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Cognitive Aspects of Panic Attacks
Content, Course and Relationship to Laboratory Stressors

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Twenty patients with panic attacks and ten controls were given a standardised interview about thoughts occurring during times of anxiety or panic attacks. The interviewer was blind to the subject's diagnosis. The 20 panic patients underwent a psychophysiological test battery which included a cold pressor test, mental arithmetic task, and 5.5% CO_2 inhalation. More patients than controls reported thoughts centred on fears of losing control and shame when anxious. Panic patients rated their thoughts as stronger and clearer than did controls and they had more difficulty excluding them from their minds. A feeling of anxiety preceded anxious thoughts in patients. This suggests that 'faulty cognitions' are not the initial event in a panic attack, although anxious thoughts may exacerbate or maintain them. Significant correlations were found between the intensity of anxiety-related thoughts in anticipation of mental arithmetic and changes in diastolic blood pressure and heart rate during mental arithmetic.

The phenomenology of panic attacks includes physiological, cognitive, and behavioural components. While the physiological and behavioural components of panic have received considerable attention, much less is known about the cognitive component. Recently, researchers have started to apply cognitive theories of anxiety disorders to the study of panic attacks. Beck *et al* (1985) assume that anxiety patients are characterised by "overactive cognitive patterns (schema) relevant to danger that are continually structuring external and/or internal experience as a sign of danger" (Beck *et al*, 1985). Psychophysiological theories posit that panic attacks are the result of a positive feedback loop between bodily symptoms of anxiety and the individual's response to these symptoms (Lader, 1975; Goldstein & Chambless, 1978; Mathews *et al*, 1981; Margraf *et al*, 1986; Clark, 1986; Ehlers *et al*, 1988; Van den Hout, 1988). Internal cues are suggested as triggers for panic attacks. Cognitive processes such as the appraisal of bodily changes or environmental cues perceived as dangerous or as indicating loss of control are considered to be involved in the exacerbation of anxiety. Thus, in this model, a function of cognitions is amplification, leading to higher and higher states of arousal.

The role of cognitions in panic attacks is supported by retrospective interview studies (Beck *et al*, 1974; Hibbert, 1984; Rapee, 1985; Ottaviani & Beck, 1987). Patients with anxiety neurosis reported cognitions related to physical or psychological harm both before and during severe episodes of anxiety (Beck *et al*, 1974). Hibbert (1984) found similar results in 25 outpatients with generalised anxiety or panic disorder. Each of 30 patients with panic disorder interviewed by Ottaviani & Beck (1987) identified ideation centring on themes of physical, mental or behavioural catastrophes. Hibbert (1984) and Rapee (1985) found the cognitions of panic disorder patients during anxiety episodes to be more catastrophic than those of patients with generalised anxiety. In addition, the ideation of panic patients was more centred on internal physical and psychological harm, whereas generalised anxiety patients worried more about social rejection and failure.

Hibbert's study also dealt with the role of physical sensations as anxiety triggers. The most frequently reported sequence of events in panic attacks was the perception of an unpleasant body sensation (e.g., sweaty palms, dsypnoea, or palpitations), followed by anxious catastrophising cognitions and the full-blown picture of a panic attack (Hibbert, 1984). Similarly, Ley (1985) found that somatic symptoms preceded fear in the majority of patients interviewed. Ottaviani & Beck (1987) reported that a misattribution of a physical sensation triggered panic in all their patients.

Since all these studies assessed cognition during panic retrospectively, the data depend on the patients' recollections of their attacks and are susceptible to bias. However, the results are very consistent and thus in line with cognitive or psychophysiological models. Thoughts related to personal danger, therefore, seem to be involved in the exacerbation of anxiety during panic attacks.

The first purpose of our study was to replicate and extend Hibbert's (Hibbert, 1984) investigation of the ideational components of panic. Subjects in Hibbert's

study were a mixture of generalised anxiety disorder patients and panic disorder patients with criteria as defined by the Research Diagnostic Criteria (RDC). All patients in the present study met the DSM-III-R criteria for panic disorder (American Psychiatric Association, 1987). We also added a control group.

The second purpose of our study was to analyse the sequence of events of a typical episode of severe anxiety in both patients and control subjects.

