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- Preparation of this manuscript was supported in part by Grant No. R01 MH052232 from the National Institute of Mental Health.
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- Received: September 11, 2002
Accepted: January 23, 2003

Interceptive Assessment and Exposure in Panic Disorder: A Descriptive Study

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Cognitive behavioral treatment (CBT) protocols for panic disorder (PD) typically include some form of interoceptive exposure (IE)—repeated exposure to internal sensations. Despite the widespread clinical use of IE, there is a notable absence of empirical reports about the nature of interoceptive assessments and IE. The present study was designed to describe the type, frequency, and typical anxiety extinction for a variety of interoceptive exercises typically used to treat panic disorder. Interoceptive assessment and IE data were compiled for patients with PD completing a CBT protocol. Data suggest that interoceptive assessment typically provokes fairly specific symptoms that often result in anxiety and even panic. On average, patients completed approximately 25 IE sessions during the course of treatment. Despite the use of a wide variety of interoceptive exercises, 4 exercises (hyperventilation, breathing through a narrow straw, breath holding, and spinning) accounted for the majority of IE sessions, and the majority of IE sessions led to within-session anxiety reduction.

THE EVOLUTION in psychological treatments for panic disorder has been rapid and exciting during the past 15 years (Wolfe & Maser, 1994). Historically, the practice of encouraging patients to repeatedly confront situations that produce intense fear and avoidance has been the hallmark of behavioral treatments for agoraphobia and panic. Cognitive models of panic have offered new directions for intervention (Barlow, 1988; Clark, 1986). Within the cognitive framework, panic attacks are conceptualized as the result of catastrophic misinterpretation of benign bodily sensations that are typically involved in the normal anxiety response (e.g., heart palpitations, dizzi-

ness, dyspnea). Cognitive behavioral therapy (CBT), derived from this cognitive framework, typically focuses on correcting the patient's hypersensitivity to bodily sensations and the misinterpretation of these sensations as signaling immediate threat. These treatments are multimodal, meaning that they consist of a set of interventions including (a) education, (b) training in cognitive reappraisal, (c) repeated exposure to bodily sensations connected to the fear response (i.e., interoceptive exposure; IE), (d) repeated exposure to external situations connected to the fear response (i.e., in vivo exposure), and (e) training in breathing control techniques such as diaphragmatic breathing. Overall, CBT for panic disorder has been found to demonstrate good efficacy in controlled trials using both individual (Barlow, Craske, Cerny, & Klosko, 1989) and group-administered (Telch, Lucas, et al., 1993) treatment.

Cognitive and Behavioral Practice 11, 81–92, 2004

1077-7229/04/81–92\$1.00/0

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In this article, we focus attention on the interoceptive component of CBT protocols for panic disorder. Early ideas regarding interoceptive conditioning focused on the role of classical conditioning (Goldstein & Chambless, 1978; Razran, 1961). According to this model, internal cues such as heart palpitations or dyspnea symptoms may become established as conditioned stimuli by predicting an aversive unconditioned stimulus (i.e., panic attack). Later, the panic attack becomes a conditioned response to these interoceptive stimuli. The interoceptive conditioning model of panic has been questioned on both empirical as well as conceptual grounds (McNally, 1990; Reiss, 1988). However, recently it has been suggested that criticisms of the interoceptive model can be addressed when more current theories of conditioning and associative learning are considered (Bouton, Mineka, & Barlow, 2001).

Although the debate continues regarding the adequacy of interoceptive conditioning models, this early conceptualization of panic attacks inspired the incorporation of so-called interoceptive exercises into CBT protocols for panic disorder (Barlow & Craske, 1994; Craske & Barlow, 2001; Telch et al., 1993). In most CBT protocols, IE is usually preceded by a discussion of interoceptive conditioning, using Pavlovian conditioning analogies. Next, an interoceptive assessment is conducted. This assessment usually involves a series of exercises designed to produce strong bodily perturbations. Patients are asked to rate the distress that is elicited from these sensations. After the assessment is complete, the therapist directs the patient to conduct repeated sensation-induction exercises designed to correct the association between the bodily cue and the fear response.

Research suggests that IE in isolation from other CBT components can be helpful for patients with panic disorder. Griez and van den Hout (1986) used repeated inhalations of a high concentration of CO₂ as the interoceptive intervention and found that exposure to CO₂ was more effective than propranolol in reducing panic symptoms. These findings were also replicated in similar studies using CO₂ as the interoceptive exposure agent (Beck, Shiperd, & Zebb, 1996; van den Hout, van der Molen, Griez, Lousberg, & Nansen, 1987) as well as when hyperventilation was used as a repeated interoceptive challenge (van den Hout, De Jong, Zandbergen, & Mercelbach, 1990). Other data suggest that the interoceptive component of multicomponent CBT protocols is extremely important (Craske, Rowe, Lewin, & Noriega-Dimitri, 1997). Craske and colleagues compared the relative efficacy of interoceptive exposure and breathing retraining in the context of the other CBT components and found that IE is relatively more potent compared to breathing control exercises. On the other hand, at least one published report suggests no relative advantage of

CBT using IE compared to CBT with in vivo exposure alone (Ito et al., 2001).

The effects of IE are likely to be moderated by a number of other factors. For example, Carter and colleagues have suggested that the interoceptive component is only potent in the context of cognitive therapy (Carter, Marin, & Murrell, 1999). Beck and colleagues have noted differential patterns of responding to repeated exposure to high concentrations of CO₂. Some individuals appear to habituate in response to repeated exposure whereas others show fear sensitization (Beck & Shipherd, 1997; Beck, Shipherd, & Read, 1999). Finally, some studies indicate that cognitive factors such as anxiety sensitivity and suffocation fears moderate sensitization and habituation effects with repeated CO₂ exposure (Forsyth, Lejuez, & Finlay, 2000). A more detailed knowledge regarding the nature and use of IE in therapy may inform this literature.

