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Exploring Human Freeze Responses to a Threat Stressor

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Abstract

Despite the fundamental nature of tonic immobility in anxiety responses, surprisingly little empirical research has focused on the "freeze" response in humans. The present report evaluated frequency and predictors of a freeze response in the context of a biological challenge. A nonclinical sample (N = 404) underwent a 20-sec inhalation of 20% CO_2/balance O_2. Perceptions of immobility in the context of the challenge were reported in 13% of the sample, compared to 20% reporting a significant desire to flee. Subjective anxiety and panic during the challenge were associated with the freeze response, as were a number of anxiety symptom dimensions.

Keywords

anxiety; freeze; panic; carbon-dioxide

1.1 Background

The phrase "fight or flight" was coined by Cannon (1927, 1929) in the 1920s to describe key behaviors that occur in the context of perceived threat. This term has not only been influential in later conceptual and empirical work on anxiety and its disorders, but the phrase also has become relatively well-known in popular culture. In the context of anxiety research, the alarm or fear response described by Barlow (2002) reflects an interaction between learning and innate, biological systems designed to help animals adapt to threat. The more contemporary notion of a true or false alarm still contains the two primary features of Cannon's original expression, though the ordering of effects is probably best reversed; flight is the overwhelming action tendency subsequent to an alarm whereas relatively fewer instances of fight responses result

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from threat (Lang, 1994). Part of Barlow's (2002) description of an adaptive alarm model suggests that a freeze response may occur in some threatening situations. Specifically, freezing -- or tonic immobility -- may overwhelm other competing action tendencies. For example, when fleeing or aggressive responses are likely to be ineffective, a freeze response may take place.

Similar to the flight/fight response, a freeze response is believed to have adaptive value. In the context of predatory attack, some animals will freeze or "play dead." This response, often referred to as tonic immobility (Gallup, 1977), includes motor and vocal inhibition with an abrupt initiation and cessation. Ethologists have documented non-volitional freeze responses in several animal species (Arduino & Gould, 1984; Kalin, Shelton, Rickman, & Davidson, 1998). Freezing in the context of an attack seems counterintuitive. However, tonic immobility may be the best option when the animal perceives little immediate chance of escaping or winning a fight (Arduino & Gould, 1984; Korte, Koolhaas, Wingfield, & McEwen, 2005). For example, tonic immobility may be useful when additional attacks are provoked by movement or when immobility may increase the chance of escaping, such as when a predator believes its prey to be dead and releases it.

Despite evidence suggesting that tonic immobility may be a key facet of alarm reactions, freezing has received relatively little scientific attention in humans. One exception is the PTSD/rape literature wherein several studies have described a rape-induced paralysis that appears to share many of the features of tonic immobility (Galliano, Noble, Travis & Puechl, 1993; Mezey & Taylor, 1998; Scaer, 2001; Suarez & Gallup, 1977). This literature suggests that a relatively high percentage of rape victims feel paralyzed and unable to act despite no loss of consciousness during the assault (Burgess & Holmstrom, 1976; Heidt, Marx, & Forsyth, 2005). Since fear, predation, contact, and restraint are common to both rape and the induction of tonic immobility in animals, it has been concluded that these phenomena are essentially isomorphic (Suarez & Gallup, 1979).

Given the general paucity of research on human tendencies to freeze in the context of threat, as well as the general reliance on retrospective reports in the existed literature, we sought to expand knowledge in this area by providing a laboratory-based exploration of the tendency to freeze in the context of threat. Laboratory-based biological challenges offer controlled methods for understanding biological and psychological factors that influence the generation of fear (McNally, 1994; Schmidt et al., 2000; Zvolensky & Eifert, 2001). The primary aim of the present study was to determine whether laboratory-based threat stressors can provoke freeze responses and, if so, to evaluate the frequency and predictors of these responses. Because a CO_2 challenge has been found to be a potent stressor (Zvolensky & Eifert, 2001), and a freeze tendency is believed to be a central response to threat, we hypothesized that some participants would report these reactions, although we believed these might be less frequent than flight responses. Although the challenge did not involve physical attack, participants are somewhat physically confined by a breathing apparatus attached around the head, which may simulate some of the parameters relevant to freeze in the context of predatory grasp. The second aim of the research was to determine whether anxiety-related traits or predisposing factors might predict a freeze response. There is little prior work to guide hypotheses but it was generally expected that higher levels of anxiety-relevant traits would be associated with a freeze response. Since these responses have also been documented among some PTSD victims, we expected that PTSD symptoms might be particularly predictive of freeze reactions.