Our third purpose was to test the hypothesis that the degree to which panic patients report being disturbed by anxiety-related cognitions is correlated with the degree of physiological arousal in anticipation of, and/or during, a stressful event.

Method

Subjects

Twenty patients suffering from panic attacks were drawn from a treatment study conducted by the Laboratory for the Study of Behavioral Medicine at Stanford University Medical Center and the Laboratory of Clinical Psychopharmacology and Psychophysiology at the Palo Alto Veterans Administration Medical Center. Patients were recruited through advertisements in local newspapers; each was tested for the purposes of the present study during the baseline period of the treatment study prior to any intervention in that study. Sixteen patients were female and four were male. All were Caucasian.

Patients met DSM-III-R criteria for panic disorder with and without agoraphobia as determined by the Structured Clinical Interview for Diagnosis (Spitzer & Williams, 1983; American Psychiatric Association, 1987). Ten patients were diagnosed as having panic disorder and ten as having agoraphobia with panic attacks. Other criteria required that patients be between 18 and 60 years of age, not pregnant, have at least one panic attack per week for the three weeks preceding entrance into the study, and have no active cardiopulmonary, renal, endocrine, or neurological disease. Interviews were conducted by clinicians with special training and experience in the use of the Structured Clinical Interview for Diagnosis (SCID). The age range of the patients was 22–50 years, with a mean age of 34.9 years and a standard deviation of 8.2. The mean score of patients on the Hamilton Anxiety Rating Scale (Hamilton, 1959) was 17.8 ± 8.0.

Ten control subjects were included in the study. These individuals were also recruited through local newspaper advertisements. In order to qualify for the study, controls were required to score at or below the median on both scales of the State-Trait Anxiety Inventory (Spielberger *et al*, 1970). The age range of the controls was 23–52 years, with a mean age of 36.5 ± 11.1 years. All controls were female and Caucasian, and were paid for their participation.

Procedure

Patient and control subjects were interviewed using Hibbert's standardised interview. This instrument has been shown to be reliable and effective in eliciting the most important or troublesome thoughts during times of anxiety (Hibbert, 1984). Patients and controls were interviewed by telephone by one of two interviewers trained in the interview technique. Both interviewers were blind to the diagnostic status of the interviewee.

Interview

Hibbert designed the interview to elicit thoughts which had occurred during times of anxiety during the preceding three weeks. Following introductions and verbal permission to record the conversation, the interviewer said, "I would like you to try to tell me what thoughts have been going through your mind when you have been anxious or something has been making you anxious in the last three weeks". If this question elicited no thoughts, the subject was asked to recall the last time that he or she felt anxious and to describe the situation in detail. Following this description, the subject was asked to recall any thoughts that he or she was having at the time. If this failed to elicit any thoughts, the subject was asked to select a symptom which he or she associated with anxiety and was asked, "What does this symptom/feeling mean to you?" If the reported thoughts were not clearly verbalised, clarification questions were asked. For example, "Can you be more specific about the thought . . . ?" or "Can you tell me what . . . means to you?" were used to clarify any ambiguities. Once a series of thoughts were elicited, the subject was asked to pick the three which seemed most important and to rank these three in order. Subsequently, two independent raters blindly assigned each of these three thoughts to one of seven categories (illness, injury, death, losing control, failure, shame, and other) determined by Hibbert (1984). A satisfactory level of inter-rater reliability was attained (70%). When there was no agreement, the thought was assigned to a category by consensus.

In order to determine the range of thoughts, subjects were asked whether they had had thoughts in the preceding three weeks which fit into six predetermined categories. As Hibbert (1984) points out, these categories are not meant to be 'all inclusive', only to be similar to those indicated by Beck (1974). Next, the quality of the most important thought was determined by asking the subject to rate this thought on an 11-point Lickert scale (0 = 'not at all' and 10 = 'completely' or 'always') with respect to strength, clarity, credibility, frequency, and tenacity.

