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Sensory Intolerance: Latent Structure and Psychopathologic Correlates

Steven Taylor, Ph.D.[1],[*], **Christine A. Conelea, Ph.D.**[2], **Dean McKay, Ph.D.**[3], **Katherine B. Crowe, B.A.**[3], and **Jonathan S. Abramowitz, Ph.D.**[4]

[1]Department of Psychiatry, University of British Columbia, Vancouver, BC, Canada

[2]Alpert Medical School, Brown University, Providence, RI, USA

[3]Department of Psychology, Fordham University, New York, NY, USA

[4]Department of Psychology, University of North Carolina, Chapel Hill, NC, USA

Abstract

Background—Sensory intolerance refers to high levels of distress evoked by everyday sounds (e.g., sounds of people chewing) or commonplace tactile sensations (e.g., sticky or greasy substances). Sensory intolerance may be associated with obsessive-compulsive (OC) symptoms, OC-related phenomena, and other forms of psychopathology. Sensory intolerance is not included as a syndrome in current diagnostic systems, although preliminary research suggests that it might be a distinct syndrome.

Objectives—First, to investigate the latent structure of sensory intolerance in adults; that is, to investigate whether it is syndrome-like in nature, in which auditory and tactile sensory intolerance co-occur and are associated with impaired functioning. Second, to investigate the psychopathologic correlates of sensory intolerance. In particular, to investigate whether sensory intolerance is associated with OC-related phenomena, as suggested by previous research.

Method—A sample of 534 community-based participants were recruited via Amazon.com's Mechanical Turk program. Participants completed measures of sensory intolerance, OC-related phenomena, and general psychopathology.

Results—Latent class analysis revealed two classes of individuals: Those who were intolerant of both auditory and tactile stimuli (*n* = 150), and those who were relatively undisturbed by auditory or tactile stimuli (*n* = 384). Sensory intolerant individuals, compared to those who were comparatively sensory tolerant, had greater scores on indices of general psychopathology, more severe OC symptoms, a higher likelihood of meeting caseness criteria for OC disorder, elevated scores on measures of OC-related dysfunctional beliefs, a greater tendency to report OC-related phenomena (e.g., a greater frequency of tics), and more impairment on indices of social and occupational functioning. Sensory intolerant individuals had significantly higher scores on OC symptoms even after controlling for general psychopathology.

[*]Corresponding author: Department of Psychiatry, 2255 Wesbrook Mall, University of British Columbia, Vancouver, BC, Canada, V6T 2A1. taylor@mail.ubc.ca, Tel: 011-1-604-785-7558, Fax: 011-1-604-822-7756.

Conclusions—Consistent with recent research, these findings provide further evidence for a sensory intolerance syndrome. The findings provide a rationale for conducting future research for determining whether a sensory intolerance syndrome should be included in the diagnostic nomenclature.

1. Introduction

Sensory intolerance refers to high levels of distress evoked by everyday sounds (misophonia; e.g., sounds of people chewing) or commonplace tactile sensations (e.g., sticky or greasy substances, or tactile sensations from clothing such as clothing tags) [1]. Much remains to be learned about the nature and etiology of sensory intolerance. Preliminary research in child samples suggest that sensory intolerance might constitute an empirically defined psychiatric syndrome, as defined by the co-occurrence of distressing symptoms or signs, along with impairment in social or occupational functioning [2–3]. Little is known as to whether such a syndrome can be found in adults. Sensory intolerance in adults is not described in either DSM-5 or ICD-10.[1] However, clinical observations and preliminary findings suggests that it can be highly distressing and is associated with obsessive-compulsive (OC) symptoms [4–7]. Sensory intolerance has been implicated in tic disorders, which are related to obsessive-compulsive disorder (OCD) [8–10].

In a study of 42 adult patients referred to an OCD clinic with misophonia as a presenting problem, Schröder et al. [5], concluded that misophonia should classified as a discrete psychiatric disorder, based on the fact that misophonia is distressing, associated with functional impairment, and cannot be attributed to psychiatric disorders described in current diagnostic systems. It is unclear, however, whether the disorder should be limited to, or emphasize, auditory intolerance (misophonia); it may be that auditory and tactile intolerance are *both* prominent features of a sensory intolerance syndrome.