1.2 Method

1.2.1 Participants

Participants took part in a longitudinal, primary prevention study (see Schmidt et al., in press for additional details). Exclusion criteria for this study include age restrictions (i.e., age range = 14–25) and the presence of any current Axis I diagnosis. Participants were recruited from the Columbus, OH metropolitan area school system (n = 46), the Ohio State University (n = 263), and the Columbus, OH community (n = 96). The sample was relatively young (age M = 19.3, SD = 3.9) with the majority being female (61%). The sample was also primarily white (74%) with 10% African-American, 9% Asian-American, 2% Hispanic, and 3% Other. Completion of college was the most frequently endorsed level of parental education with 30% of mothers and 29% of fathers finishing college.

1.2.2 Assessments

1.2.2.1 Interview Measures

1.2.2.1.1: Psychiatric diagnoses were made using structured diagnostic interviews (SCID-IP; First, Spitzer, Gibbon, & Williams, 1994). Interviews were conducted by advanced graduate students in clinical psychology who had received extensive training in SCID administration and scoring. A consensus method of diagnosis was used at weekly staff meetings where positive diagnostic findings were reviewed. The typical inter-rater reliability evaluation was not conducted due to participant selection criteria at baseline (i.e., absence of Axis I pathology).

1.2.2.1.2 Family History of Anxiety: Family history of anxiety disorders was assessed using a semi-structured interview that was embedded within the SCID. Similar methods of assessing family history have been used in prior studies of anxiety pathology (Plehn & Peterson, 2002; Yehuda, Halligan, & Bierer, 2001), and it appears to be a valid and reliable method (Andreasen et al., 1977). Following the anxiety disorders section of the SCID, the interviewer asked participants whether they were aware of any first degree relatives that had been diagnosed and treated for anxiety disorders or were likely to have suffered from these conditions despite a lack of treatment. A score of very likely, likely, or unlikely was assigned for mother, father and any siblings. In the present report, participants received a score of 1 for any “very likely” designation. The range of scores include (0 (negative across all family members) to 3 (positive for mother, father, and at least one sibling).

1.2.2.1.3 Panic Disorder Severity Scale (PDSS): The PDSS is a semi-structured interview rating scale for panic disorder (Shear et al., 1997). In the present report, only the PDSS item indexing spontaneous panic frequency during the past month was utilized since the majority of items were not appropriate for a nonclinical sample.

1.2.2.2 Self-Report Measures

1.2.2.2.1 Acute Panic Inventory (API): The API is a 17-item inventory for assessing symptoms of arousal associated with panic attacks (Liebowitz, Gorman, Fyer, Dillon, & Klein, 1984). The API has been used extensively in panic provocation studies (Fyer et al., 1987; Schmidt, Eggleston, Trakowski, & Smith, 2005). Participants rate the severity of each symptom from 0 (absent) to 3 (severe). The API includes a SUDS rating of self-reported anxiety (0 - No Anxiety, 100 - Extreme Anxiety). In addition to the standard API items, several additional items were added including one that assessed freeze (e.g., During the procedure (or resting period), I felt that I could not move) and another that assessed flight (e.g., During the procedure (or resting period), I felt that I wanted to flee). Each of these items was rated on a 0 (Not at all) to 100 (Extreme) scale.

