**Anxiety Sensitivity and Disgust Sensitivity Predict**

**Blood-Injection-Injury Fears in Individuals with Dental Anxiety**

Jedidiah Siev1, Rachel H. Sinex1, Samantha D. Sorid2, & Evelyn Behar3

1 Swarthmore College

Department of Psychology

500 College Avenue

Swarthmore, PA 19081

USA

2 College of William & Mary

Department of Psychological Sciences

540 Landrum Drive

Williamsburg, VA 23185

USA

3 City University of New York – Hunter College

Department of Psychology

695 Park Avenue

HN 611

New York, NY 10065

USA

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**Abstract**

Background: Anxiety sensitivity (AS) and disgust sensitivity (DS) are transdiagnostic vulnerability factors for anxiety. Both correlate with blood-injection-injury (BII) phobia symptoms in several studies; however, there is ambiguity about their relative contributions, and studies investigating this have relied on unselected samples. Furthermore, although DS reliably predicts BII in studies that do not account for AS, this may be limited to domain-specific DS rather than DS more broadly.

Aims: The aims of this study were to examine AS and DS as separate and simultaneous predictors of BII fears in a sample with a wide range of BII symptoms, and with attention to the specificity of DS to BII-relevant domains.

Method: 53 participants who scored above a clinical threshold on a validated measure of dental anxiety and who represented a wide range of BII severity completed measures of AS, DS, and BII symptoms.

Results: AS and DS were moderately-to-strongly correlated with BII severity (*r*s = .40 and .47, *p*s = .004 and < .001), and both independently predicted BII severity when entered as simultaneous predictors (βs = .32 and .35, *p*s = .045 and .015). Furthermore, after omitting DS about injections and blood draws, domain-general DS was still moderately correlated with BII severity (*r* = .33, *p* = .017). However, domain-general DS did not significantly predict BII severity after accounting for AS (β = .20, *p* = .164).

Conclusions: AS and DS both predict BII symptoms, and prospective research is warranted to examine them as potential vulnerability factors.

Keywords: blood-injection-injury phobia; anxiety sensitivity; disgust sensitivity; dental anxiety

**Introduction**

Blood-injection-injury phobia (BII) affects approximately 4% of the U.S. population (Stinson et al., 2007). BII is characterized by marked and persistent fear of stimuli related to blood, injuries, injections, and mutilation (Ayala et al., 2010). Although dental phobia is considered a subtype of BII (*DSM-5*; American Psychiatric Association, 2013), considerable debate exists regarding this classification. On one hand, some studies find that there is a modest relationship between these constructs (De Jongh et al., 1998), that only 13% of dental phobics endorse a history of BII symptoms (e.g., dizziness, fainting) during dental treatment (van Houtem et al., 2014), that only 16% of dentally anxious individuals are also classified as BII fearful (Locker et al., 1997), and that fewer than 20% of BII phobics report strong dental fears (Öst, 1992). On the other hand, some studies show that individuals with dental anxiety (compared to those without dental anxiety) endorse greater BII fears (Vika et al., 2008), that dental anxiety and BII load on the same factor (Fredrikson et al., 1996; De Jongh et al., 2011), and that 57% of treatment-seeking dental phobics are also BII phobic (De Jongh et al., 1998). Despite the prevalence of dental fears and BII fears, research on their overlap remains limited, particularly in samples with dental anxiety. Moreover, although past studies have examined a range of transdiagnostic vulnerability factors for BII fears, including anxiety sensitivity (AS) and disgust sensitivity (DS), few studies simultaneously considered multiple factors, especially in samples where BII is elevated and there is a broad range of BII symptoms.

AS is the fear of arousal-related sensations due to the belief that such sensations will lead to adverse physical, cognitive, or social consequences (Olthuis et al., 2015; Reiss et al., 1986; Taylor et al., 2007). Several studies have reported a small-to-moderate positive relationship between AS and BII symptoms (e.g., Cisler et al., 2008; Winder et al., 2021), with a meta-analysis likewise finding a positive mean correlation between these constructs (⍴ = .36; Naragon-Gainey, 2010). Fewer studies have explored the relationship between AS and BII in dental anxiety. One study by Kılıç et al. (2014) found that AS predicted BII severity, but not dental phobia severity, in dentally anxious individuals.[[1]](#footnote-1) However, their sample consisted of participants scoring higher than 15 on the Modified Dental Anxiety Scale (MDAS) as opposed to the suggested cutoff score of 18, which yields appreciably greater specificity (78.68% versus 89.30%). In addition, Kılıç et al. did not account for other theoretically relevant variables such as DS in examining the relationship between AS and BII.

