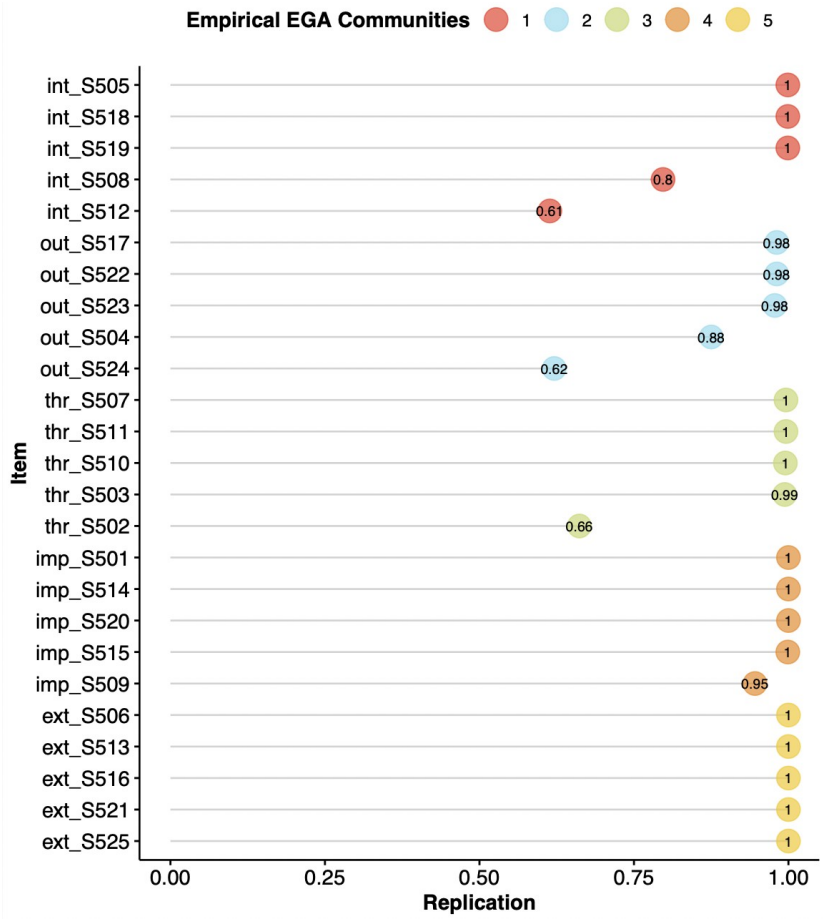


Figure 3. Proportion of times each item was replicated in their designated dimensions across 1000 bootstrapped samples. 1 (red) signifies internalising appraisals, 2 (blue) corresponds to outburst, 3 (green) indicates threat, 4 (orange) refers to impact on life, and 5 (yellow) signifies externalising appraisals.

Measurement invariance

A MIMIC model was fitted to evaluate whether the probability of endorsing an item is influenced by gender adjusted for age. Significant directs effects of gender were found on 4 items, namely imp_S501 (“Do not meet friends”), imp_S514 (“Avoid places”), out_S523 (“Shout at people”), and thr_S510 (“Experience distress”). At any given value of misophonia, women scored 1.08 and 0.95 units higher on out_S523 and thr_S510 respectively (on a scale of 0 to 10) than men. Men were more likely to endorse imp_S501 and imp_S514, that is, they scored 1.27 and 1.33 units higher respectively than women while controlling for the level of misophonia. The remaining 21 items of the S-Five were measurement invariant, that is non-biased with respect

to gender (adjusted for age). The direct effects of gender on these four items were negligible, thus allowing comparison of the S-Five scores between women and men. Women scored significantly higher on the S-Five total score and its three subscales (internalising, threat, outburst) compared to men (see Table 4).

Reliability

Test-retest reliability at item level indicated very good agreement for both Psi and ICC (please see Table 1). Internal consistency within each subscale was satisfactory according to McDonald's omega (ω=0.82-0.92) and Cronbach's alpha (α=0.81-0.87). Further internal consistency investigations with respect to average IIC, ITC, AID, and OID revealed all items to exhibit values within acceptable range.

Table 2. Norms and internal consistency reliability of the five factors of the S-Five and total score (N=288).

	Mean (SD)	Median (Q1-Q3)	Mode (min-max)	Gender difference	Age rho	Internal consistency			
						ITC	AID	OID	α/ ω
Externalising	34.65 (12.81)	38 (27-45)	50 (0-50)	U=3670	0.11	0.57-0.65	0.78-0.80	0.78-0.80	0.86/0.82
Internalising	28.22 (13.74)	29 (19-40)	32 (0-50)	U=3102	*-0.13	0.64-0.77	0.84-0.87	0.84-0.87	0.87/0.91
Impact	20.98 (13.87)	20 (10-32)	2 (0-50)	U=3786	-0.04	0.66-0.83	0.88-0.91	0.88-0.91	0.85/0.88
Outburst	28.38 (12.36)	29 (20-38)	27 (0-50)	**t(45.339)=2.829	-0.06	0.75-0.84	0.90-0.91	0.90-0.92	0.81/0.91
Threat	41.88 (10.08)	46 (39-50)	50 (0-50)	**U=2855.5	-0.10	0.72-0.84	0.88-0.90	0.88-0.91	0.86/0.92
Total	154.1 (47.29)	160 (129-187)	133 (6-250)	**t(267)=3.416	-0.07	0.44-0.68	0.92-0.92	0.91-0.92	0.92/0.92

Note. SD: standard deviation; Q1-Q3: first and third quartile; U: Mann–Whitney test; t: independent samples t test; ITC: item-total correlations; AID: alpha if item deleted; OID: omega if item deleted; ω: McDonald's omega; α: Cronbach's alpha; *p<0.05; **p<0.01.

Validity

Moderate to strong correlations were found between the S-Five and its subscales and MisoQuest, indicating concurrent convergent validity of the scale (refer to Table 3). Additionally, evidence of concurrent convergent validity was supported by moderate to strong correlations between the S-Five and MQ, as well as its MSES and MEBS subscales. On the other hand, weak correlations were observed between four S-Five factors (except for impact) and MSYS subscale,

suggesting distinctiveness of the misophonia aspects measured by these scales. Impact had moderate correlation with MSYS.

The S-Five subscales, with the exception of externalizing, displayed weak to moderate correlations with depression. Notably, the externalizing factor did not exhibit any significant associations with depression. A moderate correlation was observed between S-Five total and its internalizing subscale with anxiety as assessed by GAD-7. In contrast, the remaining subscales were weakly associated with anxiety, particularly the externalizing factor. Furthermore, anxiety sensitivity (ASI-3) and its social and cognitive factors showed moderate correlations with the internalizing factor of S-Five, while very weak correlation was observed with the physical factor. As for the other S-Five factors, ASI-3 and its social and cognitive factors exhibited very weak associations with them excluding the externalising factor, which exhibited no correlations with any of the ASI-3 subscales. Total S-Five had very weak correlation with physical subscale of ASI-3.

With respect to reactions to triggers, none of the S-Five subscales correlated with *irritation*, *negative* and *physiological* reactions. Externalising factor only correlated with *anger*. The remaining factors had associations with *distress*, *anger*, *panic* and were negatively related to *no feeling*. Outburst factor was additionally negatively associated with *disgust* and *positive reactions*. The total S-Five score emerged positively correlated with *distress*, *anger* and *panic*, and negatively correlated with *no feeling* and *disgust*.

Table 3. Intercorrelations of the S-Five scores with concurrent validity measures (Spearman's rho).

	Externalising	**Internalising**	**Impact**	**Threat**	**Outburst**	**Total**
S-Five (N=288)						
Externalising	1					
Internalising	0.26**	1				
Impact	0.34**	0.50**	1			
Threat	0.31**	0.52**	0.53**	1		
Outburst	0.38**	0.48**	0.49**	0.44**	1	
Total	0.61**	0.75**	0.80**	0.69**	0.74**	1
MisoQuest (N=252)						

Total	0.36**	0.53**	0.69**	0.72**	0.47**	0.70**
MQ (N=221)						
MEBS	0.38**	0.51**	0.63**	0.64**	0.63**	0.71**
MSYS	0.26**	0.18**	0.32**	0.26**	0.24**	0.30**
MSES	0.37**	0.40**	0.64**	0.50**	0.49**	0.65**
Total	0.38**	0.44**	0.59**	0.56**	0.53**	0.63**
PHQ-9 (N=264)						
Total	0.04	0.31**	0.26**	0.22**	0.19**	0.28**
GAD-7						
Total	0.15*	0.33**	0.25**	0.29**	0.27**	0.35**
ASI-3 (N=234)						
Social	-0.02	0.33**	0.20**	0.15*	0.09	0.22**
Cognitive	0.08	0.38**	0.18**	0.19**	0.20**	0.29**
Physical	0.08	0.15*	0.09	0.11	0.12	0.14*
Total	0.06	0.33**	0.18**	0.18**	0.15*	0.25**

Note. MQ: Misophonia Questionnaire; PHQ-9: Physical Health Questionnaire; GAD-7: Generalised Anxiety Disorder Assessment; ASI: Anxiety Sensitivity Index; ω: McDonald's omega. *p<0.05, **p<0.001.