1.2.2.2.2 Anxiety Sensitivity Index (ASI): The ASI (Reiss et al., 1986) is a 16 item self-report measure of the fear of bodily sensations associated with arousal (Schmidt & Joiner, 2002; Zinbarg, Barlow, & Brown, 1997; Zvolensky, McNeil, Porter, & Stewart, 2001).

1.2.2.2.3 Impact of Events Scale – Revised (IES-R): The IES-R is update of the popular IES that is used to measure intrusion and avoidance behaviors resulting from traumatic events (Weiss & Marmar, 1997).

1.2.2.2.4 Panic Attack: The API was used to index panic responding. In accordance with DSM-IV panic attack criteria describing the discrete and abrupt onset of fear and symptoms, the presence of a panic attack was determined by a composite index including: (a) reporting a 40 point increase in SUDS from baseline to challenge indicating a significant increase in anxiety, and (b) reporting four or more DSM symptoms as moderate to severe during the challenge. This method as well as similar methods of operationalizing panic response has been utilized in other reports (Schmidt, Eggleston, Trakowski, & Smith, in press; Schmidt, Miller, Lerew, Woolaway-Bickel, & Fitzpatrick, 2002)

1.2.2.2.5 Penn State Worry Questionnaire (PSWQ): The PSWQ is a self-report measure of pathological worry (Brown et al., 1992; Gillis et al., 1995; Meyer et al., 1990).

1.2.2.2.6 Social Interaction Anxiety Scale (SIAS): The SIAS assesses fears of social interaction and is well validated with good psychometric properties (Mattick & Clark, 1998).

1.2.2.2.7 Trait Anxiety (STAI): The STAI assesses state and trait anxiety (Knight, Waal-Manning, & Spears, 1983). Only the trait scale, which measures general levels of anxiety, was utilized in the present study. Raw scores were used for analyses by summing responses to this scale (after reverse scoring negatively-worded items).

1.2.2.3 Challenge

1.2.2.3.1 20% CO_2 Challenge: A 20% CO_2-enriched (balance O_2) biological challenge provided an index of fear responding to a novel stimulus. To control for different expectancies regarding the consequences of breathing CO_2-enriched air, all participants were informed of several possible symptomatic consequences of breathing CO_2-enriched air including: breathlessness, dizziness, chest pain, and tachycardia. Participants were not informed regarding the onset, timing, dose, or offset of the inhalation of CO_2. Participants underwent a 20-s gas inhalation (20% CO_2, 80% O_2) administered through a continuous positive air pressure Downs C-Pap Mask with nose clip and head strap. Attached to one free port of a manually controlled 3-Way Stop Cock valve (Hans Rudolph, Inc.) was a 30-L meteorological balloon, which was inflated with the CO_2 mixture. Participants breathed the CO_2 gas directly from the balloon reservoir to minimize detection from pressurized CO_2 to nonpressurized room air. The C-Pap mask was connected to a free 22-mm port of the Stop Cock Valve via 1.8-m of aerosol tubing and the remaining port was left unattached and fed room air. A remote device was used to control of the 3-Way Stop Cock valve for unobtrusive switching between CO_2-enriched air and room air.

1.2.3 Procedure

These data are derived from a primary prevention study that included both an experimental and a prospective design. "At risk" participants (i.e., those with high anxiety sensitivity) with no current or recent psychiatric illness were randomly assigned to a risk reduction or control condition and followed for approximately 24 months (see Schmidt et al., (2007) for more details). The experimental manipulation was modeled after educational and behavioral procedures commonly used with patients with anxiety disorders. This presentation describes the nature of stress and the effects of stress on the body. The goal of the presentation is to emphasize the benign nature of stress in regard to its immediate effects on the body. This process is explained along with a description of behavioral exercises that are designed to correct interoceptive conditioning (Schmidt & Trakowski, 2004). Approximately half of the participants were randomized to a health and nutrition condition designed to control for any effects of general education and time spent with the experimenter. These participants received a computer-based presentation of equal length. In the present report, we statistically control for experimental condition in all relevant analyses.