The subjects were then asked whether or not they had mental images when anxious in the last three weeks and, if so, a series of questions similar to those used for thoughts were asked in order to determine the range and quality of the most important image. The subjects were asked to select from four choices about what happened when they started to get anxious. Similarly, they were asked to select from four choices about what happened when their anxiety began to ease up. Next they were asked to describe briefly what a typical anxiety episode was like for them. Two raters, blind to whether the subject was a patient or a control, independently decided whether a physical sensation, cognition or emotional state occurred first. Inter-rater agreement (agreements divided by agreements plus disagreements) was 83%.

Finally, the subjects were asked to rate the items on the Stanford Panic Appraisal Inventory (SPAI; Telch, 1984). This instrument consists of 20 statements reflecting some common feelings and thoughts that people report at times of fear and anxiety, and is rated using an 11-point Lickert-like scale (0='not at all troubling' and 10='extremely troubling'). The items were selected by asking a group of patients with panic to rank order their five most troublesome concerns with respect to panic from a larger list of possible items. Twenty items were selected which had the highest overall ranking. In an analysis of 100 patients with panic disorder Brouillard (1988) found a Chronbach alpha for internal consistency of 0.90. For test–retest up to ten months $r=0.73$ was obtained. The SPAI is also sensitive to treatment changes (Brouillard, 1988).

The three most important thoughts from the open-ended interview and the three thoughts with the highest scores from the SPAI were used to create a six-statement instrument. This instrument was presented to patients during the physiological testing described below. The statements were listed in random order and rated on an 11-point Lickert scale (0='not at all troubling' and 10='extremely troubling').

Physiological testing

Only patients participated in this portion of the study. In order to minimise interpersonal influences, psychophysiological testing took place in a sound-attenuated, electrically shielded chamber. The patient sat alone and could not see the laboratory personnel during the test periods, but could communicate with them by intercom at any time.

Patients were familiar with the test setting and the assessment procedures since they had undergone a psychophysiological test battery in the same laboratory on the previous afternoon. The cold pressor test and mental arithmetic were presented in balanced order. During the cold pressor test, the patient's dominant foot was immersed in ice water (at 4°C) for one minute. The mental arithmetic task took five minutes and consisted of serial subtractions of 13 starting at 7683 (Ward *et al*, 1983). The recovery periods and the breaks between these two stress tests were sufficient in length to prevent carry-over effects from one stressor to the other. After these 'non-specific' stress tests, subjects were challenged with CO_2 using a single-blind protocol similar to that of Gorman *et al* (1984). Following 15 minutes of room air (placebo), 5.5% CO_2 in room air was given for 20 minutes. The CO_2 inhalation was terminated before 20 minutes if patients reported severe anxiety and asked to stop. Although the patient was blind to the beginning of the CO_2 challenge, he or she was told when it was over. The next 15 minutes was a recovery period in which the patient breathed room air.

Each patient's electrocardiogram was continuously recorded. Heart rate (HR) was calculated from interbeat intervals and was averaged every ten seconds. Systolic (SBP) and diastolic (DBP) blood pressures were measured automatically. For each paradigm, the first blood pressure measurement was taken 60 seconds after the start of the paradigm and then every 4.5 minutes during baseline, every 2 minutes during cold pressor and mental arithmetic tests, and every 2.5 minutes during CO_2 inhalation.

Patients received written instructions prior to each of the three test paradigms (cold pressor, mental arithmetic, and CO_2 challenge). Instructions mentioned the possibility that subjects might feel increases of anxiety with any of the stress tests. After reading the instructions, and in anticipation of the particular test, patients rated the intensity of their three most important interview thoughts and the three thoughts with the highest scores from the SPAI.

Results

Structured interview

The rater-determined categories of the three most important thoughts provided by the patients can be seen in Table I. Patients reported significantly more thoughts focusing on loss of self-control than did control subjects; controls had significantly more thoughts categorised by the raters as 'other'. The subject-determined range of thoughts indicated that patients reported having significantly more thoughts of losing control and shame than did controls (Table II).

TABLE I

Rater-determined categories of three most important interview thoughts

Category	*Patients (n=60 thoughts)*		*Controls (n=30 thoughts)*	
	%	n	%	n
Illness	18	(11)	13	(4)
Death	7	(4)	0	(0)
Loss of self-control	23	(14)	3	(1)*
Injury to self or other	3	(2)	0	(0)
Inability to cope	12	(7)	17	(5)
Social embarrassment	5	(3)	6	(2)
Other	30	(19)	60	(18)**

*$P<0.02$, controls v. patients (χ^2 test).
**$P=0.01$.