One well-established and empirically validated CBT protocol for panic disorder is Barlow's Mastery of Anxiety and Panic (MAP) program (Barlow & Craske, 1994). The MAP protocol emphasizes the use of IE and suggests nine different sensation-induction exercises: head shake, head lift, step-ups, breath holding, tension, spinning, hyperventilation, breathing through a narrow straw, and staring. In the present report, a similar set of interoceptive exercises that we have routinely used in our structured CBT outcome trials is described (Schmidt & Woolaway-Bickel, 2000). There are slight deviations from the exercises described in the MAP program. In our studies, jogging in place replaces step-ups, push-ups replace the muscle tension exercise, and spinning while standing typically replaces spinning in a chair (see Table 1 for details for each of these exercises). Furthermore, patients conduct a gag-reflex exercise but do not routinely conduct a staring exercise. In addition to the more standardized interoceptive assessment, we often have patients conduct additional interoceptive exercises depending on reported difficulties with other types of sensations. Tables 2 and 3 describe these additional interoceptive exercises, including some less frequently used exercises.

In sum, IE is a central intervention to most current CBT modules for panic disorder, but there is relatively little research describing the use of these techniques in therapy. Therefore, this report will (a) provide basic descriptive information on patients' responding to typical interoceptive assessments, and (b) provide descriptive information regarding subjective response during interoceptive practice sessions.

Method

Participants

The sample consisted of 50 patients meeting the following criteria: (a) principal *DSM-IV* (American Psychiatric

Association, 1994) Axis I diagnosis of panic disorder with or without agoraphobia, (b) no change in medication type or dose during the 12 weeks prior to treatment, (c) no evidence of serious suicidal intent, (d) no evidence of current substance abuse, (e) no evidence of current or past schizophrenia, bipolar disorder, or organic mental disorder. Sixty-eight percent of participants were female, with an average age of 37.5 ($SD = 12.0$). A majority of the patients were Caucasian (84%), married (61%), and employed full-time (78%). Fifty-four percent of patients received at least one current co-occurring Axis I diagnosis, with 33% reporting another anxiety disorder diagnosis and 15% reporting a mood disorder diagnosis.

Procedure

Patients were applicants presenting for evaluation at an academic research center specializing in the assessment and treatment of anxiety disorders who met study criteria and were later treated in a group CBT protocol for panic disorder. Diagnostic assessment was based on an initial phone screening interview followed by a face-to-face structured clinical interview using the SCID-NP (First, Spitzer, Gibbon, & Williams, 1994). Randomly selected videotaped interviews from this sample ($n = 11$) have demonstrated perfect interrater agreement for the panic disorder diagnosis ($\kappa = 1.0$).

Each of the patients in the present report was enrolled in a CBT group treatment for panic disorder. Data from these outcome trials have been published elsewhere (Schmidt et al., 2000). However, the specific information regarding IE has not been reported. Of the 53 patients involved in this trial, 50 provided interoceptive assessment and exposure data that are reported here. Patients were treated in small groups of 5 to 7 with 12 sessions of CBT over a 12-week period.

In this particular protocol, the interoceptive component spanned several sessions. During Session 5, an initial interoceptive assessment was conducted and the Interoceptive Exposure Assessment form was completed (see Table 1 for a description of these exercises). During the next session, some in-session interoceptive work was completed, and out-of-session interoceptive homework was typically assigned during the next few weeks. For some patients, additional assessments were conducted during later sessions if the individual endorsed any avoidance of caffeine, avoidance or potential fear of heat, or changes in the visual field (see Table 2 for a description of these exercises).

Interoceptive assessment. An Interoceptive Assessment form was used to record various subjective responses to the interoceptive exercises. Patients described the type of sensation experienced in an open-ended manner (e.g., dizzy, heart palpitations) as well as the intensity of the sensations (0 = *none* to 10 = *extreme*), the intensity of

Table 1
Description of Interoceptive Assessment Exercises

Exercise	Duration	Description
Head shake	30 seconds or until extremely dizzy	With eyes open, turn head from shoulder to shoulder, completing approximately one turn/second.
Head between legs	30 seconds	Standing upright with legs spread somewhat apart, bend at waist forward as far as possible, placing head between legs.
Running in place	60 seconds	Jog vigorously in place with knees high. Walking up and down stairs was sometimes substituted depending on physical restrictions.
Breath holding	As long as possible	Pinch nostrils and take a deep breath, hold as long as possible and exhale, then wait as long as possible prior to inhalation.
Gag reflex	One exposure	Using index finger or tongue depressor, touch back of throat to produce gag reflex.
Spin	60 seconds or until extremely dizzy	Standing with eyes open and spotter present, spin in place. Seated in a swivel chair can be substituted if one is available.
Push-ups	As many as possible	Complete as many push-ups as possible, when additional push-ups are too difficult, hold in the "up" position for as long as possible. Push-ups on knees can be substituted.
Hyper-ventilate	120 seconds	Deep breaths through the mouth at 1 breath/2 seconds.
Straw	120 second maximum	Using a straw with 1 mm diameter (e.g., coffee stirrer), pinch nostrils and breath as long as possible.

Table 2
Description of Advanced Interoceptive Exercises

Exercise	Duration	Description
Caffeine	Dose sufficient to induce sensations	Depending on typical caffeine intake, drink 1–5 cups of caffeinated coffee rapidly (2 minutes).
Heat	Approximately 10 minutes or long enough to produce strong heat sensations	Turn on hot water in shower, close bathroom door, enter bathroom after steamy wearing winter coat. Substitute sitting in car in the sun with windows up; sitting in sauna; sitting in hot tub.
Staring at wall	5 minutes	Standing approximately 3 feet from a wall, stare without blinking.
Staring at mirror	5 minutes	Standing approximately 3 feet from a mirror, stare without blinking.
35% CO ₂ challenge	1 vital capacity inhalation	Wearing nostril clamp, take as deep a breath as possible of a gas containing 35% CO ₂ /balance O ₂ , hold for 5 seconds.