Participants initially completed the SCID and, if eligible, the remaining interviews and self-report measures. Eligible participants were then randomly assigned to one of two conditions that are not relevant to the present report (see Schmidt et al., 2007, for details). As an additional check that the pattern of findings was not accounted for by the experimental manipulation, all relevant analyses were re-run after excluding participants assigned to the treatment condition. These analyses revealed the same pattern of findings. At this point, participants were led to a comfortable recliner in a dimly lit sound attenuated chamber and fitted with the CO_2 apparatus (e.g., mask). Participants completed an API following a 5-minute adaptation period. After approximately 3 minutes, participants received a 20-s inhalation of CO_2-enriched air. Immediately following the inhalation, participants returned to breathing normal room air and completed another API. Community and high school participants received $25 as compensation for the baseline assessment whereas college students received course credit.

1.3 Results

1.3.1 Prevalence of a Freeze Response to the Challenge

To evaluate the prevalence of a freeze response to the challenge, we examined the frequency distribution of the freeze item added to the API (see Table 1). Prior to the challenge, the majority of participants (84%) rated this item between 0 and 10 and only 5% gave a rating of 40 or greater. For comparative purposes, the baseline ratings on the desire to flee item indicated a comparable percentage of individuals endorsing both little or no desire to flee (82% scoring 10 or less) or moderate desire to flee (6% scoring 40 or greater).

Following the challenge, a frequency distribution indicated that 69% reported little or no feelings of immobility (10 or less), 18% endorsed mild feelings of immobility (11–39), and 13% reported modest or greater feelings of immobility (40 or greater). The comparison item for fleeing indicated that 61% reported little or no desire to flee (10 or less), 19% endorsed a mild desire to flee (11–39), and 20% reported a modest or greater desire to flee (40 or greater). A repeated measures MANOVA evaluating changes in freeze and flee pre-post challenge indicated significant increases as a result of undergoing the challenge ($F(1,349) = 82.97$, $p < .01$, Partial $eta^2 = .19$), significant differences between variables such that participants tended to report a greater desire to flee than to freeze ($F(1,349) = 14.39$, $p < .01$, Partial $eta^2 = .04$) as well as a significant time × variable interaction ($F(1,349) = 7.69$, $p < .01$, Partial $eta^2 = .02$). As expected, tests of the simple effects of the interaction revealed that while both variables increased significantly from baseline to challenge, the flee variable increased to a greater extent (Freeze: $F(1, 349) = 60.60$, $p < .01$, partial $eta^2 = .15$; Flee: $F(1, 398) = 104.18$, $p < .01$, partial $eta^2 = .21$). Consistent with hypothesis, these analyses suggest that flight responses are somewhat more common than freeze responses but that a sizable percentage of individuals endorsed significant immobility feelings during the stressor.

1.3.2 Descriptive Data and Zero-Order Relations among Theoretically-Relevant Variables

Table 1 provides correlations, means and standard deviations of the relevant predictor and criterion variables. Trait anxiety was significantly related to desire to flee as well as feeling immobile. Anxiety sensitivity also exhibited significant and somewhat stronger associations with these ratings (all *p*s < .01). Consistent with expectation, subjective anxiety was also strongly associated with flight and freeze ratings. Subjective anxiety ratings (SUDS) were highly associated with desire to flee ($r = .83$, $p < .01$) as well as perceived immobility ($r = .68$, $p < .01$). The flee and immobility items were also strongly associated ($r = .74$, $p < .01$). The family history of anxiety, history of panic attacks, and trauma-relevant variables, on the other hand, did not show significant associations with the flee or immobility variables.