The available research, although limited, suggests that sensory intolerance might form a syndrome in adults and might be associated with OC symptoms and related phenomena. Sensory intolerance has long been described as a common feature of adults diagnosed with OCD [11]. Contemporary models of OCD, including cognitive-behavioral models, fail to explain sensory intolerance. The sound of someone chewing loudly, for example, cannot be explained by cognitive-behavioral models of OCD. Those models emphasize the roles of personal perfectionism, personal responsibility for preventing harm, and catastrophic beliefs about the meaning of unwanted intrusive thoughts [12]. Such models do not explain sensory intolerance. Further research is needed to understand such phenomena and, in turn, to develop empirically informed explanations.

The present study investigated (a) whether auditory and tactile intolerance tend to co-occur (as defined by Latent Class Analysis), (b) if so, whether sensory intolerance is associated with social and occupational impairment, as would be required to diagnose a clinical

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[1]There is a provisional diagnostic category in the Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood-Revised, called "Regulation Disorder of Sensory Processing, Hypersensitive subtype" (34). The diagnostic system is not official. The disorder, which has poor inter-rater reliability (1), is considered to be transient and therefore unlikely to be found in adult samples.

syndrome, and (c) to investigate the psychopathologic correlates of sensory intolerance; in particular, to investigate whether it is associated with OC-related phenomena. To investigate the specificity of the association between sensory intolerance and OC-related phenomena, we also conducted analyses in which we controlled for general psychopathology.

2. Method

2.1. Participants

A community-based sample of 534 English-speaking adults, expressing interest in clinical psychology research, participated in this study. The utility of such an analogue sample is justified in another unrelated analysis of this dataset [13] and, more broadly, in a recent review [14]. Such samples are useful because psychopathologic phenomena such as mild or moderately severe OC-related symptoms and sensory intolerance appear to be common in the general population, and may be even more common in people who express interest in participating in clinical research [14].

The mean age of the sample was 33 years (SD = 12 years; range 18–82 years) and 58% were female. Most (81%) lived in the United States. Most (73%) were Caucasian, and almost all (99%) had at least a high school level of education. The remaining 1% had completed at least some high school. Most participants were either single (43%) or married (40%), with the remainder cohabiting (9%), divorced or separated (7%) or widowed (1%). Most were employed full-time (42%), with the remainder being employed part time (22%), unemployed (21%), full-time students (10%), retired (3%), or subsisting on disability benefits (2%).

2.2. Measures

Given the paucity of measures of sensory intolerance, we developed two face-valid, true/false items. Tactile intolerance was assessed by item, "I am very bothered by certain tactile sensations, such as clothing textures or tightness; substances that feel sticky, greasy, or wet, or activities like haircuts or cutting my nails." Auditory intolerance was assessed by the item, "I am very bothered by certain auditory sensations, such as the sound of alarms, sirens, appliances, or background noises like people talking or ticking clocks."

We assessed four other domains of psychopathology: (a) OC symptoms (and OCD caseness), (b) OC-related dysfunctional beliefs, (c) other OC-related phenomena (i.e., incompleteness, tics, and disgust proneness), and (d) three indices of general psychopathology: depression, harm avoidance, and negative emotionality. Incompleteness is the sense or feeling that one's actions, intentions, or experiences have not been properly achieved; that is, the experience that something is not "just right" (e.g., the feeling that both shoelaces are not tied to precisely the same tension or that a door lock has not been properly locked [15]. Incompleteness may be a motivator of OC symptoms [13]. Harm avoidance refers to the tendency to worry about and avoid all sources of potential general, along with general fearfulness [16]. Although harm avoidance is correlated with OC symptoms, it is, just like depression, a nonspecific marker of psychopathology in that it is associated with many different forms of psychopathology [13]. Negative emotionality refers to the proneness to experience all kinds of aversive emotions, such as general anxiety, depression, and anger [17].