Table 3
Description of Less Frequently Used Interoceptive Exercises

Exercise	Description	Frequency in Sample ($N = 50$)
Head stand	On a pillow or carpeted area on ground near a wall which can be used for balance and conduct head stand (use spotter) (30 sec).	$n = 5$
Roll up in sheets/blankets/rug	Roll self up—use of bed sheet, blanket, rug as well as time can be varied for more or less intensity (30 sec).	$n = 5$
Salt induction/dehydration	Eating very salty foods (e.g., popcorn) with no water.	$n = 2$
Cold medicine/antihistamines	Taking prescribed dose of over-the-counter medication.	$n = 2$
Nausea jar	Take food (e.g., eggs), tobacco products (e.g., smoked cigar), etc., and place in jar with tight-sealing lid; allow contents to rot for several days (single breaths from jar).	$n = 2$
Food consumption for "choking" concerns	Consuming chewy (e.g., meat products), gritty foods (e.g., popcorn) without water.	$n = 2$
Niacin	Take Niacin tablet (500 mg dose).	$n = 1$
Head under water	Place head under water (as long as possible).	$n = 1$
Ben-Gay	Rub topical analgesic on neck.	$n = 1$
Paper bag CO ₂	Place paper bag over mouth and nose; breathe deeply (1 min).	$n = 1$
Overeating	Overeat to the point of discomfort.	$n = 1$
Belt around chest	Wrap belt somewhat tightly around chest (30 sec).	$n = 1$

their anxiety response to the sensations (0 = *none* to 10 = *extreme*), and the similarity of the sensation to a panic attack (0 = *not at all similar* to 10 = *extremely similar*). During the administration of this form, the distinction between sensations and an anxiety or fear response to the sensations was explained to patients to avoid possible confounding of these ratings. Patients were asked to complete all of the exercises in the order indicated in Table 1 (i.e., head shake, head between legs, etc.). Several minutes between exercises were provided to minimize "contamination" effects from residual sensations and anxiety produced by a previous exercise.

In later weeks, many patients were instructed to complete additional assessments outside of the session using caffeine induction, heat induction, or staring assignments. A specific assessment instrument (i.e., Advanced Interoceptive Assessment) was utilized for the caffeine, heat, and staring exercises. This form includes ratings of the intensity of sensations and the intensity of anxiety. For the caffeine and heat exercises, ratings were made at different time intervals. During Session 9, many patients also completed interoceptive exposure to a 35% CO₂ challenge using an experimental apparatus (see Schmidt, Trakowski, & Staab, 1997, for a description of the CO₂ procedure). Other interoceptive exercises were often prescribed for patients based on idiosyncratic fears of particular sensations. These less frequently used exercises are

listed in Table 3 along with the frequency of use.

Specification of IE assignments. Interoceptive work in and out of therapy sessions was based on patients' anxiety responding during assessment. All exercises that generated a fear response were assigned in a hierarchical fashion (i.e., less challenging exercises being assigned prior to more highly fear-provoking exercises). In some cases, patients who did not report subjective anxiety during the assessment but who did report high similarity to panic were asked to practice that exercise outside of the context of the session. This was done when the therapist felt that some generation of anxiety was likely with the removal of salient safety signals from the group therapy session. During the course of therapy, interoceptive work was prescribed in the following manner. An exercise that generated some fear was selected. That exercise was specified in order to produce moderate levels of subjective anxiety. For example, hyperventilation for 20 seconds (versus 60 seconds) may be sufficient to produce moderate

fear responding. Patients were instructed to repeat the exercise during one IE session until subjective fear was extinguished (e.g., repeatedly hyperventilate for 20 seconds until the SUDS rating was 0). Any particular type of exercise (e.g., straw breathing) was practiced across sessions until there was no reported fear during the first trial of a practice session that generated strong physical sensations. The IE assignments were recorded using an Interoceptive Practice Form. The Interoceptive Practice Form included fields for rating the type and duration of the exercise along with intensity of sensation (0 = *none* to 10 = *extreme*) and intensity of anxiety ratings (0 = *none* to 10 = *extreme*). In our CBT protocols, therapists continue to prescribe interoceptive exercises until fear responding to all exercises was extinguished.

In the active treatment groups, treatment integrity was maintained by utilizing a structured and manualized treatment protocol (Schmidt, 1994) that describes the specific goals and strategies for each session. In our lab, an independent rater's assessment of adherence (Young, Beck, & Budenz, 1983) to the treatment protocol has yielded extremely high rates of adherence (see Schmidt & Woolaway-Bickel, 2000). The first author administered the treatment to all groups. He is a licensed clinical psychologist with approximately 10 years of experience with cognitive-behavioral treatment of anxiety disorders. In each group, there was also a graduate fellow in clinical

psychology, a psychiatry resident, or a psychiatrist acting as cofacilitator.

Results

Response to the Interoceptive Assessment

A summary of subjective responding to the in-session, interoceptive assessment is provided in Tables 4 and 5. Table 4 provides information on the frequency of subjective symptoms that are generated for each exercise. As is evident from Table 4, these exercises produced an array of symptoms, but in most cases patients tended to endorse only one or two predominant symptoms provoked by most of the exercises. For example, 78% of patients reported some dizziness during the head-shaking exercise. A review of the dominant symptoms across each exercise suggests that these exercises were successful in provoking their intended sensations. So, for example, head shaking and spinning provoked dizziness, the gag reflex produced choking symptoms, holding breath produced dyspnea, and so forth. Vestibular symptoms such as dizziness were among the most common symptoms. Dizziness was endorsed during all but one exercise and was ranked as the most common symptom in three of the nine exercises (i.e., head shake, spin, hyperventilate) and ranked second for the head between the legs exercise. Pulmonary symptoms were also common including dyspnea sensations, which were ranked highest in straw breathing, running in place, and gagging, and ranked second for the push-ups. Finally, cardiac symptoms were fairly common and were especially prominent during the running and push-up exercises. Thus, the interoceptive exposure assessment exercises appear to primarily elicit vestibular and cardiopulmonary symptoms.