1.3.3 Association between Freeze and Panic Symptoms

Based on the criteria utilized, approximately 6% (24/404) of the sample met criteria for panic challenge. Logistic regression analyses controlling for experimental condition as well as during the CO_2 baseline levels of freeze indicated that panic was significantly associated with the freeze variable (*Exp* $\beta = 1.06$, 95% CI = 1.04–1.08; *Wald* = 28.36, $p < .001$). Similar analyses indicated that panic was also associated with the flight variable (*Exp* $\beta = 1.09$, 95% CI = 1.06–1.12; *Wald* = 36.3, $p < .001$). When both freeze and flight variables were simultaneously entered, only flight remained as a significant predictor (*Exp* $\beta = 1.09$, 95% CI = 1.05–1.13; *Wald* = 24.1, $p < .001$). Correlations between the freeze item and other API items were examined to provide a more detailed analysis of the association between freeze and other symptoms. These analyses indicated that 9 API items showed substantial correlations with the freeze item (*r* range = .45 – .60) compared to the remaining items, which showed a more modest association in the range of .20–.35. The majority of items that were more highly associated with freeze included those focused on cognitive symptoms of anxiety (e.g., confusion, unreality, detached, concentration, inner shakiness) as well as fear of losing control.

1.3.4 Predicting “Freeze” Responses

Hierarchical linear regression analyses were performed with each of the primary dependent measures (see Table 2). At level 1 in the model, experimental condition was included as a covariate (entered) to ensure any observed effects were not due to this factor. In addition, the baseline measure of “freeze” was entered to yield a prediction of reactivity. At level 2 in the model, the predictor variable of interest was entered. In this model, any observed effects for variables at level 2 in the model are unique and cannot be attributed to variance with factors in level 1 (Cohen & Cohen, 1983). Consistent with expectation, the pattern of findings suggested that higher levels of anxiety-related traits were associated with increased perceptions of immobility. Interestingly, the IES-R did not significantly predict freeze.

Since trait anxiety was a significant predictor and may represent an overarching vulnerability factor that encompasses elements of the other symptom measures, we conducted follow-up analyses that were similar but also included trait anxiety as a covariate. Thus, we evaluated whether the other psychological risk factors continued to add unique variance to the prediction of freeze. These analyses indicated that the ASI ($\beta = .14$, $t = 3.11$, $p < .01$) and the SIAS ($\beta = .15$, $t = 3.49$, $p < .001$) contributed to the prediction of freeze after controlling for trait anxiety. However, the PSWQ was no longer significantly associated with freeze after accounting for trait anxiety ($\beta = .05$, $t = 1.11$, $p > .10$).

1.3.5 Unique prediction of Freeze

Because highly anxiously individuals may have a response style that leads to a consistent overendorsement of anxiety-related variables, additional analyses were used to ascertain whether freeze response was able to predict fear and panic responses beyond the effects of desire to flee. Hierarchical regression analyses similar to those described above were used. In level 1, baseline fear, baseline freeze, and experimental condition were entered along with desire to flee during the procedure. At level 2, perceptions of immobility during the challenge were entered. As would be expected from the panic analyses reported above, immobility was not predictive of panic response. However, immobility was a significant incremental predictor of subjective anxiety to the challenge ($\beta = .13$, $t = 2.18$, $p = .03$).

1.4 Discussion

Although freeze responses are believed to be fundamental to the well-known fight-flight alarm action tendencies (Barlow, 2002), to our knowledge the current report is the first to empirically document a relationship between tonic immobility and a laboratory-based stressor in humans. This is a novel and potentially meaningful contribution to current theory, given that researchers have long hypothesized that tonic immobility may be a native biological response to extreme stress. Indeed, the current results are highly consistent with this conceptualization, inasmuch as we found that tonic immobility was most often reported by those individuals who also experienced significant fear during the challenge.