S-Five: Triggers

Stability

With respect to test-retest reliability of the reaction counts (RC), all RCs demonstrated good to very good agreement ranging from 0.74 (*physiological reaction*) to 0.91 *(no feeling)* with respect to Psi. ICC values ranged from 0.84 (*physiological reaction*) to 0.91 (*no feeling*), also indicating very good agreement in time. Psi coefficients for RIRS, FIRS and TC were very good (>0.86) and ICC also indicated very good agreement (>0.88). With respect to the intensity trigger sounds, Psi ranged from 0.74 (footsteps) to 0.91 (muffled sounds, baby crying) indicating good to very good agreement, ICC values showed very good agreement (0.83-0.90) for all sounds.

Reaction counts

No feeling was on average the most frequently reported reaction. Specifically, an average of 12 out of 37 trigger sounds did not evoke any reactions, followed by *irritation* (10 out of 37) and *anger* (6 out of 37). With respect to differences in scores, women scored significantly higher on the *negative* RC than men whilst men had significantly higher score on *no feeling* RC.

Distress, *anger, panic* emerged weakly correlated with MisoQuest and MQ and all its subscales. Additionally, MQ had very weak negative correlations with *positive* reaction. MSYS was also moderately associated with *irritation*, whereas MEBS emerged negatively and very weakly correlated with *disgust*. The measures of depression and anxiety were only weakly correlated with *distress* and *panic.* All subscales of ASI-3 had a weak association with *disgust* and all but physical subscale had weak correlations with *panic*.

All S-Five subscales were weakly to moderately correlated with FIRS and RIRS and all with the exception of externalising subscale correlated weakly with TC. MisoQuest and MQ, the other measures of misophonia, were weakly to strongly associated with FIRS, RIRS, and TC. Depression and anxiety were weakly correlated with TC and FIRS, while anxiety only showed a very weak association with RIRS. TC and FIRS had weak correlations with all ASI-3 subscales, while RIRS had no significant correlations with any ASI-3 subscales.

Intensity

Descriptive indices for intensity of sounds are presented in Table 6 and mean intensity of each trigger sound is represented in Figure 4. The sounds for which the highest intensity of reactions was evoked include lip smacking, loud chewing, chewing gum, slurping, snoring, loud/unusual breathing, crunching, and normal eating sounds. The lowest intensity was reported for yawning, certain words, footsteps, sneezing, and repetitive engine noises. Women had significantly higher intensity of reactions on sound of clipping nails, swallowing, lip smacking, normal breathing, loud unusual breathing, repetitive coughing, repetitive sniffing, snoring, chewing gum, slurping, muffled sounds, throat clearing, clock ticking, crunching, teeth sucking.

Figure 5 illustrates the percentages of participants selecting each of nine emotional reactions to 37 triggers. ‘Repetitive engine noises’ (78.8%), ‘footsteps’ (67.6%), and ‘sneezing’ (66.2%) were selected the most frequently as eliciting *no feeling*. On the other hand, triggers such as sound of ‘tapping’ (48.2%), ‘repetitive barking’ (45.5%), and ‘loud/unusual breathing’ (39.2%) predominantly evoked *irritation*. ‘Snoring’ (13.1%), ‘lip smacking’ (10.8%) and ‘slurping’ (8.6%) were selected most frequently as causing *distress*, while sounds such as ‘kissing’ (27%), ‘mushy foods’ (23.9%), and ‘chewing gum loudly’ (23%) most often elicited *disgust*. The triggers that predominantly induced *anger* were ‘lip smacking’ (45.9%), ‘slurping’ (38.3%), and ‘loud chewing’ (37.4%). For *panic*, ‘lip smacking’ (13.1%), ‘chewing gum loudly’ (9.9%), ‘loud chewing’ (8.1%) were selected most frequently. ‘Certain accents’ (11.7%), ‘certain letter sounds’ (10.8%), ‘snoring’ (9.5%) were reported the most frequently to cause *other negative emotions* whilst ‘repetitive engine noises’ (5%), ‘keyboard tapping’ (4.5%), ‘clock ticking’ (4.5%) were selected most often as eliciting *other positive emotions*. Finally, physiological reactions were evoked most frequently by ‘cutlery noises’ (3.6%) and ‘rustling plastic or paper’ (2.7%).

Table 4. Norms and reliability of the S-Five-T scores.

	Mean (SD)	Median (Q1-Q3)	Mode (min-max)	Gender difference (U)	Age rho	Stability (N=36)	
						Psi (95% CI)	ICC
No feeling (N=222)	12.36 (6.19)	12 (8-16)	11 (0-33)	**3341.5	-0.03	0.91 (0.87, 1)	0.91
Irritation (N=222)	10.65 (4.47)	10 (8-13)	9 (1-23)	2076	-0.01	0.82 (0.75, 1)	0.86
Distress (N=222)	1.02 (1.81)	0 (0-1)	0 (0-11)	1982.5	-0.09	0.78 (0.73, 1)	0.85
Disgust (N=222)	2.18 (2.18)	2 (0-3)	0 (0-9)	2329.5	-0.08	0.85 (0.81, 1)	0.88
Anger (N=222)	6.54 (4.66)	6 (3-9)	6 (0-23)	2081.5	0.11	0.85 (0.79, 1)	0.87
Panic (N=222)	1.55 (2.86)	0 (0-2)	0 (0-20)	2249	-0.12	0.83 (0.78, 1)	0.87
Negative (N=222)	1.99 (2.41)	1 (0-3)	0 (0-14)	*1756	0.02	0.79 (0.74, 1)	0.85
Positive (N=222)	0.38 (0.87)	0 (0-0)	0 (0-5)	2778.5	*-0.16	0.78 (0.72, 1)	0.85
Physiological (N=222)	0.33 (1.18)	0 (0-0)	0 (0-11)	2247	0.04	0.74 (0.7, 1)	0.84
TC (N=221)	24.29 (6.25)	25 (21-28)	26 (4-37)	**1360	0.04	0.91 (0.87, 1)	0.91

FIRS (N=221)	162.22 (64.14)	157 (120-201)	133 (12-342)	**1331	0.13*	0.93 (0.88, 1)	0.91
RIRS (N=221)	6.54 (1.50)	6.58 (5.65-7.50)	5.84 (0.75-9.50)	1827.5	0.20*	0.86 (0.8, 1)	0.88

Note. SD: standard deviation; Q1-Q3: first and third quartile; U: Mann–Whitney test; rho: Spearman's correlation coefficient; Psi coefficient and 95% confidence intervals; ICC: intraclass correlation coefficient (two-way mixed effects, absolute agreement); *p<0.05; **p<0.01.

Table 5. Intercorrelations of the S-Five-T and correlations with other measures (Spearman's rho).

	No feeling	Irritation	Distress	Disgust	Anger	Panic	Negative	Positive	Physiological	TC	FIRS	RIRS
S-Five RC (N=222)												
Irritation	-0.42**											
Distress	-0.26**	-0.04										
Disgust	-0.16*	0.07	0.01									
Anger	-0.37**	-0.11	0.03	-0.22**								
Panic	-0.27**	-0.19**	0.18**	0.12	-0.07							
Negative	-0.17*	-0.08	-0.07	0.08	-0.23**	0.1						
Positive	0.02	-0.15*	0.05	0.03	-0.16*	0.1	0.1					
Physiological	-0.05	-0.09	0.05	0.05	-0.14*	0	0.25**	0.16*				
TC (N=219)	-0.99**	0.43**	0.24**	0.15*	0.38**	0.25**	0.17*	-0.14*	0.04			
FIRS (N=219)	-0.82**	0.24**	0.24**	0.03	0.48**	0.28**	0.06	-0.12	-0.03	0.83**		
RIRS (N=219)	-0.33**	-0.10	0.13	-0.11	0.40**	0.21**	-0.13*	-0.07	-0.10	0.34**	0.76**	
S-Five (N=222)												
Externalising	-0.10	-0.02	0.05	-0.08	0.15*	-0.05	0.03	-0.1	0.02	0.12	0.27**	0.36**
Internalising	-0.24**	-0.02	0.17**	-0.10	0.22**	0.16*	-0.05	-0.06	-0.06	0.25**	0.31**	0.26**
Impact	-0.28**	-0.09	0.19**	-0.10	0.23**	0.30**	-0.01	-0.03	0.04	0.28**	0.40**	0.40**
Outburst	-0.22**	-0.08	0.14*	-0.17**	0.27**	0.15*	-0.04	-0.15*	0.03	0.24**	0.38**	0.42**
Threat	-0.26**	-0.13	0.25**	-0.06	0.17**	0.29**	-0.04	-0.05	0.02	0.28**	0.43**	0.45**
Total	-0.26**	-0.10	0.20**	-0.14*	0.24**	0.22**	-0.01	-0.1	0.03	0.28**	0.45**	0.47**
MisoQuest (N=208)												
Total	-0.24**	-0.12	0.24**	-0.14*	0.30**	0.24**	-0.1	-0.03	0.02	0.26**	0.43**	0.48**
MQ (N=210)												
MEBS (N=183)	-0.21**	-0.13	0.20**	-0.17*	0.25**	0.28**	-0.08	-0.14	-0.01	0.22**	0.41**	0.46**
MSYS (N=183)	-0.73**	0.30**	0.18**	0.08	0.37**	0.22**	0.11	-0.13	-0.001	0.75**	0.77**	0.45**