OC symptoms and OCD caseness were assessed with the Obsessive Compulsive Inventory – Revised (OCI-R; [18]). Caseness (i.e., full or subclinical OCD) was defined by a score of 4 on the Obsessions subscale, which best discriminates, in terms of sensitivity and specificity, OCD patients from controls [18]. OC-related dysfunctional beliefs were measured by the Obsessive Beliefs Questionnaire-44 [19], which measures three empirically derived types of dysfunctional beliefs: (a) inflated responsibility and overestimation of threat, (b) perfectionism and intolerance for uncertainty, and (c) overimportance of thoughts and need to control of thoughts. Incompleteness and harm avoidance were measured by the Obsessive-Compulsive Core Dimensions Questionnaire – Trait Version [15]. Disgust proneness was measured by subscales from the Disgust Sensitivity Scale [20]: (a) core disgust (avoidance of oral incorporation of disgusting stimuli), (b) animal reminder disgust (stimuli that remind us of our animal origins, such as those pertaining to sex, body violation, and death), and (c) contamination disgust (related to disease and contagion) [21]. Lifetime history of tics was assessed by the self-report version of the Yale Global Tic Severity Scale [22]. Negative emotionality was assessed by the Positive and Negative Affect Scale [17]. Depression was measured with the Center for Epidemiologic Studies Depression Scale [23]. The validity scale of the Psychopathic Personality Inventory [24] was used to detect abnormally elevated and therefore likely invalid responses. Each of these measures had acceptable psychometric properties (reliability and validity), as indicated in the above-mentioned references.

2.3. Procedure

Participants were recruited via the Mechanical Turk program operated by Amazon.com. The Mechanical Turk is a well-established crowd-sourcing platform frequently used in behavioral research [25]. It has been found to be a valid and acceptable means for conducting psychopathology survey research [26]. Participants were included if they provided informed, voluntary, written consent, and were proficient in English. Exclusion criteria were failure to complete the measures or abnormally elevated scores (3 or more deviant responses) on the validity scale of the Psychopathic Personality Inventory [27].

2.4. Statistical Procedures

Latent Class Analysis, using Robust Maximum Likelihood (RML), was computed with *MPlus* version 6.1 [28]. RML was used because it is robust to departures of normality in the data distribution. Input variables were the two sensory intolerance items. Four models were compared, consisting of either 1, 2, 3, or 4 classes, with the best-fitting model having the smallest values on three fit indices based on information criteria: The Akaike Information Criterion, Bayesian Information Criterion (BIC), and the sample sized adjusted BIC.

Once the best-fitting model was identified, the classes were compared in terms of demographic and other variables. Scores on the questionnaires were modeled as latent variables using RML with *MPlus*. This was done in order to minimize error variance. Factor scores for each latent variable were also computed via *MPlus*. To facilitate the interpretation of the results, for statistical comparisons between classes, factor scores were transformed into T scores ($M = 50$, $SD = 10$ across the entire sample for each latent variable). Given the number of analyses conducted in this study, α was set at .01 in order to reduce Type I error

without unduly inflating Type II error. To further facilitate the interpretation of the magnitude of between-class differences, effect sizes were computed, based on Cohen's *d* [29]. According to Cohen's criteria, small, medium, and large effect sizes are indicated by *d* values of .2, .5, and .8, respectively.

3. Results

3.1. Latent Class Analysis

Fit indices (Table 1) indicated a 2-class model, in which Class 1 ($n = 150$) was classified as sensory intolerant and Class 2 ($n = 348$) was classified as relatively sensory tolerant. All participants in Class 1 reported being distressed by *both* tactile and auditory stimuli. Participants in Class 2 mostly reported being distressed by neither tactile nor auditory stimuli (59% of that class), or were bothered by only tactile (21%) or only auditory (21%) stimuli.