Ratings for intensity of sensations, anxiety response, and similarity to natural panic are indicated in Table 5. These ratings were made with respect to the entire constellation of symptoms produced by an exercise (i.e., each symptom provoked was not given a separate rating). The intensity ratings suggest that most exercises produced mild to moderate levels of symptoms. On a 0-to-10-point scale, we find that most exercises produced intensity ratings averaging around 4 to 6. The least intense, not surprisingly, was the head between the legs exercise, and the most intense was spinning, followed by hyperventilation exercises.

In terms of the anxiety ratings, the interoceptive assessment exercises provoked anxiety in the vast majority of cases. Only four participants (8%) reported no anxiety to all of the exercises, and one participant (2%) reported anxiety to only one exercise. Thus, 90% experienced anxiety to two or more of the exercises. In terms of the level of anxiety, the exercises tended to provoke mild to moderate anxiety. Seven of the exercises elicited an average

level of anxiety less than 3 on the 0-to-10 scale. Only the straw breathing and the hyperventilation exercises, with mean ratings around 4, were more consistently provocative of moderate anxiety ratings. There is also evidence to suggest that the general intensity of an exercise is related to the level of anxiety it elicits. The three most intense exercises (i.e., spin, straw, hyperventilate) are also those with the highest anxiety ratings. The overall correlation between intensity and anxiety ratings is high ($r = .58, p < .0001$), suggesting a general propensity toward increased fear responding to any increase in bodily perturbations.

The final subjective rating made during the assessment requires patients to assess the degree to which the symptoms remind them of the symptoms they experience during a panic attack. The rationale for this rating is that it may identify relevant ratings that could be missed when anxiety ratings are negligible. During the assessment, anxious responding may be attenuated due to factors specific to the assessment (e.g., the controllability and predictability of sensation induction, presence of "safety cues" such as therapists, other patients, and so forth). Thus, ratings of high panic similarity but low anxiety should be investigated further. In many cases, we ask the patient to repeat these exercises when they are alone at home, and it is not unusual for this to produce a stronger anxiety response. The pattern of responses to this item suggests that most exercises elicit sensations that are mildly to moderately similar to natural panic. Sensations produced from the gag reflex and head between the legs were the least similar to panic and the hyperventilation, spin, and straw exercises were the most similar to panic. There is an association between the high-intensity exercises and the level of similarity to panic. The overall association between intensity and similarity is high ($r = .67, p < .0001$), while the association between anxiety and similarity is also high ($r = .73, p < .0001$).

Panic During Interoceptive Assessment

It is not unusual for patients to panic during the interoceptive exposure assessment. While panic was not formally measured during the assessments, ratings from the assessment monitoring form can be utilized to give an estimate of panic frequency. Based on our experience, it was rare for a patient to report panicking and not provide very high ratings of anxiety and similarity to panic. As a result, three thresholds that can be used to approximate panic responding were evaluated. The most liberal threshold was a rating of 8 to 10 on both the anxiety and similarity to panic ratings, and the most conservative threshold was a rating of 10 on the anxiety and similarity ratings. An intermediate threshold using a 9 to 10 rating on both ratings was also examined. Panic frequency ratings using these various thresholds are reported in

Table 4
Typical Sensations Induced During Interoceptive Assessment Exercises

Exercise, Reported Sensations	Frequency of Sensation (%)	Exercise, Reported Sensations	Frequency of Sensation (%)
Head shake		Spin	
Dizziness	78	Dizziness	86
Light-headedness	12	Light-headedness	22
Blurred vision	10	Nausea	12
None reported	10	Blurred vision	10
Tingling, hands tingling	4	Headache	8
Nausea	4	Chest pounding/rapid heartbeat	6
Disorientation	4	Disorientation	4
Discomfort	2	Shortness of breath	4
Headache	2	Loss of balance	4
Place head between legs		None reported	2
Pressure in head	32	Hot flash	2
Dizziness	30	Sweating	2
None reported	30	Pressure in head	2
Light-headedness	16	Push-ups	
Shortness of breath	4	Shoulder/arm/muscle pain	42
Tingling, hands tingling	2	Shortness of breath	36
Chest pounding/rapid heartbeat	2	Chest pounding/rapid heartbeat	30
Headache	2	None reported	14
Disorientation	2	Dizziness	12
Discomfort	2	Sweating	10
Blurred vision	2	Hot flash	6
Shoulder/arm/muscle pain	2	Nausea	6
Shaking/trembling	2	Shaking/trembling	6
Run in place		Discomfort	4
Shortness of breath	74	Headache	2
Chest pounding/rapid heartbeat	62	Tingling/hands tingling	2
None reported	8	Breathe through straw	
Light-headedness	4	Shortness of breath	48
Shoulder/arm/muscle pain	4	Choking/suffocation	20
Dizziness	2	Chest pounding/rapid heartbeat	20
Hot flash	2	None reported	16
Shaking/trembling	2	Dizziness	12
Dry mouth/throat	2	Light-headedness	6
Sweating	2	Headache	6
Loss of balance	2	Shaking/trembling	4
Hold Breath		Hot flash	4
None reported	26	Blurred vision	2
Shortness of breath	24	Pressure in head	2
Light-headedness	18	Tingling/hands tingling	2
Headache	6	Hyperventilate	
Dizziness	6	Dizziness	62
Choking/suffocation	4	Tingling/hands tingling	24
Blurred vision	2	Light-headedness	20
Pressure in head	2	Chest pounding/rapid heartbeat	18
Relaxed/peaceful	2	Derealization	16
Hot flash	2	Shortness of breath	12
Sweating	2	Dry mouth/throat	12
Blood rush to head	2	Shaking/trembling	10
Nausea	2	Hot flash	6
Discomfort	2	None reported	4
Gag Reflex ^a		Natural "buzz"	4
Choking/suffocation	43.8	Sweating	4
Nausea	25	Nausea	4
None reported	18.8	Headache	4
Discomfort	6.8	Discomfort	4
Chills	4.5	Blurred/spots in vision	4
Chest pounding/rapid heartbeat	4.5		
Light-headedness	2.3		
Shortness of breath	2.3		
Dry mouth/throat	2.3		
Eyes watered	2.3		
Blood rushing to the head	2.3		

^a $n = 44$.