MSES (N=210)	-0.27**	-0.06	0.18**	-0.12	0.30**	0.20**	-0.03	-0.08	0.06	0.29**	0.46**	0.46**
Total (N=183)	-0.53**	0.07	0.26**	-0.09	0.37**	0.32**	0.02	-0.16*	-0.006	0.56**	0.70**	0.56**
PHQ-9 (N=215)												
Total	-0.25**	-0.01	0.27**	0.12	0.1	0.20**	-0.01	0.02	0.02	0.26**	0.26**	0.14*
GAD-7 (N=217)												
Total	-0.22**	-0.05	0.20**	0.08	0.12	0.15*	-0.02	-0.08	-0.02	0.24**	0.29**	0.23**
ASI-3 (N=195)												
Social	-0.24**	0.08	0.07	0.26**	0.07	0.16*	-0.05	-0.01	0	0.25**	0.18*	0.06
Cognitive	-0.27**	0.1	0.1	0.18*	0.05	0.17*	-0.06	0	-0.05	0.27**	0.21**	0.08
Physical	-0.27**	0.11	0.06	0.16*	0.14	0.08	-0.07	-0.03	-0.06	0.27**	0.23**	0.14
Total	-0.29**	0.12	0.09	0.24**	0.09	0.17*	-0.08	-0.02	-0.04	0.30**	0.23**	0.10

Note. RC: reaction count; TC: trigger count; FIRS: Frequency-intensity reaction score; RIRS: relative intensity reaction score; MQ: Misophonia Questionnaire; PHQ-9: Physical Health Questionnaire; GAD-7: Generalised Anxiety Disorder Assessment; ASI-3: Anxiety Sensitivity Index. ω: McDonald's omega. *p<0.05, **p<0.001.

Table 6. Norms and reliability of the intensity items for the 37 S-Five-T sounds.

Trigger sounds	Mean (SD)	Median (Q1-Q3)	Mode (min-max)	Gender difference (U)	Age rho	Stability (N=36)	
						Psi (95% CI)	ICC
Normal eating sounds (N=279)	6.25 (3.27)	7 (4-9)	8 (0-10)	3536.5	-0.02	0.88 (0.83, 1)	0.89
Certain letter sounds (N=258)	2.18 (3.02)	0 (0-5)	0 (0-10)	3406.5	-0.06	0.81 (0.76, 1)	0.86
Mushy foods (N=253)	5.09 (3.56)	6 (1-8)	0 (0-10)	2977	-0.05	0.83 (0.77, 1)	0.87
Sound of clipping nails (N=251)	3.64 (3.9)	3 (0-7)	0 (0-10)	*2233	0.04	0.85 (0.8, 1)	0.88
Swallowing (N=251)	5.77 (3.61)	6 (3-9)	10 (0-10)	*2241	0.05	0.89 (0.84, 1)	0.89
Keyboard tapping (N=250)	3.53 (3.76)	3 (0-7)	0 (0-10)	2709.5	0.01	0.84 (0.79, 1)	0.87
Lip smacking (N=249)	8.62 (2.26)	10 (8-10)	10 (0-10)	*2426.5	0.07	0.81 (0.74, 1)	0.86
Normal breathing (N=248)	2.53 (3.45)	0 (0-5)	0 (0-10)	*2313.5	*-0.12	0.82 (0.77, 1)	0.86
Repetitive engine noises (N=248)	0.87 (2.28)	0 (0-0)	0 (0-10)	2904.5	-0.12	0.75 (0.7, 1)	0.84
Loud/unusual breathing (N=245)	6.32 (3.21)	7 (4-9)	10 (0-10)	*2102	0.00	0.87 (0.82, 1)	0.88
Mobile phone sounds (N=245)	3.11 (3.31)	2 (0-6)	0 (0-10)	2810.5	-0.01	0.85 (0.79, 1)	0.88
Repetitive coughing (N=243)	4.95 (3.41)	5 (2-8)	0 (0-10)	*2092	0.07	0.86 (0.82, 1)	0.88
Humming (N=242)	3.64 (3.48)	3 (0-7)	0 (0-10)	2303	**0.19	0.83 (0.78, 1)	0.87
Repetitive sniffing (N=242)	7.2 (3.04)	8 (5-10)	10 (0-10)	**1691	**0.20	0.87 (0.82, 1)	0.88
Snoring (N=241)	7.15 (3.19)	8 (5-10)	10 (0-10)	*2021.5	**0.15	0.9 (0.87, 1)	0.9
Certain accents (N=241)	3.13 (3.42)	2 (0-6)	0 (0-10)	2403	*0.13	0.79 (0.73, 1)	0.85
Whistling sound (N=241)	3.12 (3.54)	2 (0-6)	0 (0-10)	2405	**0.21	0.83 (0.76, 1)	0.87
Sound of tapping (N=238)	4.73 (3.42)	5 (1-7)	0 (0-10)	2256	**0.27	0.84 (0.79, 1)	0.87
Rustling plastic or paper (N=238)	3.38 (3.47)	3 (0-6)	0 (0-10)	2420.5	**0.20	0.81 (0.75, 1)	0.86
Chewing gum (N=237)	7.72 (2.93)	9 (6-10)	10 (0-10)	*2108	**0.16	0.84 (0.8, 1)	0.87
Footsteps (N=236)	1.79 (3.02)	0 (0-3)	0 (0-10)	2438.5	-0.08	0.74 (0.69, 1)	0.83
Hiccups (N=236)	2.92 (3.43)	2 (0-6)	0 (0-10)	2384	0.02	0.84 (0.79, 1)	0.87
Slurping (N=234)	7.66 (3.01)	9 (6-10)	10 (0-10)	*1917.5	**0.18	0.87 (0.82, 1)	0.88
Cutlery noises (N=233)	4.14 (3.77)	4 (0-8)	0 (0-10)	2491	0.08	0.86 (0.81, 1)	0.88
Sneezing (N=233)	1.72 (2.92)	0 (0-3)	0 (0-10)	2277.5	0.04	0.77 (0.72, 1)	0.85
Certain words (N=233)	1.97 (2.99)	0 (0-4)	0 (0-10)	2177	-0.03	0.81 (0.75, 1)	0.86
Kissing (N=232)	3.6 (3.48)	3 (0-7)	0 (0-10)	2192	0.02	0.8 (0.74, 1)	0.86
Joint cracking (N=233)	3.32 (3.61)	2 (0-7)	0 (0-10)	2345	*0.14	0.86 (0.82, 1)	0.88
Muffled sounds (N=232)	3.06 (3.61)	1 (0-6)	0 (0-10)	*1887.5	-0.02	0.91 (0.87, 1)	0.9
Throat clearing (N=229)	5.5 (3.61)	6 (2-9)	0 (0-10)	*1552	*0.15	0.84 (0.79, 1)	0.87
Baby crying (N=228)	4.82 (3.75)	5 (0-8)	0 (0-10)	2769.5	-0.11	0.91 (0.87, 1)	0.9
Repetitive barking (N=227)	4.74 (3.46)	5 (2-8)	0 (0-10)	2081	0.11	0.84 (0.78, 1)	0.87
Loud chewing (N=227)	7.96 (2.8)	9 (7-10)	10 (0-10)	1921.5	0.02	0.83 (0.78, 1)	0.87
Clock ticking (N=225)	3.24 (3.69)	2 (0-7)	0 (0-10)	*1680	*0.13	0.85 (0.8, 1)	0.88
Crunching (N=224)	6.27 (3.81)	8 (3-10)	10 (0-10)	*1741.5	0.12	0.85 (0.8, 1)	0.88
Teeth sucking (N=224)	4.26 (3.8)	4 (0-8)	0 (0-10)	*1792	**0.28	0.81 (0.75, 1)	0.86
Yawning (N=224)	1.98 (3.26)	0 (0-3)	0 (0-10)	1978.5	*0.14	0.78 (0.73, 1)	0.85

Note. SD: standard deviation; Q1-Q3: first and third quartile; U: Mann–Whitney test; rho: Spearman's correlation coefficient; Psi coefficient and 95% confidence intervals; ICC: intraclass correlation coefficient (two-way mixed effects, absolute agreement); *p<0.05; **p<0.01.