TABLE II

Patient-determined range of thoughts; percentage of individuals who have thoughts with the designated content when anxious

Category	*Patients (n=20)*		*Controls (n=10)*		*Hibbert (n=17)*	
	%	n	%	n	%	n
Illness	55	(11)	20	(2)**	77	(13)
Death	35	(7)	10	(1)	53	(9)
Losing control	85	(17)	40	(4)*	94	(16)
Injury	45	(9)	50	(5)	12	(2)
Failure	60	(12)	60	(6)	71	(12)
Shame	70	(14)	30	(3)*	47	(8)

*$P<0.05$, controls v. patients (Fisher's exact test).
**$P<0.08$.

TABLE III
Subjective qualities of 'most important' thought

Subjective qualities	*Patients* (n = 20)*	*Controls* (n = 10)*	P**	*Hibbert patients* (n = 17)*
Strength	8.1	4.5	0.0001	8.0
Clarity	8.9	7.0	0.02	7.8
Ability to exclude from mind when anxious	2.8	6.7	0.0007	3.5
Credibility when anxious	5.8	7.4	NS	3.5
Anxiety present when having this thought	7.9	4.8	0.007	7.3

*Mean Lickert scale (0–10) scores.
**Hotelling T^2-test.

Only two controls reported thoughts centring on illness when they were anxious ($P<0.08$, patients v. controls). Patients in Hibbert's study reported a slightly different pattern from patients in this study, with fewer of them worried about injury during the event and more worried about death.

Table III shows the 'subjective quality' of the most important thoughts for patients and controls. An overall Hotelling T^2-test showed a significant difference between the two groups ($P<0.05$). Subsequent comparisons on single variables revealed that patients were significantly more anxious when having their 'most important thought' than were controls ($t=2.93$, $P=0.007$). In addition, there were significant differences between patients and controls in the subjective quality of the most important thoughts with respect to strength ($t=4.81$, $P=0.0001$), clarity ($t=2.46$, $P=0.02$), and ability to exclude these thoughts from the mind when anxious ($t=3.85$, $P=0.0007$).

When asked during the interview which of four events occurred first during an episode of anxiety, both patients and controls reported that, most frequently, a feeling of anxiety without a thought was the first event of their anxiety (70% for both). Ratings of the patients' and controls' descriptions of a typical anxiety episode corroborated that a feeling of anxiety without a thought was the first reported event, at least in patients. With 83% agreement, two independent raters found that 85% of the patients described a bodily event as the initial occurrence during a typical anxiety episode, while only 44% of controls described a bodily event as the first occurrence.

Presented with four possible sources of relief of anxiety, 40% (8/20) of patients chose 'you fight it and force it out of you', compared with 10% (1/10) of controls ($P<0.1$, Fisher's exact test), while 60% (6/10) of controls chose 'you reassure yourself', compared with 20% (4/20) of patients ($P<0.05$, Fisher's exact test).

Questionnaire

Patients scored significantly higher on the SPAI than controls (85.0 and 26.5, respectively; $t=4.19$, $P=0.0003$).

Physiological correlations

The ratings given by patients to the six thoughts (three interview, three highest scored from SPAI) before exposure to the three stress tests (CO_2 inhalation, cold pressor, mental arithmetic) were correlated with changes in systolic and diastolic blood pressure and changes in heart rate in the anticipation and stress periods. For this purpose, and for each of the stressors' changes, scores were calculated between the sum of the baseline values of these variables and the respective values during anticipation and stress. Correlations using sums of thought ratings yielded the same results as using either individual thoughts or weighted sums of thoughts (i.e. the value given by the patient to the first thought multiplied by three, the value given to the second thought multiplied by 2, and the value given to the third thought multiplied by 1 prior to summing the three thoughts).

The only significant correlation between the sum of anxious thoughts and physiological parameters in *anticipation* of the three stress tests was between the sum of the interview thoughts and the changes in diastolic blood pressure ($r=0.46$, $P<0.05$) in anticipation of mental arithmetic.