Table 5
Subjective Responses to Interoceptive Exposure Exercises

Exercise	Intensity of Sensation (0–10) <i>M (SD)</i>	Intensity of Anxiety (0–10) <i>M (SD)</i>	Similarity to Panic (0–10) <i>M (SD)</i>
Head shake	4.28 (2.71)	1.31 (2.11)	2.12 (2.81)
Place head between legs	2.98 (2.58)	0.83 (1.48)	1.47 (2.49)
Run in place	5.00 (2.70)	1.44 (2.63)	2.64 (3.35)
Hold breath	4.04 (3.23)	2.08 (2.81)	2.58 (3.39)
Gag reflex ^a	3.38 (3.19)	1.61 (2.90)	1.36 (2.84)
Spin	7.00 (2.64)	2.98 (3.01)	4.27 (3.53)
Push-ups	4.72 (2.99)	1.38 (2.11)	2.08 (2.86)
Breathe through straw	5.60 (3.24)	3.95 (3.50)	4.17 (3.58)
Hyperventilate	6.46 (2.56)	4.36 (3.19)	5.52 (3.52)

^a *n* = 44.

Table 6. When these thresholds are used, the overall rate of panic was either 36% (*n* = 18; 8 to 10 threshold ratings), 24% (*n* = 12; 9 to 10 threshold ratings), or 18% (*n* = 9; 10 threshold ratings) of the sample. Table 6 indicates 10 instances of 10 (threshold) panic because one patient made two such ratings. Therefore, even the most conservative estimate suggests that as many as 1 in 5 patients experiences a panic attack during the interoceptive assessment. This level of frequency is consistent with our clinical impressions regarding the level of panic endorsement by patients during these assessments. The most challenging exercise, not surprisingly, is the hyperventilation exercise, with 10% of the sample endorsing the most conservative panic index. The highest threshold ratings were also found for at least one patient during the run-

Table 6
Probable Panic Responses to Interoceptive Exposure Exercises
and a Function of Several Ratings Thresholds

Exercise	Threshold (8–10) % (<i>n</i>)	Threshold (9–10) % (<i>n</i>)	Threshold (10) % (<i>n</i>)
Head shake	2 (1)	none	none
Place head between legs	none	none	none
Run in place	6 (3)	2 (1)	2 (1)
Hold breath	6 (3)	none	none
Gag reflex ^a	4.5 (2)	2.3 (1)	2.3 (1)
Spin	8 (4)	8 (4)	4 (2)
Push-ups	2 (1)	none	none
Breathe through straw	20 (10)	6 (3)	2 (1)
Hyperventilate	16 (8)	12 (6)	10 (5)

Note. Ratings of 8 to 10 on both the anxiety and similar to panic ratings were required for the most liberal threshold; ratings of 9 to 10 were required for the intermediate threshold, and ratings of 10 were required for the most conservative threshold.

^a *n* = 44.

ning in place, gag reflex, spinning, and straw-breathing exercises.

Advanced Interoceptive Assessment Exercises

There are a series of so-called advanced interoceptive exercises that we regularly, but not routinely, use with patients (see Table 2). These are exercises that are not practical to administer during the initial assessment (e.g., heat, caffeine), are somewhat time consuming (e.g., staring), or are somewhat more challenging (e.g., CO₂). The assessment forms that are used for these exercises differ from the Interoceptive Assessment Rating form as they only contain intensity ratings for sensations and anxiety. A summary of these ratings is found in Table 7. In terms of the caffeine exercise, it is notable that sensations were relatively low during the first assessment, but these increased at the post 15- and post 30-minute assessment times, consistent with the time needed for caffeine to enter the blood stream. The anxiety response was fairly low during this exercise and appears to peak in terms of anticipatory anxiety to the exercise (as noted by the first assessment period yielding the highest anxiety rating and the lowest sensation rating). Ratings from the heat exercise are somewhat surprising at first glance because of a lower sensation response during the second assessment period. The reason for these findings is that some patients (*n* = 7) terminated the exercise prior to the second assessment if they had already achieved a high level of sensation, whereas another group (*n* = 8) with relatively lower ratings continued with the exercise through the second assessment period. The staring exercises tended to provoke a moderate sensation response but yielded relatively little anxiety. The CO₂ procedure tended to be the most chal-

Table 7
Subjective Responses to “Advanced” Interoceptive
Exposure Exercises

Exercise	Intensity of Sensation (0–10) <i>M (SD)</i>	Intensity of Anxiety (0–10) <i>M (SD)</i>
Caffeine		
Post 2 min.	1.80 (2.05)	1.40 (1.67)
Post 15 mins.	3.00 (2.56)	0.67 (1.41)
Post 30 mins.	3.44 (3.13)	0.44 (1.01)
Heat		
Post 2 mins.	3.71 (3.50)	1.42 (1.81)
Post 10 mins.	2.29 (3.15)	1.43 (2.95)
Stare at dot	4.00 (3.75)	0.31 (0.63)
Stare at mirror	4.04 (3.97)	0.83 (1.27)
CO ₂	7.86 (3.79)	5.24 (3.67)

Note. *n* = 9 (caffeine), 15 (heat), 13 (staring), 18 (CO₂).

lenging exercise, with very strong sensation and anxiety responses.