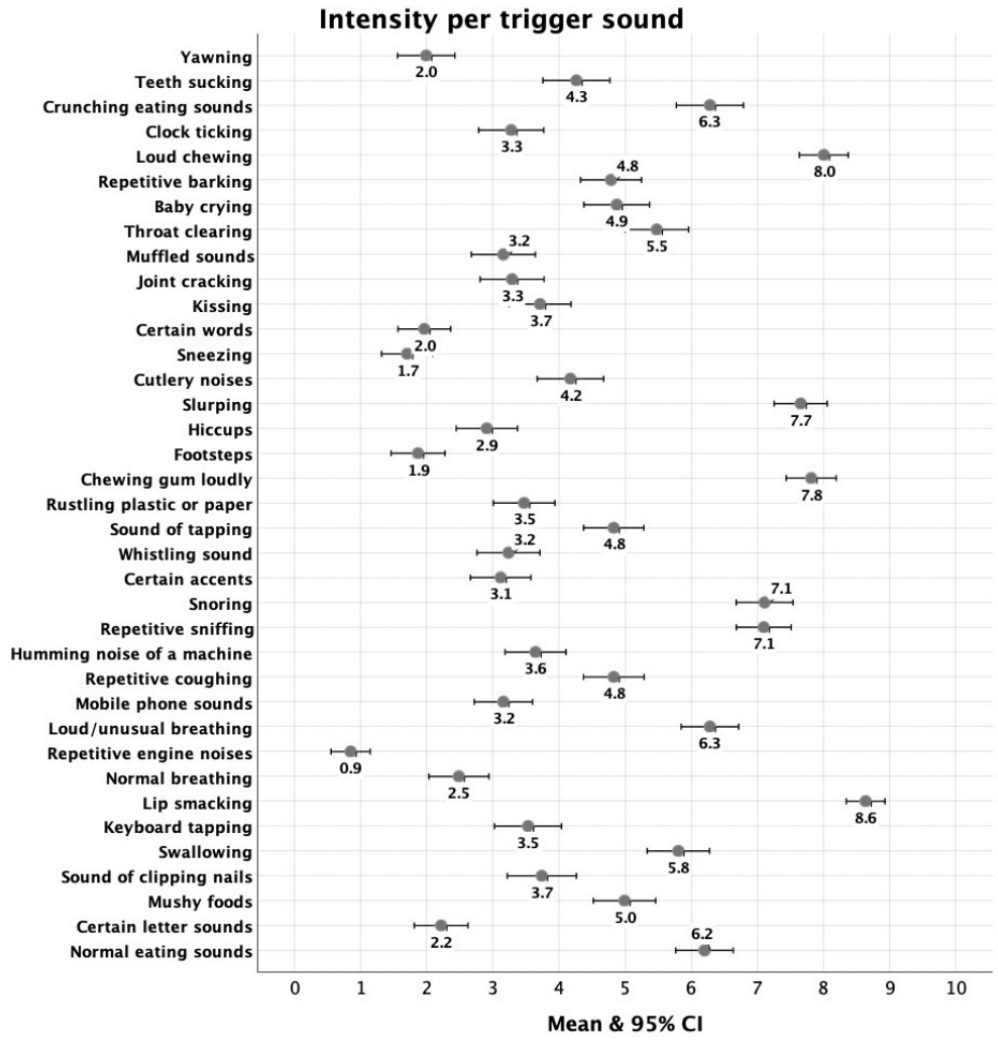
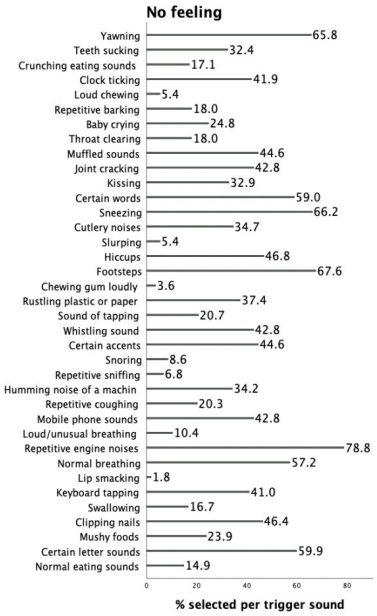
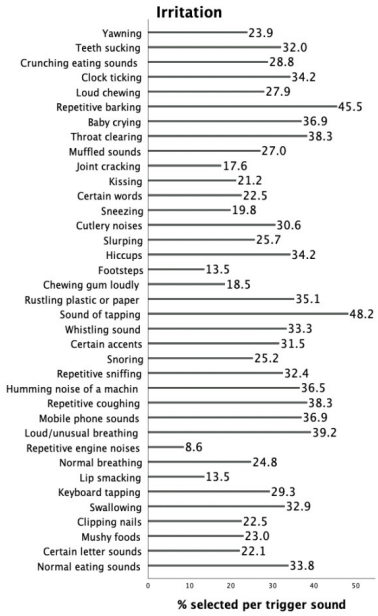
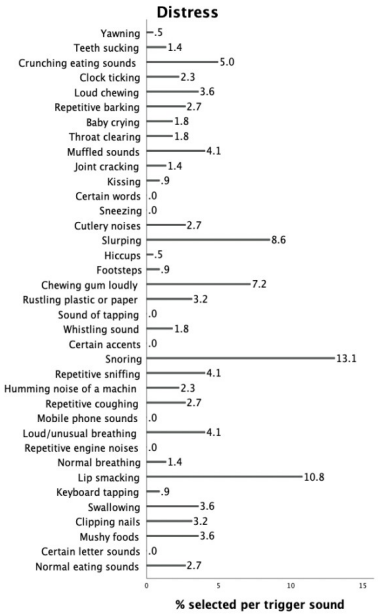
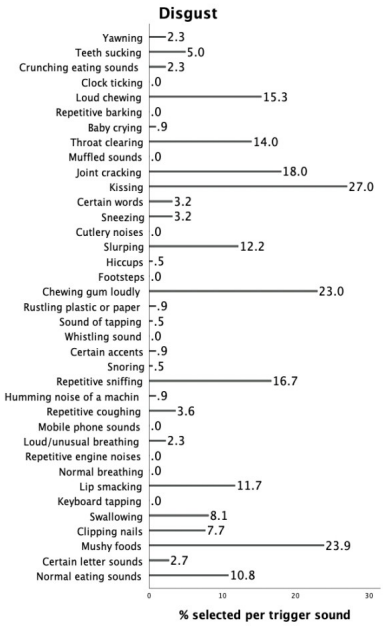


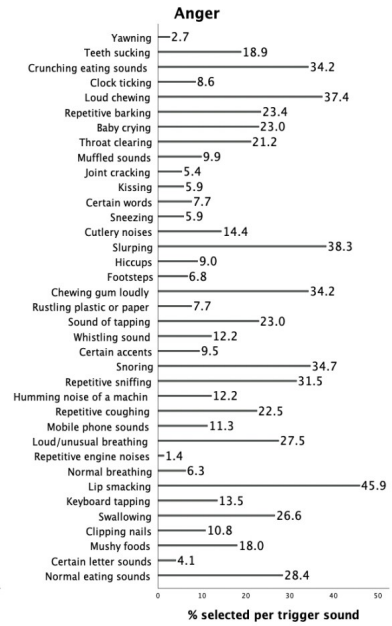
Figure 4. Mean intensity for each selected trigger.