3.2. Comparisons between Classes

The classes did not differ in age ($t(df = 532) = 2.37, p > .01$) or gender ($\chi^2(df = 1) = 0.59, p > .40$). The classes differed in marital status, tested by an omnibus test across the above-mentioned five categories of marital status; $\chi^2(df = 4) = 13.80, p < .01$. Follow-up analysis indicated that people classified as sensory intolerant were more likely to be single, whereas people classified as sensory tolerant were more likely to be married; $\chi^2(df = 1) = 8.77, p < .005$, Cohen's $d = 0.35$. The classes also differed in an omnibus test of employment status (i.e., across the above-mentioned six categories of employment status); $\chi^2(df = 4) = 13.80, p < .01$. People classified as sensory intolerant, compared to those classified as sensory tolerant, had a lower level of occupational functioning, in that people classified as sensory intolerant were less likely to be employed full-time and more likely to be employed only on a part-time basis; $\chi^2(df = 1) = 12.19, p < .001$, Cohen's $d = 0.46$.

There was a higher proportion of OCD caseness in people classified as sensory intolerant (59%) as compared to people classified as sensory tolerant (26%); $\chi^2(df = 1) = 52.21, p < .001$, Cohen's $d = 0.78$. There was also an overrepresentation of a lifetime history of tics among people classified as sensory intolerant (17%) as compared to people classified as sensory tolerant (6%); $\chi^2(df = 1) = 11.40, p < .001$, Cohen's $d = 0.57$.

Table 2 shows a comparison between classes in terms of dimensional measures of OC-related variables and indices of general psychopathology. The table shows that people classified as sensory intolerant, compared to those classified as sensory tolerant, tended to have higher levels of psychopathology. Effect sizes were generally medium to large, with the exception of measures of disgust, which showed small effects. Analyses of covariance, in which OC-related variables served as dependent measures and three indices of general psychopathology served as a covariates, showed that the sensory intolerant class, compared to the sensory tolerant class, had higher scores on OC symptoms but not on OC-related phenomena or OC-related dysfunctional beliefs (see Table 2).

4. Discussion

Latent class analysis revealed two groups of individuals; those who were intolerant of both auditory and tactile stimuli, and those who were mostly undisturbed by auditory or tactile stimuli. Sensory intolerant individuals, compared to their comparatively tolerant counterparts, had greater scores on indices of general psychopathology, more severe OC symptoms, a higher likelihood of meeting caseness criteria for OCD, more severe scores on measures of OC-related dysfunctional beliefs, a greater proneness toward OC-related phenomena (e.g., incompleteness phenomena and tics), and more impairment on indices of social and occupational functioning. For the dimensional measures, OC symptom scores were significantly higher in the sensory intolerant class even after controlling for general psychopathology. Effect sizes tended to be medium-to-large, indicating that the statistically significant group differences were not simply due to the large sample size. Our findings complement and extend the recent findings of Schröder and colleagues [5]. Those authors concluded that misophonia should be regarded as a diagnostic syndrome that is related to, but different from, OCD and other disorders. Our findings suggest that the syndrome should be defined more broadly than misophonia, to emphasize both auditory and tactile sensory intolerance. Our findings, like those of Schröder et al., provide a rationale for conducting further investigations, including studies of people suffering from clinically severe sensory intolerance. Such individuals could be recruited from Internet websites and support groups focusing on sensory intolerance (e.g., www.misophonia.com).

We found that sensory intolerance was related to OC symptoms even after simultaneously controlling for three indices of general psychopathology. Our finding of an association between sensory intolerance and OC symptoms is consistent with previous studies [4,5,30]. However, further research is required to evaluate whether sensory intolerance can be regarded as an OCD-related disorder. A number of clinical conditions are currently regarded as OCD-related disorders, such as body dysmorphic disorder, trichotillomania, and excoriation (skin picking) disorder [31].

Sensory intolerance has been observed in people with autism spectrum disorder [31, 32]. Our sample consisted of educated, mostly employed, computer literate adults. Although we did not assess autism spectrum disorder, it seems likely that few if any of the people in our sample suffered from this rare clinical condition. Even so, it remains to be determined whether our findings generalize to people diagnosed with autism spectrum disorder. It could be that some forms of sensory intolerance, just like some types of OC symptoms, take the form of a diagnostic syndrome but sometimes are only associated features of autism spectrum disorder or other disorders. Future research is needed to investigate this possibility.