Description of Interoceptive Exposure Practice Sessions

The interoceptive exposure practice forms indicated that each patient completed approximately 25 out-of-session practice sessions. Interestingly, the average number of trials per session was only about 3. More specifically, the total number of practice sessions was 1,164 ($1,164/50 = 23.4$), and the total number of trials was 3,089 ($3,089/1,164 = 2.7$). There were considerable individual differences in amount of practice in terms of number of sessions and number of trials per session. It is likely that these differences are influenced by a number of factors, including the amount of prescribed work, compliance with the interoceptive exercises, and anxiety extinction rates. Evaluation of the frequency of various exercises indicates that two exercises accounted for over 50% of all interoceptive practice—hyperventilation (28%) and breathing through a narrow straw (28%). Breath holding (9%) and spinning (8%) were also fairly frequently used. Thus, these four exercises dominated the interoceptive portion of the protocol as they constituted almost 75% of the work in this area.

In regard to within-session changes in anxiety, Table 8 indicates changes in anxiety ratings during a practice session for some of the more frequently conducted exercises. The average level of change was fairly consistent across the different types of exercises. In general, we found average reductions of approximately 2 points on a 10-point scale. Given that the typical starting anxiety level was generally rated to be around 4 (moderate anxiety), this level of change represents almost a 50% reduction during these exercises. In 69% of the IE sessions with over two trials per session, there was at least a 1-point reduction in anxiety, suggesting that the majority of sessions were effective in producing at least some anxiety reduction, although many exercises did not terminate with complete extinction of subjective fear.

Case Example: IE in Panic Disorder

To provide a more concrete example of interoceptive work, we offer the following description of a patient completing IE in the context of the CBT group. In this particular case, the initial interoceptive assessment indicated a range of responses that is fairly typical. This patient showed no anxiety in response to the head shake and head between the legs exercises. The gag, spin, and push-ups created a small amount of anxiety (SUDS = 3, 2, and 2, respectively) and the most challenging exercises included breath holding, running, hyperventilation, and straw breathing (SUDS = 6, 6, 7, and 8, respectively). This pattern of responses is consistent with interoceptive sensitivity to cardiopulmonary sensations.

Table 8
Anxiety Extinction Rates for Interoceptive Exposure Practice

Exercise	Average Beginning Anxiety	Average Ending Anxiety	Average Change in Anxiety
Straw ($n = 144$)	4.33	2.30	2.03
Hyperventilate ($n = 140$)	3.47	1.49	1.98
Breath holding ($n = 55$)	2.05	0.94	1.11
Spin ($n = 46$)	4.38	2.75	1.63
Stairstep/running ($n = 40$)	3.50	1.52	1.98
Gag reflex ($n = 24$)	3.20	1.13	2.07
Stare at mirror ($n = 18$)	4.22	2.32	1.90
Stare at dot/wall ($n = 17$)	3.55	1.04	2.51
Coffee/caffeine ($n = 12$)	6.33	3.67	2.66

Note. Anxiety ratings range: 0 to 10. Only exercises with two or more trials with an overall number (n) of exposure sessions >10 were included in this table.

At the end of the interoceptive assessment session, we were able to complete several exercises with this particular patient. The gag exercise was chosen initially because it was only modestly challenging and is one that patients often habituate to rapidly. After 5 trials, the patient reported no anxiety in response to this exercise. At this point, we shifted to the somewhat more challenging breath-holding exercise. Once again, the patient showed nice habituation after 10 repetitions (SUDS decreased from 6 to 2). The patient was assigned to work on the gag and breath-holding exercises for homework during the week, with the goal of one session per day.

This patient was compliant with the homework and conducted good exercises that led to anxiety reductions in each instance. By the next session, she reported no distress with the gag exercise and very little distress with breath holding. During the next treatment session, it was decided to work on the most challenging exercise (straw breathing) due to the success with a similar task (breath holding). The patient showed good habituation (SUDS decreased from 6 to 2) after 8 trials of straw breathing. At this point, we shifted to hyperventilation, which was another related exercise that had been challenging. During session, the patient completed 8 trials with some habituation (SUDS decreased from 8 to 4). She was instructed to work on straw breathing and hyperventilation during the week. Once again, the patient was compliant and successful, with both of these exercises producing relatively little anxiety by the next week. Because hyperventilation continued to produce small levels of anxiety during the initial practice trials (SUDS = 3), the patient was instructed to continue to practice this. The patient was also instructed to work on running in place, particularly if, after several days of additional work, hyperventilation no longer generated anxiety. At the next session, the patient

was reporting minimal distress with all of the assigned exercises.

In reviewing the patient's assessment form, it was determined that it might be beneficial to reevaluate the spinning exercise: The interoceptive work up to this point did not include an exercise generating high levels of dizziness, and this cue appeared to account for the anxiety the patient reported in the initial assessment. Although the spinning exercise did not appear very challenging, the patient was instructed to conduct this on her own during the week and to do repeated interoceptive sessions if anxiety was produced. In addition, this patient was avoiding caffeine and was instructed to do an initial caffeine challenge. This involved drinking one cup of coffee. At the next session, the patient reported minimal distress with the spin and caffeine exercises, but the caffeine induction had not produced significant sensations. Therefore, the patient was instructed to complete another caffeine induction with two cups of coffee. In session, we arranged to do a CO₂ challenge for this patient, which had provoked a panic response in her prior to treatment (consistent with her strong pulmonary sensitivity). After 5 CO₂ trials, the patient showed nice habituation (SUDS reduced from 6 to 1). The next caffeine induction did create some sensations but with minimal anxiety. The patient was instructed to do one more caffeine induction (three cups) to provoke even stronger caffeine sensations, and this was completed with little distress. At this point, the patient had returned to drinking coffee on a daily basis. Further assessment indicated no other areas of interoceptive sensitivity and so these interventions were concluded.