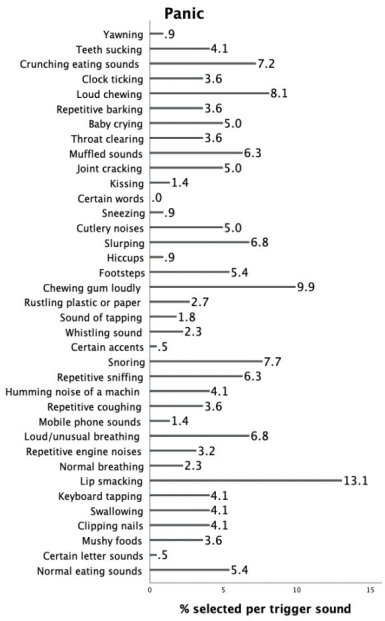

No feeling
Yawning 65.8
Teeth sucking 32.4
Crunching eating sounds 17.1
Clock ticking 41.9
Loud chewing 5.4
Repetitive barking 18.0
Baby crying 24.8
Throat clearing 18.0
Muffled sounds 44.6
Joint cracking 42.8
Kissing 32.9
Certain words 59.0
Sneezing 66.2
Cutlery noises 34.7
Slurping 5.4
Hiccups 46.8
Footsteps 67.6
Chewing gum loudly 3.6
Rustling plastic or paper 37.4
Sound of tapping 20.7
Whistling sound 42.8
Certain accents 44.6
Snoring 8.6
Repetitive sniffing 6.8
Humming noise of a machin 34.2
Repetitive coughing 20.3
Mobile phone sounds 42.8
Loud/unusual breathing 10.4
Repetitive engine noises 78.8
Normal breathing 57.2
Lip smacking 1.8
Keyboard tapping 41.0
Swallowing 16.7
Clipping nails 46.4
Mushy foods 23.9
Certain letter sounds 59.9
Normal eating sounds 14.9
0 20 40 60 80
% selected per trigger sound


Irritation
Yawning 23.9
Teeth sucking 32.0
Crunching eating sounds 28.8
Clock ticking 34.2
Loud chewing 27.9
Repetitive barking 45.5
Baby crying 36.9
Throat clearing 38.3
Muffled sounds 27.0
Joint cracking 17.6
Kissing 21.2
Certain words 22.5
Sneezing 19.8
Cutlery noises 30.6
Slurping 25.7
Hiccups 34.2
Footsteps 13.5
Chewing gum loudly 18.5
Rustling plastic or paper 35.1
Sound of tapping 48.2
Whistling sound 33.3
Certain accents 31.5
Snoring 25.2
Repetitive sniffing 32.4
Humming noise of a machin 36.5
Repetitive coughing 38.3
Mobile phone sounds 36.9
Loud/unusual breathing 39.2
Repetitive engine noises 8.6
Normal breathing 24.8
Lip smacking 13.5
Keyboard tapping 29.3
Swallowing 32.9
Clipping nails 22.5
Mushy foods 23.0
Certain letter sounds 22.1
Normal eating sounds 33.8
0 10 20 30 40 50
% selected per trigger sound


Distress
Yawning .5
Teeth sucking 1.4
Crunching eating sounds 5.0
Clock ticking 2.3
Loud chewing 3.6
Repetitive barking 2.7
Baby crying 1.8
Throat clearing 1.8
Muffled sounds 4.1
Joint cracking 1.4
Kissing .9
Certain words .0
Sneezing .0
Cutlery noises 2.7
Slurping 8.6
Hiccups .5
Footsteps .9
Chewing gum loudly 7.2
Rustling plastic or paper 3.2
Sound of tapping .0
Whistling sound 1.8
Certain accents .0
Snoring 13.1
Repetitive sniffing 4.1
Humming noise of a machin 2.3
Repetitive coughing 2.7
Mobile phone sounds .0
Loud/unusual breathing 4.1
Repetitive engine noises .0
Normal breathing 1.4
Lip smacking 10.8
Keyboard tapping .9
Swallowing 3.6
Clipping nails 3.2
Mushy foods 3.6
Certain letter sounds .0
Normal eating sounds 2.7
0 5 10 15
% selected per trigger sound


Disgust
Yawning 2.3
Teeth sucking 5.0
Crunching eating sounds 2.3
Clock ticking .0
Loud chewing 15.3
Repetitive barking .0
Baby crying .9
Throat clearing 14.0
Muffled sounds .0
Joint cracking 18.0
Kissing 27.0
Certain words 3.2
Sneezing 3.2
Cutlery noises .0
Slurping 12.2
Hiccups .5
Footsteps .0
Chewing gum loudly 23.0
Rustling plastic or paper .9
Sound of tapping .5
Whistling sound .0
Certain accents .9
Snoring .5
Repetitive sniffing 16.7
Humming noise of a machin .9
Repetitive coughing 3.6
Mobile phone sounds .0
Loud/unusual breathing 2.3
Repetitive engine noises .0
Normal breathing .0
Lip smacking 11.7
Keyboard tapping .0
Swallowing 8.1
Clipping nails 7.7
Mushy foods 23.9
Certain letter sounds 2.7
Normal eating sounds 10.8
0 10 20 30
% selected per trigger sound


Anger
Yawning 2.7
Teeth sucking 18.9
Crunching eating sounds 34.2
Clock ticking 8.6
Loud chewing 37.4
Repetitive barking 23.4
Baby crying 23.0
Throat clearing 21.2
Muffled sounds 9.9
Joint cracking 5.4
Kissing 5.9
Certain words 7.7
Sneezing 5.9
Cutlery noises 14.4
Slurping 38.3
Hiccups 9.0
Footsteps 6.8
Chewing gum loudly 34.2
Rustling plastic or paper 7.7
Sound of tapping 23.0
Whistling sound 12.2
Certain accents 9.5
Snoring 34.7
Repetitive sniffing 31.5
Humming noise of a machin 12.2
Repetitive coughing 22.5
Mobile phone sounds 11.3
Loud/unusual breathing 27.5
Repetitive engine noises 1.4
Normal breathing 6.3
Lip smacking 45.9
Keyboard tapping 13.5
Swallowing 26.6
Clipping nails 10.8
Mushy foods 18.0
Certain letter sounds 4.1
Normal eating sounds 28.4
0 10 20 30 40 50
% selected per trigger sound


Panic
Yawning .9
Teeth sucking 4.1
Crunching eating sounds 7.2
Clock ticking 3.6
Loud chewing 8.1
Repetitive barking 3.6
Baby crying 5.0
Throat clearing 3.6
Muffled sounds 6.3
Joint cracking 5.0
Kissing 1.4
Certain words .0
Sneezing .9
Cutlery noises 5.0
Slurping 6.8
Hiccups .9
Footsteps 5.4
Chewing gum loudly 9.9
Rustling plastic or paper 2.7
Sound of tapping 1.8
Whistling sound 2.3
Certain accents .5
Snoring 7.7
Repetitive sniffing 6.3
Humming noise of a machin 4.1
Repetitive coughing 3.6
Mobile phone sounds 1.4
Loud/unusual breathing 6.8
Repetitive engine noises 3.2
Normal breathing 2.3
Lip smacking 13.1
Keyboard tapping 4.1
Swallowing 4.1
Clipping nails 4.1
Mushy foods 3.6
Certain letter sounds .5
Normal eating sounds 5.4
0 5 10 15
% selected per trigger sound

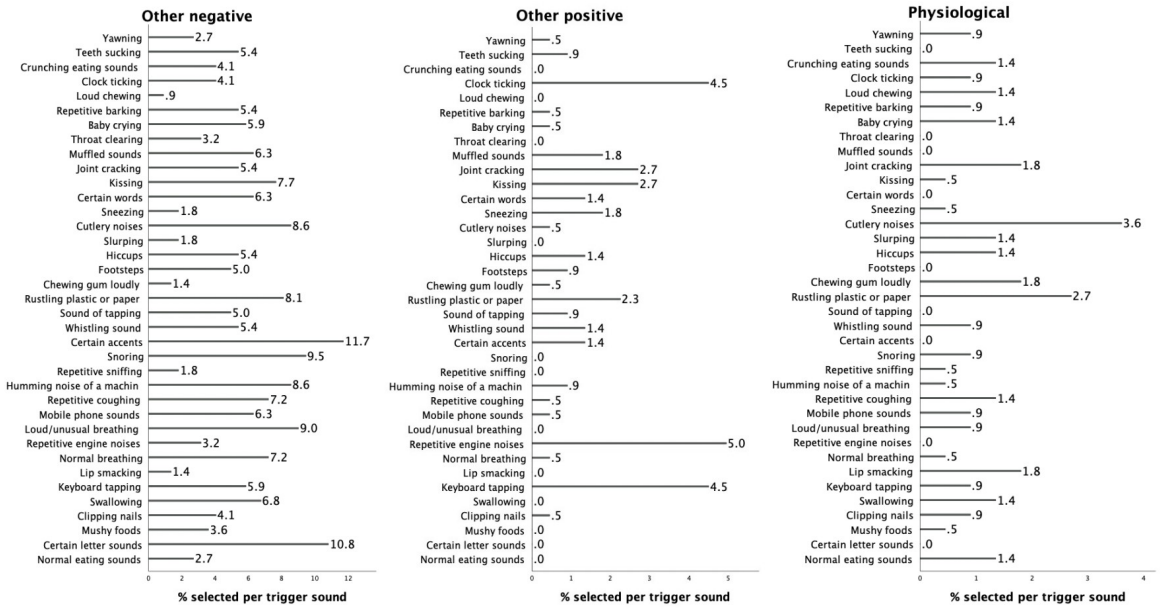


Figure 5. Percentages for each selected trigger per emotional reaction.