DS is the propensity to experience disgust in response to unpleasant stimuli (de Jong & Merckelbach, 1998; Haidt et al., 1994). Disgust can occur in response to a broad range of stimuli, and its occurrence in reaction to fear stimuli likely reflects concerns about contamination or disease (e.g., Davey, 2011; Matchett & Davey, 1991) as is evidenced by its association with avoidance of disgust-inducing stimuli (Woody & Tolin, 2002). Overall, the role of disgust in the etiology and maintenance of specific phobias is a matter of some debate. Matchett and Davey (1991) found that DS was correlated with fear of animals that do not attack humans but are nonetheless feared by individuals (e.g., cockroaches, rats), but not correlated with fear of animals that are perceived as likely to attack humans (e.g., tigers, sharks), leading them to suggest that DS is a vulnerability factor for the development of phobias. Furthermore, Davey (1991) reasoned that some fears may be motivated by avoidance of disease rather than defense from danger.

In examining the relationship between BII fears and disgust, studies have consistently found strong correlations between the two constructs (e.g., *r* = .55, Bianchi & Carter, 2012; *r* = .68, Sawchuk et al., 2000). Additionally, there is evidence that certain domains of disgust may be more strongly associated with BII fears than others. Three studies have examined this issue by comparing BII phobics and spider phobics, with all three studies finding that BII phobics evidence equal (Bianchi & Carter, 2012) or greater (Sawchuk et al., 2000; Tolin et al., 1997) DS compared to spider phobics and/or non-phobics. Taken together, the results of these studies suggest evidence of disgust domain specificity among BII phobics. On one DS measure, Sawchuk et al. (2000) found that compared to spider phobics, BII phobics were specifically elevated in DS with regard to injections and mutilation/death; Tolin et al. (1997) found that BII phobics were specifically elevated in DS regarding body envelope violations and death; and Bianchi and Carter (2012) found that BII phobics evidenced greater DS with regard to injections, blood draws, and mutilation (compared to animals, rotting foods, and odors). Similarly, even in an unselected undergraduate sample, de Jong and Merckelbach (1998) found that the relationship between DS and BII fears was specific to disgust regarding body envelope violations. Thus, in comparison to other fears, BII fears may be uniquely characterized by sensitivity to disgust regarding blood, injections, injury, and violations to the body envelope.

Although the aforementioned studies indicate that at least some types of AS and DS correlate with BII symptoms, their relative contributions remain ambiguous. Cisler et al. (2008) found that both AS and DS independently predicted BII fears; however, although the interaction of AS and DS predicted contamination fears, it did not predict BII fears. Winder et al. (2021) found that DS predicted BII fears after controlling for AS, but AS no longer predicted BII after controlling for DS. This finding not only supports the likely prominence of disgust in BII fears, but it also may provide counterevidence for the centrality of AS in BII. Critically, both studies used unselected non-clinical samples. Furthermore, although DS reliably predicts BII in studies that do not account for AS, this may be limited to domain-specific DS (e.g., Bianchi & Carter, 2012; de Jong & Merckelbach, 1998) rather than DS more broadly.

In the current study, we examined AS and DS as separate and simultaneous predictors of BII symptoms in a sample of participants who scored above a clinical threshold on a validated measure of dental anxiety, and who represented a wide range of BII severity. Considering that DS about injections and blood draws is similar to symptoms of BII, we tested both total DS (including DS about injections and blood draws) as well as DS excluding domain-specific DS about injections and blood draws.