Discussion

The present report is the only one we are aware of that provides specific details about the nature of IE in a CBT protocol for panic disorder. Hopefully, this description will be useful to researchers and clinicians utilizing interoceptive procedures (Barlow & Craske, 1994; Craske & Barlow, 2001). This evaluation has revealed a number of interesting and potentially important findings. First, this study documents that the interoceptive exposure assessment provokes anxiety in most patients with panic disorder (approximately 90% of patients assessed). Although the present study does not allow us to assess the mechanisms responsible for the production of anxiety, these findings are at least consistent with interoceptive conditioning or learning-based models of panic (Bouton et al., 2001) that predict anxiety provocation to arousal sensations.

The assessment exercises tended to be anxiogenic and a substantial proportion of patients appeared to experi-

ence a panic attack. The experience of panic can be potentially disruptive to therapy because of its aversive nature. We react to high anxiety or panic by reminding patients that this is an important demonstration of the conceptual model of interoceptive conditioning (e.g., here are clear signs that you have developed an association between certain sensations and your fear responding). Consistent with an interoceptive conditioning model, we find that it is useful to point out that, despite the fact that patients can predict and control the generation of sensations because they are conducting the exercises, these sensations still yield an anxiety response. After the first exercise or two, and certainly after a patient reports a panic attack, the therapist also emphasizes that it is positive for patients to have identified specific sensations that are provocative of anxiety because we now have a better understanding of the nature of their panic attacks. In addition to reviewing these issues regarding the experience of anxiety during the interoceptive assessment, we also find that it is important to recognize that this is often the most difficult and uncomfortable of the therapy sessions because of the generation of unpleasant sensations and anxiety. To make sure patients appropriately attribute sensations experienced later that day or the next day, they are warned that they may continue to experience some sensations following the assessment because of the physical demands associated with completing approximately 10 different exercises.

Due to the nature of the assessment, where a series of exercises is conducted during a 30- to 45-minute time frame, it is important to consider whether later exercises are contaminated by earlier exercises. In other words, it is possible that residual sensations and anxiety may affect sensation and anxiety reports for the later exercises. A review of the symptom frequency data suggests that some sensations may have persisted across several assessments. Although the therapist does provide some time between assessments to allow symptoms to ameliorate, the exercises were usually separated by only a few minutes, and so there is some likelihood that later assessments were somewhat confounded by persistent sensations. Hence, someone who is acutely sensitive to dizziness produced during the first exercise (i.e., head shake) may have continued to experience (and be vigilant to) these symptoms during later exercises. In cases where a patient experiences a panic attack, a somewhat longer interval between exercises is often required for the patient's anxiety to return to lower levels. Because of such effects, we intentionally administer some of the more demanding exercises that tend to produce higher levels of sensations and anxiety (i.e., spin, straw, hyperventilate) at the end of the assessment. It may be that a longer separation between exercises would produce a somewhat different pattern of symptom response, but it is often impractical to allow for

this, especially in a group treatment format. In fact, there is often a fair amount of anticipatory anxiety during this session that likely also contributes to and confounds the subjective reports. Despite these issues, we should point out that each of the exercises produced an anticipated and seemingly face-valid sensation profile. Therefore, we have some assurance that while there are some confounding effects, these do not significantly alter the assessment's viability.

Another element that requires attention during the interoceptive assessment is low-sensation intensity ratings. During the initial exposure assessment, time limits are commonly used for most exercises (see Table 1). After patients complete an exercise, the data are reviewed by the therapist. At this point, it is not unusual to discover that some patients reported relatively low-intensity sensations. Although certain exercises (e.g., head between the legs) do not typically provoke strong sensations, it is unusual for other exercises (e.g., hyperventilation) to produce weak-sensation intensity ratings. When such a discrepancy exists, the therapist responds in two ways. First, it is important to review the sensation-anxiety distinction. Many patients continue to confound sensations with anxiety (i.e., anxiety = sensations) and will not endorse sensations when they have little anxiety. Second, we discuss whether the patient conducted the exercise as it was prescribed. It is not unusual for patients to try to "cheat" during the exercises, that is, patients often do not conduct the exercises as vigorously as possible, which tends to reduce the intensity of symptoms. If we believe this is the case, we ask the patient to repeat the exercise. Alternatively, sometimes a more intensive exercise is required. For example, we might extend the duration or number of trials for the exercise, or we could suggest a related exercise (see Tables 2 and 3). There are other instances when it is apparent that the patient is not at all bothered by the particular sensations that are typically produced by the exercise and so we would not necessarily repeat the exercise. The issue of "cheating" is more likely to be an issue during a group-administered assessment, relative to an individual session when patients can be more closely monitored and encouraged.

Another question that might be considered in light of these findings is whether the entire interoceptive assessment is needed for patients with panic disorder. On the one hand, evaluation of the anxiety and similarity to panic ratings suggests that each of the exercises may be useful (i.e., every exercise received some level of endorsement in terms of anxiety and panic similarity). Sometimes having a comprehensive assessment yields important clinical data. At times, patients and therapists were surprised at the elicitation of anxiety responses to certain exercises. Often, these responses would not have been predicted based on interview or rating forms such as the

Body Sensations Questionnaire (Chambless, Caputo, Bright, & Gallagher, 1984) or the Anxiety Sensitivity Inventory (Peterson & Reiss, 1987) that we often use to identify potentially problematic sensations. Thus, there are instances when a comprehensive assessment is likely to be beneficial.