There was relatively little endorsement of freeze behavior prior to the challenge, with significant variability in this domain emerging only after the challenge. Specifically, the majority of nonclinical participants reported little or no feelings of immobility, with about 1/5 endorsing mild feelings of immobility, and approximately 13% reporting modest or greater feelings of immobility. Thus, even among nonclinical persons undergoing a 20% CO_2 challenge, there appears to be variability in the experience of freezing. Further inspection of these data indicated that endorsement of a flight response was highly associated with the freeze response. Similarly, panic endorsement was highly associated with perceptions of tonic immobility as would be predicted by models of panic (Barlow, 2002). This suggests that panic and significant desire to flee appear to be fairly closely linked with perceptions of immobility. An interpretational problem arises with the high correlation between freeze and flight because these behaviors are potentially incompatible. One possibility is that the freeze item asked for the experience of immobility but the flight item asked for the wish to flee. It is conceivable that an individual may experience immobility, combined with the wish to flee (but not being able to execute it). Another explanation is that the responses, as per the model of Braca (2004), naturally follow each other. We attempted to dismantle these reactions statistically by evaluating whether perceptions of immobility could uniquely predict panic and fear responses while controlling for endorsement of desire to flee. Findings with regard to anxiety, but not panic, were consistent with the idea that immobility does add something unique to the desire to flee. More sophisticated designs are needed to more clearly delineated these associations. Overall, the pattern of findings is consistent with the view that the freeze response may be an integral part of the overall syndrome of psychological responses to acutely stressful circumstances.

Other findings indicated that theoretically-relevant individual difference factors are also related to perceptions of tonic immobility. However, the predictors did not demonstrate a great deal of specificity (i.e. nearly every anxiety-relevant variable was somewhat related to tonic immobility), which leaves open the possibility that the anxiety variables indexed were all tapping into a more general trait vulnerability. However, additional analyses suggest that after controlling for trait anxiety, social anxiety and anxiety sensitivity possessed some unique predictive relation to tonic immobility. Thus, it may be that these variables possess a unique relation to tonic immobility. However, it is more likely that these are particularly robust indicators of the general tendency to react fearfully to the CO_2 challenge, which, in turn, is related to a freeze response. In any case, that anxiety-related individual differences moderate exhibition of the freeze response is consistent with previous primate studies indicating that high basal cortisol levels, which are related to heightened stress responses - are predictive of freeze responses in the presence of immediate threat (e.g., Kalin et al., 1998).

Some of our data suggested that reports of freeze were more highly associated with certain cognitive symptoms of anxiety (e.g., confusion, unreality, detached, concentration, inner shakiness). This leads to some very interesting speculation regarding whether freeze responses are also manifested cognitively (i.e., the cognitive system, together with the behavioral system, being shut down). There has been some speculation that a form of cognitive paralysis occurs due to immense cognitive demands that occur in the context of life-threatening situations or stressors (Leach, 2005). Unfortunately, there are currently many questions regarding cognitive paralysis, including what cognitive components might be involved in this. A better understanding of freeze in both the cognitive and behavioral domains is highly relevant to better understand extreme reactions during stress.

A number of interpretative caveats should be considered. As with any initial foray, this study possessed a number of limitations that warrant consideration but also provide potential fruitful directions for future research. First, we could not investigate the temporal relations as outlined by Bracha (2004) in terms of freeze-flight-fight-fright in this study. However, there were clear relationships between subjective anxiety and the tendency to want to flee as well as perceptions of tonic immobility, which is consistent with current alarm models that link these variables. A second limitation is that only perceptions of freeze were measured; the study did not include a behavioral demonstration of immobility. Additional work is needed to more carefully establish that behavioral immobility occurs in humans in the context of threats. In addition, it may be important to clarify the relationship between subjective perceptions of immobility and actual behavioral manifestations of immobility. Third, as with all non-experimental designs, causal relations cannot be unambiguously inferred, leaving the results open to a number of alternative interpretations. Forth, the present sample is limited in the sense that it is comprised of a relatively homogenous group of young adults who volunteered to participate in the study as part of a prevention-oriented investigation. Therefore, to rule out the possibility that the present results are somehow related to a self-selection bias among persons with these characteristics, it will be important for researchers to draw from a more diverse population as well as to utilize different recruitment tactics (e.g., random sampling procedures). Fifth, the experimental procedure informed participants that they could expect certain types of symptoms. The process of providing such information is likely to have attenuated fear responding to some degree (Schmidt & Telch, 1994). There is evidence to suggest that unanticipated or unpredictable CO_2-induced sensations are likely to increase fear responding (Zvolensky et al., 2001). On the other hand, IRB restrictions on challenge research and ethical constraints on fear-induction procedures must be balanced with procedural considerations.