**Method**

**Participants**

 Participants were 53 individuals who scored above a clinical threshold on a validated self-report measure of dental anxiety and participated in a study of attentional processes in dental anxiety (Siev et al., 2020; Stevens et al., 2021). Exclusion criteria included presence of a psychotic or bipolar disorder, substance abuse or dependence, suicidality or homicidality, as well as evidence of intellectual disability, dementia, brain damage, or other cognitive impairment. Participants were required to be between the ages of 18 and 65 years old, and the mean age was 39.96 (*SD* = 14.89). Forty-two (79.2%) participants were women and 11 (20.8%) men. Racially, 31 (58.5%) were White, 11 (20.8%) Black or African-American, 10 (18.9%) Asian or Asian-American, and 1 (1.9%) multiracial. Forty-three (81.1%) identified as non-Hispanic, and 10 (18.9%) as Hispanic.

**Measures**

**Modified Dental Anxiety Scale (MDAS)**. Participants were screened using the Modified Dental Anxiety Scale (MDAS; Humphris et al., 1995), a 5-item self-report measure of dental anxiety. Each item is scored from 1 (*not anxious*) to 5 (*extremely anxious*), resulting in a total score ranging from 5 to 25. The MDAS demonstrates strong psychometric properties, including reliability and validity (Humphris et al., 1995; Humphris et al., 2000). In the present study, participants were required to meet the clinical cutoff score of 19, which maximizes sensitivity and specificity in detecting cases and non-cases of dental phobia (Humphris et al., 1995; King & Humphris, 2010). Because all participants scored between 19 and 24 on the MDAS, we did not examine internal consistency in this sample (see Fife et al., 2012).

**Injection Phobia Scale - Anxiety (IPS-Anx).**Blood-injection-injury phobia symptoms were measured with the Injection Phobia Scale - Anxiety (IPS-Anx; Öst et al., 1992), which consists of 18 items that assess participants’ anxiety levels in response to different contexts of injections and blood draws. All items are scored on a scale from 0 (*no anxiety*) to 4 (*maximum anxiety*). Example IPS-Anx items include “Giving a blood sample by having a finger pricked,” “Having a shot in the upper arm,” and “Having one’s ear pierced.” The IPS-Anx has excellent reliability and validity in prior research (α = .93 to .96; Olatunji et al., 2010), and demonstrated excellent internal consistency in the current study (α = .95).

**Anxiety Sensitivity Index-3 (ASI-3)**. The Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007) is an 18-item self-report measure of anxiety sensitivity that assesses an individual’s beliefs regarding the consequences of arousal and anxiety symptoms. Participants rate each item from 0 (*very little*) to 4 (*very much*). The ASI-3 yields a total score, as well as subscales for physical concerns (e.g., “It scares me when my heart beats rapidly”), cognitive concerns (e.g., “When my mind goes blank, I worry there is something terribly wrong with me”), and social concerns (e.g., “I worry that other people will notice my anxiety”). In prior research, the ASI-3 has shown sound psychometric properties, including indices of reliability and validity (Taylor et al., 2007). In this study, we used the ASI-3 total score, for which internal consistency was excellent (α = .93).

**Disgust Emotions Scale (DES).** The Disgust Emotions Scale (DES; Olatunji et al., 2007; Walls & Kleinknecht, 1996) is a 30-item self-report measure of disgust sensitivity across five domains: animals (e.g., “A sewer rat”), injections and blood draws (e.g., “Receiving a hypodermic injection in the arm”), mutilation and death (e.g., “Photos of wounded soldiers”), rotting foods (e.g., “A glass of spoiled milk”), and smells (e.g., “The smell of vomit”). Each factor comprises six items. Participants are asked to rank how much disgust or repugnance they would experience if they were exposed to the situation presented in each item from 0 (*no disgust or repugnance at all*) to 4 (*extreme disgust or repugnance*). The DES has demonstrated strong internal consistency (α = .84) and convergent validity (Olatunji et al., 2007) in previous research. In the present study, we used the DES total score (DES-Total). In order to examine the association between BII and domain-general DS, we created a DES total score omitting the injections and blood draws scale, which may be too similar to the measure of BII symptoms. Internal consistency in this study was excellent for both the DES-Total (α = .95) and the abridged version omitting the injections and blood draws scale (DES-NonBII; α = .94).