With regard to treatment implications, our findings suggest that clinicians should make a detailed assessment of patients presenting with problems of sensory intolerance. If a patient presents, for example, with distress about auditory intolerance (e.g., sounds of people chewing) then our results suggest that clinicians should also inquire about intolerance in other sensory modalities (e.g., tactile intolerance) and any associated avoidance or OC rituals (e.g., handwashing rituals after touching sticky surfaces, or excessive avoidance of unwanted sounds by wearing headphones with music played loud). Cognitive-behavioral

interventions are among the first-line treatments for OCD, but it remains to be seen as to whether they are effective for sensory intolerance. Further research is needed.

A limitation of the present study, as with other studies in this area, concerns the measurement of sensory intolerance. Schröder et al. [5] developed a detailed, face-valid measure of misophonia, but did not report data on the reliability and validity of their instrument. Measures of sensory intolerance in children (e.g., [33]) have not been adapted for adult samples and have unknown psychometric properties. We developed face-valid items assessing auditory and tactile sensory intolerance but we too do not have data on their psychometric properties. Nevertheless, it is noteworthy that our assessment yielded evidence suggestive of a psychopathologic syndrome. In order to better understand whether sensory intolerance can be regarded as a psychiatric syndrome, it is important to develop reliable, valid measures of many different forms of sensory intolerance, including auditory and tactile intolerance, along with visual intolerance (e.g., distress evoked by witnessing someone fidgeting; [5]), and olfactory intolerance (e.g., distress evoked by commonplace odors).

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Table 1

Fit indices for latent class analyses of sensory intolerance variables.

Number of latent classes	Akaike Information Criterion	Bayesian Information Criterion (BIC)	Sample-size Adjusted BIC
1	1,462.86	1,471.42	1,465.07
2	**1,383.45**	**1,404.85**	**1,388.98**
3	1,389.45	1,423.69	1,398.29
4	1,395.45	1,442.53	1,407.61

Bold = best-fitting model

Table 2

Class comparisons for continuous variables: T score means (SDs).

Domain of variable	Variable	Class 1: Sensory Intolerant (n = 150)	Class 2: Sensory Tolerant (n = 384)	t(df = 532)	Effect size for class differences: Cohen's d	Controlling for general psychopathology: ANCOVA F(1, 529)
OC symptoms						
	Checking	54.4 (10.1)	48.3 (9.4)	6.66***	0.64	10.61***
	Hoarding	54.0 (9.6)	48.4 (9.7)	6.00***	0.58	6.64*
	Neutralizing	54.2 (10.1)	48.3 (9.5)	6.36***	0.61	8.25**
	Obsessing	55.5 (9.6)	47.9 (9.3)	8.44***	0.81	26.62***
	Ordering	54.2 (9.5)	48.4 (9.7)	6.25***	0.60	14.06***
	Washing	55.3 (9.6)	47.9 (9.4)	8.12***	0.78	26.82***
OC-related phenomena						
	Incompleteness	54.4 (9.4)	48.3 (9.7)	6.67***	0.63	4.62
	Disgust – Core disgust	51.0 (9.2)	49.6 (10.3)	1.51	0.14	0.33
	Disgust – Animal reminder	51.1 (9.8)	49.6 (10.0)	1.65	0.15	0.81
	Disgust – Contamination related	52.0 (10.1)	49.2 (9.9)	2.96**	0.28	2.14
OC-related dysfunctional beliefs						
	Importance and control of thoughts	53.1 (10.1)	48.8 (9.7)	4.57***	0.44	3.19
	Perfectionism and intolerance of uncertainty	52.9 (9.1)	48.9 (10.1)	4.27***	0.41	1.16
	Inflated responsibility and overestimation of threat	53.3 (9.3)	48.7 (10.0)	4.88***	0.47	1.64
General psychopathology						
	Harm avoidance	54.3 (9.5)	48.3 (9.7)	6.39***	0.59	--
	Depression	53.3 (10.2)	48.7 (9.6)	4.93***	0.47	--
	Negative emotionality	53.7 (9.9)	48.6 (9.7)	5.47***	0.52	--

*
  p < .01,

**
  p < .005,

***
$p < .001.$

ANCOVA = analysis of covariance; OC = obsessive-compulsive.