Finally, there may be other types of threat stressors or challenges that are more likely to provoke a freeze response. Thus, one could argue that it would be most appropriate to understand the present findings in reference to anxiety focused on bodily sensations and perceived intensity of symptoms but not intense terror/panic. We have attempted to provide a measure of panic responding that suggests that higher levels of anxiety or panic may be more intimately related to freeze responses. However, future work should employ other challenge procedures to evoke greater variability in anxiety and bodily sensations to better understand the relation between freeze and affect intensity. One way to conduct such work would be to sample clinical as well as nonclinical participants.

We based our study hypotheses and analyses on contemporary theories of fear behavior (Barlow, 2002). Building from this work, it would be worthwhile to extend this type of research to a broader array of processes related to fear behavior. For example, researchers could examine various parameters of freeze behavior during the challenge and how such responsivity relates to theoretically-relevant processes such as recovery time, duration of activation, and variability in other specific response components, as well as other cognitive and affective processes known to accompany fearful responses. Such emotional reactivity dimensions may inform researchers of clinically relevant individual variation in affective vulnerability related to freeze responses.

In conclusion, the present investigation addresses the nature of fear behavior in the context of a CO_2 challenge. The present findings indicate that there is meaningful variability in freeze behavior among nonclinical participants and that this variability is related to other theoretically-relevant constructs such as subjective anxiety and panic. By continuing to utilize the integrative framework of emotion theory to understanding the nature of freeze responding, there likely will be new insights into anxiety and its disorders.

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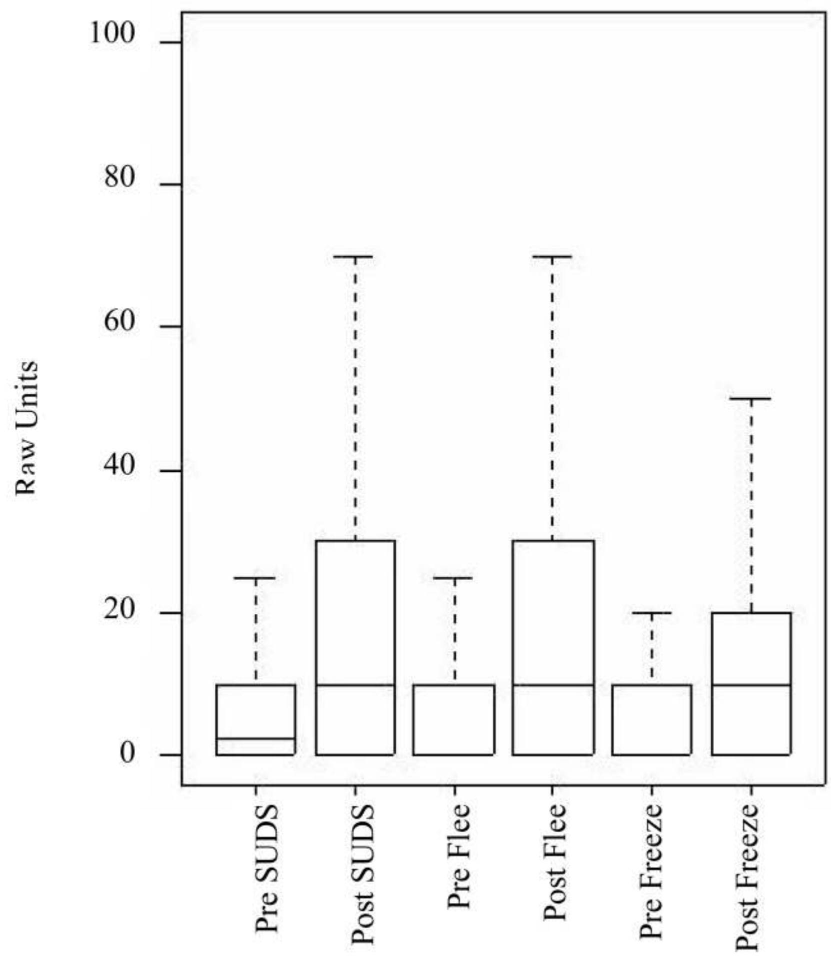