**Missing Data**. Missing data were imputed for any participant based on their mean scale (IPS-Anx) or subscale (ASI-3, DES) score provided they were missing fewer than 20% of the items on that scale or subscale. As a result, scores could be calculated for participants missing up to 3 out of 18 IPS-Anx items, and no more than 1 out of 6 items on any ASI-3 or DES subscale. In fact, IPS-Anx scores were imputed for one participant with two missing items and eight participants with one missing item. ASI-3 scores were imputed for one participant with two missing items (on different subscales) and eight participants with one missing item. DES scores were imputed for one participant with two missing items (on different subscales) and seven participants with one missing item.

**Ethical Statement**. This research was conducted in accordance with the Declaration of Helsinki, and with the approvals of the Institutional Review Boards at Nova Southeastern University (protocol 12041203Exp.) and the University of Illinois at Chicago (protocol 2014-0005). All participants provided informed consent.

**Results**

Participants’ IPS-Anx scores were elevated and also indicated a broad range of BII symptoms, *M* = 29.51, *SD* = 17.08. As a benchmark, IPS-Anx scores in normative data were *M* = 44.84, *SD* = 8.86 for BII phobics, and *M* = 9.20, *SD* = 11.40 for nonphobic controls (Olatunji et al., 2010). For descriptive data and intercorrelations among study measures, see Table 1.

<Insert Table 1 approximately here>

BII severity correlated with ASI-3, *r* = .40, *p* = .004, and with DES-Total, *r* = .47, *p* < .001. We regressed IPS-Anx on ASI-3 (centered), DES-Total (centered), and their interaction. Tests of heteroscedasticity, multicollinearity, and the distribution of residuals indicated appropriate normality and sufficient independence of variables. The model accounted for 28% of the variance in BII severity, *F* (3, 45) = 5.86, *p* = .002. Both ASI-3 (β = .32, *t* = 2.07, *p* = .045) and DES-Total (β = .35, *t* = 2.54, *p* = .015) independently predicted IPS-Anx when controlling for the other variable. Their interaction was not significant, β = -.13, *t* = -0.89, *p* = .379.

Disgust sensitivity about injections and blood draws may simply be a proxy measure of BII fear, as evidenced by the strong correlation between the DES injections and blood draws subscale (DES-Inj) and IPS-Anx (*r* = .75, *p* < .001). We therefore omitted DES-Inj and created a composite score of non-BII-related DS using the DES mutilation and death, animals, rotting foods, and smells subscales (DES-NonBII). BII severity correlated with this composite, *r* = .33, *p* = .017. We regressed IPS-Anx on ASI-3 (centered), DES-NonBII (centered), and their interaction. Again, tests of heteroscedasticity, multicollinearity, and the distribution of residuals were not concerning. Together, the predictors accounted for 22% of the variance in BII severity, *F* (3, 45) = 4.23, *p* = .010. Only ASI-3 independently predicted BII symptoms, β = .40, *t* = 2.60, *p* = .013. Neither DES-NonBII (β = .20, *t* = 1.42, *p* = .164) nor the interaction between ASI-3 and DES-NonBII (β = -.17, *t* = -1.18, *p* = .245) were significant.

**Discussion**

In a clinical sample of individuals with dental anxiety and elevated BII fears, AS and DS both independently predicted BII symptoms, but did not interact with each other in so doing. Moreover, in contrast with some studies that implicate only domain-specific DS in BII phobia, our findings implicate domain-general DS (viz. DES total score excluding the injections and blood draws scale) as well, although not after accounting for AS. Two previous studies of non-clinical samples have reported similar analyses, and our results are consistent with one (Cisler et al., 2008) and stand in contrast to the other (Winder et al., 2021). Specifically, whereas Winder and colleagues found that only DS – but not AS – predicted BII symptoms when entered as simultaneous predictors, in the present sample, both AS and DS independently predicted BII symptoms. In fact, only AS predicted BII symptoms when considering only non-BII-related DS, although this may be an issue of power, considering that the effect was in the same direction. However, Winder and colleagues report a negligible and nonsignificant partial correlation of only .05 between BII fear and AS when covarying DS, whereas in the present study AS was a strong predictor of BII symptoms when covarying DS.