On the other hand, there are a number of arguments that could be made against a comprehensive assessment. First, it is clear (see Table 4) that some exercises are redundant in terms of the types of sensations that are typically elicited. For example, breath holding and breathing through a narrow straw both produce prominent dyspnea sensations. Head shake and spinning primarily provoke dizziness. In these instances, straw breathing and spinning are more potent exercises in terms of the typical levels of sensations and anxiety they produce. We would expect that relatively little would be lost with the deletion of the head shake and breath-holding exercises. However, it is relevant to point out that the breath-holding exercise was one of the four most frequently used exercises utilized during interoceptive practice. These data suggest that many patients would benefit from conducting breath-holding exposure even if it is omitted from the assessment phase of interoceptive treatment.

Another issue raised by the interoceptive assessment data is the high level of association between the intensity of the sensations and the anxiety response. The strong association between intensity and anxiety may be the result of a number of factors. As noted above, it is not unusual for patients to initially confound sensation and anxiety, thereby leading to an erroneously inflated correlation. The interoceptive assessment is often useful in further educating patients about this distinction. On the other hand, the sensation intensity-anxiety response association may be an accurate indicator of a general propensity toward increased fear responding to any increase in bodily perturbations. This propensity is consistent with clinical experience. We often find that patients are generally fearful of nonspecific arousal symptoms. These fears are exhibited across a wide variety of strategies designed to generally mitigate the experience of symptoms (e.g., exercise avoidance, caffeine avoidance, avoidance of emotional arousal).

Related to the issue of sensation intensity, our data make it clear that the most challenging exercise is exposure to high concentrations of CO₂. This particular exercise is likely to be more challenging, not only because of the induction of very strong sensations but also because of the task's novelty, as well as the logistics of the procedure (e.g., wearing a mask). It is our experience that many patients benefit from use of the CO₂ procedure. Some patients joke about getting their own CO₂ tanks to be able to continue to practice on their own. However, it is impractical and unsafe to prescribe CO₂ exercises outside of the context of laboratories that have specialized

equipment. One substitute exercise that can be utilized is breathing into a paper bag (McNally & Eke, 1996). Paper bag breathing has been used as a CO₂ challenge and does produce similar sensations, albeit not quite as intense as laboratory-based methods.

With the exception of the CO₂ exercise, many of the anxiety ratings were fairly modest for these so-called advanced interoceptive exercises. This may appear to be surprising because these exercises were requested of patients who reported trouble in these target areas (e.g., caffeine avoidance, anxiety following changes in the visual field). On the other hand, it is likely that anxious responding to these exercises is somewhat attenuated from prior interoceptive work. By this point in the treatment, patients had often received several weeks of interoceptive practice on other exercises. Thus, reduced anxiety during this assessment may be reflecting generalization effects from interoceptive practice with exercises producing similar sensations. Similarly, because the interoceptive work takes place in the middle of the treatment, it is likely that responses to IE were affected by the prior treatment even if this therapy was not directly targeting so-called interoceptive conditioning.

In regard to actual exposure exercises, our data suggest that patients typically conduct about 25 exposure sessions over the course of therapy. Interestingly, IE was concentrated on two exercises—hyperventilation and straw breathing. The prevalence of these exercises along with breath holding is consistent with other reports suggesting that pulmonary symptoms, particularly dyspnea, are prominent in patients with panic disorder and may create a great deal of distress (Klein, 1993). It is also worth noting that sessions tended to be brief in relation to the number of trials. This is a bit unexpected as our clinical experience suggests that in-session interoceptive work is typically more lengthy (i.e., around 10 trials per interoceptive exercise). One explanation for this discrepancy is that the in-session work may be designed to be a bit more challenging, thereby requiring lengthier sessions.

The design and conduct of IE in our protocols is dictated by a number of important guidelines. Basically, an interoceptive exercise should provoke moderate anxiety and the anxiety response should attenuate over time or trials. Therapists attempt to design practice that will yield moderate SUDS ratings (approximately 5). In addition, a repeated element is designed into each practice session that would allow for a demonstration of anxiety reduction. Instead of dictating a specific number of trials per session, we strongly recommend that all interoceptive exercises are repeated until the SUDS level is reduced as low as possible. The IE practice data suggest that these guidelines were followed. Consistent with instructions regarding the production of moderate anxiety, the anxiety intensity ratings for IE tended to be in the mild to moder-

ate range. Consistent with the anxiety reduction guidelines, we also found that despite the relative brevity of sessions, the majority of IE practice resulted in anxiety reduction.

The reader should also recall that these data were derived from a group-administered protocol and this format may differ to some extent from interoceptive work that is conducted in individual therapy. Anecdotally, it seems that the group administration often increases the willingness and compliance of certain patients to conduct these exercises. Completing exercises in the group is also likely to affect the emotional experience by either decreasing or increasing fear in terms of whether the presence of group members suggests safety. On the other hand, in individual therapy a therapist may be able to accompany patients during the interoceptive practice; this is likely to increase compliance, particularly with the more challenging exercises.

We noted in the introduction that certain individual difference variables may affect response to interoceptive tasks. In particular, there may be certain subgroups of anxiety patients that are at increased risk for interoceptive work, leading to some initial sensitization rather than habituation, particularly if the exercises are not repeated sufficiently (Beck & Shipherd, 1997; Forsyth et al., 2000). For these individuals, we would expect that interoceptive practice may need to be initiated with less challenging exercises and that the practice sessions themselves may need to be longer in duration. It is probably also useful to educate patients about individual differences in response patterns so that they don't become disheartened if more extended practice is required for them to habituate.

In sum, CBT for panic disorder is potent, and a fair amount of its potency is often attributed to interoceptive techniques. For researchers, these data offer some confirmation of the conceptual basis of interoceptive work (i.e., exposure to these exercises is anxiogenic and perhaps even panicogenic). For clinicians, we hope this report offers some insight into the nature and practice of these techniques.

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This research was supported by USUHS Grant RO72CF.

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Received: July 24, 2002

Accepted: October 10, 2002