Figure 1.
Distributions (raw unit means and interquartile range) indicating Fearful Responding (SUDS), Desire to Flee, and Perceptions of Immobility in Response to the CO_2 challenge

Table 1

Intercorrelations, Means and Standard Deviations among the Primary Variables of Interest at Baseline Assessment

	1	2	3	4	5	6	7	8	9	10	11	12	M	SD
1. API total	-												13.1	8.5
2. PDSS (PA frequency)	.10 ns	-											.1	.3
3. IES-R	.41	.02 ns	-										5.3	1.9
4. PSWQ	.50	.08 ns	.48	-									43.9	14.4
5. SIAS	.51	.10	.39	.52	-								36.0	11.8
6. STAI	.32	.40	.40	.43	.38	-							44.6	4.5
7. Family History of Anxiety	.18	.07	.17	.22	.19	.06 ns	-						.3	.5
8. API (Pre CO_2; Highest Fear)	.25	−.01 ns	.17	.13	.12	.11	.10 ns	-					7.4	9.5
9. API (Pre CO_2; Desire to Escape)	.23	.01 ns	.01 ns	.14	.17	.09 ns	.04 ns	.56	-				8.2	13.0
10. API (Pre CO_2; Feeling Immobile)	.33	−.02 ns	.15	.14	.24	.12	.10 ns	.51	.58	-			7.2	13.3
11. API (Post CO_2; Highest Fear)	.27	.01 ns	.01	.20	.14	.16	.07 ns	.51	.43	.40	-		18.2	19.8
12. API (Post CO_2; Desire to Escape)	.26	.05 ns	.12	.20	.15	.14	.02 ns	.42	.57	.42	.83	-	17.7	22.2
13. API (Post CO_2; Feeling Immobile)	.36	.04 ns	.16	.19	.29	.22	.06 ns	.42	.47	.62	.67	.74	13.7	19.4

Note. N = range from 380 – 404. All $ps < .05$ except when noted nonsignificant (ns). API = Acute Panic Inventory; PDSS = Panic Disorder Severity Scale (Panic Attack Frequency); IES-R = Impact of Events Scale-Revised; PSWQ= Penn State Worry Questionnaire; SIAS = Social Interaction Anxiety Scale; STAI = Spielberger Trait Anxiety.

Table 2

Anxiety Variables Predicting Perceived Immobility During a 20% CO_2 Challenge

Predicted Variable	Predictors in Set	ΔR^2	*t* for each Predictors	β
Post CO_2 Inhalation API-Freeze				
	Step 1	.39		
	Condition		−.69	−.03
	Baseline-API-Freeze		14.72**	.62
	Step 2a			
	ASI	.02	4.05**	.18
	Step 2b			
	IES-R	.00	1.53	.07
	Step 2c			
	SIAS	.01	3.50**	.15
	Step 2d			
	STAI	.01	3.58**	.15
	Step 2e			
	PSWQ	.01	2.34*	.10
	Step 2f			
	PDSS	.00	1.28	.06

*Note. p<.05,

**p<.01; API-Freeze = the degree to which you felt that you could not move; ASI = Anxiety Sensitivity Inventory; IES-R= Impact of Events Scale-Revised; SIAS= Social Interaction Anxiety Scale; STAI = Spielberger Trait Anxiety; PSWQ= Penn State Worry Questionnaire; PDSS = Panic Disorder Severity Scale (Panic Attack Frequency).