Discussion

The main objective of this study was to translate and validate the Polish version of the S-Five, a comprehensive questionnaire for assessing misophonia symptoms' severity. The results confirmed the five-factor structure of the S-Five in the Polish-speaking population, consisting of both individuals with and without self-identified misophonia, consistent with studies in English-speaking (Vitoratou, Uglik-Marucha, Hayes, & Gregory, 2021), German (Remmert et al., 2022), and Chinese populations (Vitoratou et al., 2022). The factor structure's robustness was further supported through the satisfactory stability of each subscale of the S-Five, that is, they are very likely to reproduce in other samples. Additionally, the questionnaire exhibited strong psychometric properties, including reliability, internal consistency, gender-related measurement invariance, and validity, replicating findings from previous research.

Are the five dimensions of misophonia stable and generalisable?

The study successfully replicated the five theoretical factors (*externalising* appraisals, *internalising* appraisals, *threat*, *impact*, and *outburst*) of the S-Five questionnaire in the Polish population, highlighting the cross-cultural validity of using the S-Five to measure misophonia. To investigate the factor structure more thoroughly, a novel method called bootEGA was employed to examine the stability of these misophonic dimensions and their item allocations across 1000 simulated samples (known as bootstrapped samples) from the original dataset. The five-factor structure was replicated with a high frequency (92% of the time), making the dimensions of the S-Five generalizable to other samples. This was further supported by successful replications of the five factors in representative sample of the UK population (Vitoratou et al., 2023), German (Remmert et al., 2022) and Mandarin-speaking Chinese (Vitoratou et al., 2022) populations.

Among the five aspects of misophonic experience assessed by the S-Five questionnaire, *externalizing* appraisals and *impact* factors demonstrated the highest structural consistency. This means that the items belonging to these factors consistently grouped together in the same dimensions. Specifically, all *externalizing*

items were allocated to their factor 100% of the time. The remaining factors were also stable, but to a lesser extent, with the *internalizing* factor showing the lowest structural consistency.

The stability issues with the *internalizing* dimension were mainly due to one specific item: 'I feel like I must be a very angry person inside because of the way I react to certain sounds.' This item shared some conceptual similarity with the *outburst* factor, and at times, it replicated on the *outburst* factor instead of its intended *internalising* factor. The item's focus on feelings of anger, rather than lack of respect or self-dislike, possibly explained its overlap with the *outburst* factor. The exploratory factor analysis also reflected this finding, as the item had the weakest association with its main factor compared to the other *internalising* items.

Regarding the *outburst* factor, one item—'I am afraid I will do something aggressive or violent because I cannot stand the noise someone is making'—occasionally replicated on both the *internalising* and *threat* dimensions. The first part of the item suggested a fear of emotions escalating, characteristic of the *threat* factor, while its association with the *internalising* factor indicated worries about potential outbursts, leading to intrusive thoughts or heightened anxiety. This item was also found to be the least meaningful indicator of the *outburst* factor. These issues align with a study by Remmert et al. (2022), which identified misspecifications in the original S-Five model relating to *outburst*. Remmert et al. proposed an alternative bifactor model that offers a clearer interpretation of the physical and verbal aspects of outbursts, which could potentially improve the item's association with its intended *outburst* factor.

Finally, one item from the *threat* factor—'If I cannot get away from certain noises, I am afraid I might panic or feel like I will explode'—shared some conceptual similarity with the *outburst* dimension. This item was the only one from its original factor that emphasized a fear of explosion, which aligns with the element of the outburst factor about being afraid of doing something aggressive, while the remaining items in the threat factor focused on feelings of distress and helplessness when unable to avoid triggers.

These findings revealed the presence of three multidimensional items (out of 25 items) in the S-Five, which measured concepts from their intended theoretical dimensions while also showing some conceptual overlap with other aspects of misophonic experience. While these three items were found to be psychometrically sound for use in the S-Five, they could benefit from alterations to improve the stability of their respective dimensions.

The secondary goal of the study was to describe characteristics of misophonia triggers, as well as the emotional and behavioural reactions to triggers, in relationship to each other, five aspects of misophonic symptoms (reflected by the five scales of the S-Five), and to the severity of anxiety and depressive symptoms. The results are consistent with the previous studies, contributing to the need for the re-evaluation of understanding of the nature of misophonia. The most important findings show that eating sounds tended to cause the most intense emotional reactions, and that misophonia symptoms were more associated with anger and panic, and not irritation or disgust. Another crucial discovery is that symptoms of anxiety and depression are differentially related to misophonia factors. There were moderate correlations between symptoms of depression and anxiety and *internalising* appraisals, and weaker or non-significant correlations with other factors.

What trigger sounds are the most related to severity of misophonia symptoms?

In the study, a variety of possible trigger sounds were presented to the participants as a part of S-Five-T, both human and non-human. The mouth sounds, such as normal eating sounds, lip smacking, loud chewing, slurping or chewing gum loudly, were reported as those evoking the most intense emotional reactions. Interestingly, repetitive sounds that are often listed among misophonic triggers (Rosenthal et al., 2021; Wu et al., 2014), such as repetitive engine noises, footsteps, or keyboard tapping, were among those that evoked the least intense reactions. In the other studies conducted in Europe with the use of S-Five (Remmert et al., 2022; Vitoratou, Uglik-Marucha, Hayes, & Gregory, 2021) similar observations were made. Meanwhile, in the study on the Chinese population (Vitoratou et al., 2022)vother types of triggers (for instance, baby crying) evoked the strongest emotions. Nonetheless, due to some methodological differences (the proportions of misophonia

sufferers in the sample), this intercultural discrepancy should be treated as preliminary data, and verified in further studies. While we acknowledge that according to the current understanding of misophonia and recent consensus (Swedo et al., 2022), misophonic triggers do not have to be necessarily human-made, the findings from this and other mentioned studies warrant further examination on the differences in experiencing misophonia triggered by human vs. other repetitive sounds in future studies. For example, a recent study by Siepsiak et al. (2022) showed that the prevalence of comorbid psychiatric disorders was significantly higher in the group of participants triggered by human oral sounds, than in those triggered by other, repetitive sounds.

It is worth to note that with respect to the listed sounds, *no feeling* was on average the most frequently reported response, which means that the participants were not triggered by the majority of the sounds from S-Five-T. This result supports the selective nature of misophonia.

What emotional, cognitive and behavioural responses are the most related to the severity of misophonia symptoms?

Despite being commonly described in the literature as one of the most characteristic emotions in misophonia (Guetta et al., 2022; Kılıç et al., 2021; Rouw & Erfanian, 2018; A. E. Schröder et al., 2017), our study found no significant relationship between frequency of reporting irritation as a primary response to triggers, and any of the five factors in the S-Five questionnaire. Similarly, while disgust is often associated with misophonia (Savard et al., 2022), our study revealed that disgust was weakly and negatively related to only one subscale, namely the *outburst,* and the total score of the S-Five. Instead, our findings indicated a positive correlation between anger and all of the S-Five scales. Additionally, both distress and panic showed positive associations with all S-Five subscales, except for *externalizing*. These three emotions were also the only positively correlated emotions with MisoQuest and MQ total. Similar to the S-Five, disgust showed only weak and negative associations with MisoQuest and MQ. These results are in line with German study (Remmert et al., 2022), where irritation was not related to any of the S-Five scales, and disgust was only weakly associated with *internalising* and

externalising scales. Interestingly, irritation correlated negatively with the total of S-Five in the original study (Vitoratou, Uglik-Marucha, Hayes, & Gregory, 2021). Therefore, this study contributes to already notable evidence for the distinctive role of anger in misophonia, diminished the role of disgust, and demonstrated diagnostic insignificance of irritation (reported as a dominant emotion) in misophonia. Importantly, the results from the current and other mentioned studies, are slightly different from the findings from the Chinese population (Vitoratou et al., 2022). In the Chinese study, although disgust was only weakly associated with *threat sub*scale, irritation correlated weakly to moderately with all of the S-Five scales, which suggest possible cultural differences with regards to irritation.