In considering these discrepancies, there are features of the present sample that make it better suited to address these research questions. All participants in the present study scored above a clinical cut-off on a validated measure of dental anxiety, which is related to BII phobia. As a result, they scored considerably higher as a group on BII symptoms compared to non-clinical samples (e.g., Olatunji et al., 2010). Moreover, there was a wide range of BII scores. As a result, this sample is well-suited to examine correlates of BII symptoms because the symptom elevations are clinically meaningful for many participants, and not limited by restricted range, as might be the case in both non-clinical as well as BII phobic samples (e.g., Stade & Ruscio, in press).

Although AS and DS are generally conceptualized as vulnerability factors for psychopathology, it is important to note that the cross-sectional nature of the present data cannot speak to temporal relationships and thus cannot rule out the possibility that BII symptoms lead to increased AS or DS. This is arguably more likely with DS, where it is conceivable that one develops a disgust response to a phobic stimulus one finds aversive; in contrast, AS is not specific to the phobic stimulus and is therefore unlikely to develop as a response to the feared stimulus. However, it is unlikely that non-domain-specific DS would be an epiphenomenon of BII symptoms, and therefore seems doubtful that DS is simply the result of BII symptoms. However, given recent evidence suggesting that conditioned disgust generalizes to other stimuli (Berg et al., 2021), it is possible that domain-specific DS may generalize to other domains of DS as well.

Our results have implications for future research. First, given that AS and DS accounted for 28% of the variance in BII severity, it is clear that other variables are important in explaining and understanding BII fears among individuals with dental anxiety. Various transdiagnostic constructs have been examined in dental fears, including pain sensitivity (Witcraft et al., 2021) and learning history (Berggren et al., 1997; Davey, 1989; de Jongh et al., 1995); however, the role that such constructs play in BII fears has been less closely explored and warrants further investigation. Second, the role of DS in BII fears has implications for treatment, given evidence indicating that disgust may not respond to extinction-based learning but may instead respond better to counterconditioning (Engelhard et al., 2014). Future investigators may wish to explore the degree to which dental phobics’ BII fears respond to exposure-based treatments versus counterconditioning-based treatments as a function of AS and DS severity.

We acknowledge several limitations to the present research. Although the composition of our sample is a strength in several ways, 53 participants was underpowered to detect small effects or test interactions. It is possible that in a larger sample, domain general DS predicts BII symptoms even after controlling for AS, whereas in this study the effect (β = .20) did not reach significance. In addition, it is well established that gender is related to study variables (e.g., Norr et al., 2015; Oaten et al., 2009), but with women composing the large majority of participants in our sample, we were not able to examine possible gender effects. Finally, cross-sectional data such as these do not permit firm conclusions about causality, temporality, or theoretically-driven judgments about factors assumed to confer risk or vulnerability.

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**Table 1.**

*Means, standard deviations, and bivariate correlations among study variables (N = 53)*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | *M* | *SD* |  | IPS-Anx | ASI-3  | DES-Total | DES-Inj | DES-NonBII |
| IPS-Anx | 29.51 | 17.08 |  | - |   |   |  |  |
| ASI-3 | 22.11 | 16.96 |  |  .40\*\* |  -  |   |  |  |
| DES-Total | 59.82 | 23.94 |  |  .47\*\*\* | .42\*\* | - |  |  |
| DES-Inj | 9.86 | 6.15 |  | .75\*\*\* | .36\*\* | .72\*\*\* | - |  |
|  DES-NonBII | 49.96 | 19.96 |  | .33\* | .39\*\* | .98\*\*\* | .56\*\*\* | - |

*Note.* IPS-Anx = Injection Phobia Scale-Anxiety (possible range: 0-72); ASI-3 = Anxiety Sensitivity Index-3 (possible range: 0-72); DES-Total = Disgust Emotion Scale - Total Score (possible range: 0-120); DES-Inj = Disgust Emotion Scale - Injections and Blood Draws Scale (possible range: 0-24); DES-NonBII = Disgust Emotion Scale - Total Score excluding the Injections and Blood Draws Scale; possible range: 0-96).

\**p* < .05; \*\**p* < .01; \*\*\**p* < .001

1. Note that there is a mistake in the abstract, which incorrectly states the opposite (S. Ak, personal communication, March 14, 2021). [↑](#footnote-ref-1)