Participants obtained the highest average score on the *threat* subscale, which aligns with the findings from a study in the UK on individuals self-identifying with misophonia (Vitoratou, Uglik-Marucha, Hayes, & Gregory, 2021). Notably, when examining samples from the general population using the S-Five, other studies report the highest average score on the *externalising* factor (Remmert et al., 2022; Vitoratou et al., 2022, 2023). This observation highlights the significant role of feeling distress (about emotions escalating) in response to triggering sounds in misophonia, rather than attributing blame to others, which may be common reaction to unpleasant sounds in the general population. Interestingly, our participants scored lowest on the *impact* subscale, a trend also observed in other samples from the general population (Remmert et al., 2022; Vitoratou et al., 2022, 2023). This factor captures a perception of limitations caused by their reactions to sounds (for example, not seeing people you'd like to see). It could be that many individuals still participate in life, although perhaps with the use of coping strategies to enable them to do so. In contrast, a study on individuals self-identifying with misophonia (Vitoratou, Uglik-Marucha, Hayes, & Gregory, 2021) reported the outburst subscale as the lowest on average. It's possible that this reflects a cultural difference, or that it reflects different sampling methods. In this study, although the majority of participants self-identified with having misophonia, we also had participants who did not have the condition, which could potentially influence this result.

When it comes to outburst reactions in response to trigger sounds, verbal aggression, shouting and fearing having an outburst were more highly rated than

physical aggression or violence. This finding is consistent with similar studies conducted in the UK (Vitoratou, Uglik-Marucha, Hayes, & Gregory, 2021), Germany (Remmert et al., 2022), China (Vitoratou et al., 2022), the Netherlands (Jager et al., 2020) and previous studies in Poland (Siepsiak, Śliwerski, et al., 2020), where physical aggression and violence were also infrequently reported in comparison to fears about resorting to violence. It's essential to distinguish between the fear of exploding and actual physical acts of violence. These results align with previous research, emphasizing that misophonia should not be portrayed as a violence issue, a misconception that can still occur, especially in mass media.

Another interesting result, in line with the previous studies (Remmert et al., 2022), is the lack of relationship between self-reported physiological reactions and misophonia symptoms. While other studies have shown physiological reactions to sounds (Edelstein et al., 2013; Kumar et al., 2017; Siepsiak, Vrana, et al., 2023), our findings suggest that when asked to select the main response to trigger sounds, they are more likely to identify an emotion than a physiological response. It’s possible that this is because people recognise that their physiological reactions form part of their emotional reactions, or it is also possible that they do not tune into physiological component of their reactions. More research into this would be helpful, given that recognition and management of psychophysiological reactions became an important part of psychotherapeutic interventions (Lehrer, 2018).

What is the relationship between anger and types of attributions in misophonic reactions?

The five-factor structure of S-Five indicates that misophonia sufferers, although characterised by distinguishable reactions to particular trigger sounds, vary in specific features. First of all, attributions regarding one's misophonic reaction can be made either externally, as other people's responsibility or blame (here, *externalising* factor), or internally, as a self-blame (here, *internalising* subscale). As expected, the correlation between these two scales was weak (and the lowest), while both of these scales correlated strongly with the total of S-Five. Notably, anger correlated with all of the misophonia scales, including both of the appraisals scales. Anger had a higher correlation to *internalising* attributions than *externalising.* One

possibility for this is that one of the items in the internalising factor is about feeling like an angry person inside, and it makes sense that this appraisal would be related to increased experiences of anger to sounds. It would be interesting to examine these relationships experimentally to better understand the pattern of causality, for example by manipulating the attribution appraisals to test their influence on emotional reactions. Furthermore, while anger, panic or disgust were already examined and discussed in misophonia literature, the significance of the feeling of guilt and self-blaming, related to *internalising* subscale, is still poorly understood and should be prioritised in further studies.

What aspects of misophonia are and are not related to symptoms of psychopathology?

In the misophonia literature, it has been already well established that misophonia symptoms are related to anxiety and depressive symptoms (Erfanian et al., 2019; Jager et al., 2020; Quek et al., 2018; Rosenthal et al., 2022; Siepsiak et al., 2022; Wu et al., 2014). This study contributed to the knowledge of misophonia by highlighting the specific dimensions of this condition are differentially related to certain symptoms of psychopathology. The findings revealed that external attributions were neither related to the symptoms of depression nor to anxiety sensitivity and were only weakly related to the symptoms of anxiety. Internal attributions were moderately and positively related to symptoms of depression and anxiety, as well as to cognitive and social anxiety sensitivity, and weakly to physical aspects of anxiety sensitivity. In previous studies, *internalising* factor was also in most cases more (moderately) related to depressive and anxiety symptoms than to *externalising* dimension (Remmert et al., 2022; Vitoratou et al., 2022; Vitoratou, Uglik-Marucha, Hayes, & Gregory, 2021).

We cannot make causal inferences about these associations; it is possible that feeling anxious and depressed can contribute to blaming oneself for reactions, or that the presence of these types of appraisals feeds into symptoms of depression and anxiety, or perhaps that cognitive and social anxiety sensitivity influence the relationship between appraisals and symptoms of depression and anxiety. Alternatively, an unmeasured variable may be fuelling all these traits and symptoms.

The rest of the scales were only weakly related to anxiety and depressive symptoms, as well as anxiety sensitivity with no specific pattern emerging. The only exception was for the physical anxiety sensitivity, which was not related to the other subscales. Although anger, panic and distress were the emotions the most related to severity of misophonia symptoms, as measured by all the three misophonia questionnaires, only distress and panic were related to symptoms of depression and anxiety. These results again indicate the specific role of anger in misophonia, as one of the features of misophonia that distinguish it from other psychopathologies.

Limitations

The sample primarily consisted of individuals referred from online misophonia support groups, but it also included individuals who did not self-identify as having the condition. To ensure comprehensive validation, it is important to verify the characteristics of the S-Five not only in individuals without any sound over-responsivities but also in fully clinical samples. Additionally, the external validity of the tool should be assessed through face-to-face diagnostic interviews for misophonia. Furthermore, the S-Five has not yet been tested for discriminative validity with respect to other disorders of sound intolerance, namely tinnitus or hyperacusis. Addressing this aspect in future research would provide valuable insights into the uniqueness of misophonia as compared to other sound-related conditions. Moreover, the data on the prevalence of comorbid conditions were derived from self-reported medical diagnoses, and thus should be interpreted with caution. Future studies would benefit from using structured clinical interviews to examine the relationship between misophonia and other disorders more thoroughly.

Conclusions

This study successfully validated the Polish version of the S-Five questionnaire, confirming its five-factor structure and robustness in measuring misophonia symptoms in the Polish-speaking population. The tool can be utilised in clinical practice for diagnostic purposes and evaluating psychotherapeutic

interventions, as well as in research, making it the first published tool in Polish to comprehensively assess misophonia severity with respect to its five components.

The study offers valuable insights into misophonia's nature, trigger sounds, emotional responses, and their links to psychopathology, enhancing our understanding of this condition. Specifically, it highlights the significant role of anger, distress, and panic, while indicating the limited role of irritation and disgust in misophonia. Moreover, the findings emphasize that mouth sounds are more characteristic triggers of misophonia compared to other repetitive sounds. Lastly, the study demonstrates that external attributions are not associated with symptoms of depression and show weak correlations with anxiety symptoms, while internal attributions moderately correlate with both depression and anxiety symptoms. These findings have important implications for further research and clinical management of misophonia.

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Additional file

S-Five Polish version - fillable form with automatic scoring.pdf

Appendix

Table A1. The S-Five in English and Polish.

Please read each statement carefully and base your answer on how true they feel to you based on your current thoughts, experiences, and reactions: 0-not at all true to 10-completely true	Proszę uważnie przeczytać każdą pozycję i oprzeć swoją odpowiedź na tym, w jakim stopniu się z nimi utożsamiasz na podstawie aktualnych myśli, doświadczeń i reakcji: 0-zupełnie nieprawdziwe, do 10-całkowicie prawdziwe.
Externalising	**Eksternalizacja**
People should not make certain sounds, even if they do not know about others' sensitivities	Ludzie nie powinni wydawać niektórych dźwięków, nawet jeśli nie zdają sobie sprawy z nadwrażliwości innych osób na te dźwięki.
I get angry at other people because of how disrespectful they are with the noises they make	Złoszczę się na innych ludzi ze względu na ich brak szacunku wobec innych, gdy wydają pewne dźwięki.
People should do everything they can to avoid making noises that might bother others	Ludzie powinni robić wszystko, co w ich mocy, aby unikać wydawania dźwięków, które mogłyby przeszkadzać innym.
I react strongly to certain sounds because I cannot stand how selfish, thoughtless, or bad-mannered people can be	Reaguję silnie na niektóre dźwięki, ponieważ nie mogę znieść tego, jak samolubni, bezmyślni lub źle wychowani mogą być ludzie.
Certain sounds are just bad manners, and it is not strange to feel intense anger about that	Wydawanie niektórych odgłosów to po prostu złe maniery i to, że kogoś bardzo złości takie zachowanie, nie jest dziwne.
Internalizing	**Internalizacja**
The way I react to certain sounds makes me wonder whether deep inside I am just a bad person	Sposób w jaki reaguję na pewne dźwięki sprawia, że zastanawiam się, czy w głębi duszy jestem złą osobą.
The way I react to certain noises makes me feel like I must be an unlikable person deep down	Sposób w jaki reaguję na niektóre dźwięki sprawia, że w głębi duszy czuję, że ciężko mnie lubić.
I respect myself less because of my responses to certain sounds	Czuję do siebie mniej szacunku przez to, jak reaguję na pewne odgłosy.
I feel like I must be a very angry person inside because of the way I react to certain sounds	Czuję, że w głębi duszy muszę odczuwać dużą złość, skoro tak reaguję na niektóre dźwięki.

I dislike myself in the moments of my reactions to sounds	Nie lubię siebie w sytuacjach, gdy reaguję negatywnie na niektóre dźwięki.
Impact	**Wpływ na życie**
My job opportunities are limited because of my reaction to certain noises	Moje możliwości zatrudnienia są ograniczone ze względu na moje reakcje na niektóre dźwięki.
I do not meet friends as often as I would like to because of the noises they make	Czuję, że nie widuję przyjaciół tak często jak bym chciał/chciała z powodu dźwięków, jakie wydają.
There are places I would like to go but do not, because I am too worried about how the noises will impact me	Są miejsca do których chciałbym/abym pójść, ale tego nie robię, bo za bardzo martwię się tym, jak wpłyną na mnie niektóre dźwięki.
I can see future where I cannot do everyday things because of my reactions to noises	Patrząc w przyszłość, potrafię wyobrazić sobie sytuacje, gdy nie jestem w stanie wykonywać zwykłych codziennych czynności z powodu moich reakcji na dźwięki.
The way I feel/react to certain sounds will eventually isolate me and prevent me from doing everyday things	Sposób w jaki reaguję na niektóre dźwięki ostatecznie mnie odizoluje i uniemożliwi mi wykonywanie codziennych czynności.
Outburst	**Wybuchy emocji**
I can get so angry at certain noises that I get physically aggressive towards people to make them stop	Pewne dźwięki mogą mnie tak zezłościć, że staję się fizycznie agresywny/a w stosunku do ludzi, żeby tylko przestali je wydawać.
Sometimes I get so distressed by noises that I use violence to try and make it stop	Czasami niektóre dźwięki są źródłem takiej udręki, że używam przemocy, żeby spróbować je przerwać.
Some sounds are so unbearable that I will shout at people to make them stop	Niektóre dźwięki są tak nie do zniesienia, że zdarza mi się krzyczeć na ludzi, żeby przestali je wydawać.
If people make certain sounds that I cannot bear, I become verbally aggressive	Jeśli ludzie wydają pewne odgłosy, których nie mogę znieść, staję się słownie agresywny/a.
I am afraid I will do something aggressive or violent because I cannot stand the noise someone is making	Obawiam się, że mogę zacząć zachowywać się agresywnie i gwałtownie, gdy nie mogę znieść niektórych dźwięków, które ktoś wydaje.
Threat	**Zagrożenie**
I feel trapped if I cannot get away from certain noises	Czuję się osaczony/a, jeśli nie mogę uciec od niektórych dźwięków.
I feel anxious if I cannot avoid listening to certain sounds	Czuję duży niepokój, jeśli nie mogę uniknąć słuchania niektórych odgłosów.
If I cannot get away from certain noises, I am afraid I might panic or feel like I will explode	Jeśli nie mogę uciec od niektórych dźwięków, obawiam się, że wpadnę w panikę lub wybuchnę.
If I cannot avoid certain sounds, I feel helpless	Jeśli nie mogę uniknąć niektórych dźwięków, odczuwam bezradność.

I can experience distress as the result of some noises	Niektóre dźwięki stanowią dla mnie duży dyskomfort/są dla mnie udręką.

Table A2. The S-Five-T in English and Polish.

Thinking about the past few weeks, what is the main feeling this sound* has caused you? *no feeling, irritation, distress, disgust, anger, panic, other feeling: negative, other feeling: positive, other: physiological reaction*	W ostatnich tygodniach, jakie uczucia najczęściej wywoływał w Tobie ten dźwięk*? żadne, irytacja, rozpacz, obrzydzenie, złość, panika, inne uczucie: negatywne, inne uczucie: pozytywne, inne: reakcję fizjologiczną
Thinking about the past few weeks, please rate the intensity of your reaction to this sound* when made by another person or object *(from 0: doesn't bother me at all to 10: unbearable/causes suffering)*	Oceń intensywność swojej reakcji na ten dźwięk* wydawany przez inną osobę lub obiekt, biorąc pod uwagę ostatnie kilka tygodni (*od 0: w ogóle mi nie przeszkadza do 10: nie do zniesienia/powoduje cierpienie*)
*List of triggers currently included in the S-Five-T: Normal eating sounds, Certain letter sounds, Mushy foods being eaten, Sound of clipping nails, Swallowing, Keyboard tapping, Lip smacking, Normal breathing, Repetitive engine noises, Loud/ unusual breathing, Mobile phone sounds, Repetitive coughing, Humming noise, Repetitive sniffing, Snoring, Certain accents, Whistling sound, Sound of tapping, Rustling, Chewing gum, Footsteps, Hiccups, Slurping, Cutlery noises, Sneezing, Certain words, Kissing, Joint cracking, Muffled sounds, Throat clearing, Baby crying, Repetitive barking, Loud chewing, Clock ticking, Crunching eating sounds, Teeth sucking, Yawning.	*Lista stresorów/wyzwalaczy (ang. trigger) obecnie zawartych w S-Five-T: Normalne odgłosy jedzenia, Brzmienie niektórych głosek, Jedzenie papkowatych potraw, Dźwięk obcinania paznokci, Połykanie/przełykanie, Stukanie w klawiaturę, Mlaskanie, Normalne oddychanie, Odgłosy pracy silnika, Głośne/nietypowe oddychanie, Dźwięki telefonu komórkowego, Powtarzający się kaszel, Buczenie, Powtarzające się/ciągłe pociąganie nosem, Chrapanie, Niektóre rodzaje akcentu/intonacji mowy, Gwizdanie, Stukanie, Szeleszczący plastik lub papier, Głośne żucie gumy, Odgłosy kroków, Czkawka, Siorbanie, Odgłosy sztućców, Kichanie, Brzmienie niektórych słów, Odgłos pocałunków, Strzelanie stawów, Przytłumione dźwięki, Odchrząkiwanie, Płacz dziecka, Powtarzające się/ciągłe szczekanie, Głośne żucie, Tykanie zegara, Jedzenie chrupiących pokarmów, Zasysanie powietrza przez zęby/Syczenie, Ziewanie.

Table A3. Item stability values for the S-Five items across 1000 bootstrapped samples.

Item	Label	1	2	3	4	5	6	7
int_S505	Respect myself less	0.999			0.001			
int_S518	Bad person inside	0.999			0.001			
int_S519	Dislike self	0.999			0.001			
int_S508	Unlikeable person	0.797	0.118	0.043	0.008		0.033	0.001
int_S512	Angry person inside	0.614	0.213	0.122	0.006	0.001	0.044	
out_S517	Physically	0.016	0.981		0.003			

	aggressive							
out_S522	Violence	0.016	0.981		0.003			
out_S523	Shout at people	0.017	0.978	0.002	0.002		0.001	
out_S504	Verbally aggressive	0.049	0.875	0.052	0.003		0.021	
out_S524	Afraid of outburst	0.198	0.621	0.128	0.001	0.001	0.051	
thr_S507	Feel anxious	0.003	0.001	0.996				
thr_S511	Feel trapped	0.003	0.001	0.996				
thr_S510	Experience distress	0.003	0.002	0.995				
thr_S503	Feel helpless	0.004	0.002	0.994				
thr_S502	Panic or explode	0.091	0.219	0.662	0.004		0.024	
imp_S501	Do not meet friends				1.000			
imp_S514	Avoid places				1.000			
imp_S520	Limited job opportunities				1.000			
imp_S515	Cannot do everyday things				0.999		0.001	
imp_S509	Eventually isolated	0.028	0.012	0.007	0.946		0.006	0.001
ext_S506	Others avoid making noises					1.000		
ext_S513	Others should not make sounds					1.000		
ext_S516	Others selfish					1.000		
ext_S521	Others bad manners					1.000		
ext_S525	Others disrespectful					1.000		

Note. 1: Internalising factor; 2: Outburst factor; 3: Threat factor; 4: Impact factor; 5: Externalising factor; 6-7: factors identified in bootstrap EGA that had a low proportion of replications and were not assigned a name.
Blank cells correspond to 0.