Table IV shows correlations between the sums of scores given to the three interview thoughts in anticipation of stress testing and the physiological parameters *during* each of the three stress tests. Significant correlations were obtained between the intensity of thoughts and changes in diastolic blood pressure and heart rate during mental arithmetic.

TABLE IV
Correlations between thought ratings in anticipation of stress testing and changes during stress testing

Sum of intensity scores[1]	*Stress testing variables: change from baseline to task*		
	SBP	*DBP*	*HR*
I-T before CO_2	0.14	0.11	0.15
SPAI-T before CO_2	0.21	0.16	0.24
I-T before MA	0.29	0.38*	0.61**
SPAI-T before MA	0.26	0.49*	0.58**
I-T before CP	0.17	−0.21	0.05
SPAI-T before CP	0.21	−0.10	0.00

*$P<0.05$.
**$P<0.01$.
1. Sum of intensity scores (0–10) of three interview thoughts (I-T) or three Stanford Panic Appraisal Inventory thoughts (SPAI-T) before CO_2, mental arithmetic (MA) or cold pressor (CP). SBP = systolic blood pressure. DBP = diastolic blood pressure. HR = heart rate.

Results were similar for the sum of the three thoughts from the SPAI (also in Table IV).

Discussion

The first purpose of this study was to replicate and extend previous findings on ideation of patients with panic disorder (Hibbert, 1984; Rapee, 1985; Ottaviani & Beck, 1987). We found, in concurrence with Hibbert, that loss of control during times of anxiety is the most common thought in anxious patients.

Of Hibbert's 17 patients with panic attacks, eight reported 'most important thoughts' as having a heart attack (five subjects) or dying (three subjects). In our interview, only one out of 20 reported a thought so directly related to personal danger ('I might have a heart attack') as 'most important'. Further, on the SPAI, the items 'I may have a heart attack' or 'I may die' were endorsed as most important of the 20 items on the scale by only four patients.

This difference might be related to the methodologies of the interviews. Hibbert's (1984) and Beck *et al's* (1974) interviews with patients were conducted face to face; ours were conducted over the telephone. A direct face-to-face interview with a clinician might produce a more anxious state in the subject and thus lead to more thoughts around the issues of personal danger. On the other hand, a telephone interview during which the subject was in familiar and 'safe' surroundings might not predispose the subject to a state of high anxiety and thus might not bias the interview towards eliciting personal danger thoughts. Indeed, several subjects commented that they felt more comfortable revealing details about themselves because the interview was *not* face to face.

The significant differences between patients and controls on the SPAI further support the notion that patients and controls differ in cognitions. Using a cut-off of 50, the SPAI correctly identified 18 anxious patients and 9 controls. Thus, in this population, the SPAI was 90% sensitive and 90% specific.

Although the use of a control group is an improvement over other studies, a control group is subject to the same methodological problems of any self-report study. For both patients and controls, the data are retrospective and subject to recall and experimental demand bias. For instance, non-anxious controls might be reluctant to report a feeling of losing control during anxiety even if they were having one.

The second purpose of this study was to analyse the sequence of events of a typical episode of severe anxiety in both patients and controls. We found that both patients and controls most frequently reported a feeling of anxiety without a thought as the first event in an anxiety episode (70% for both). There were no differences in either of the other three choices by percentage (a thought without a feeling of anxiety, both a thought and feeling at the same time, or don't know). Hibbert found that 53% of his subjects with panic attacks reported a feeling of anxiety without a thought as the first event in an episode of anxiety.

The analysis of the brief descriptions of an episode of anxiety by both patients and controls also supported this finding for patients. In 85% of the patients, a bodily event was the initial awareness of anxiety. It appears that bodily symptoms usually precede other events in anxious patients. This suggests that most of the time 'faulty cognitions' are not the initial event in a panic attack, although they may exacerbate or maintain it.

The third purpose of the present study was to test the hypothesis that the degree to which panic patients report being disturbed by anxiety-related cognitions is significantly correlated with the degree of physiological arousal in anticipation of and during stressful events. We found that the most important thought at one time is not necessarily the most important thought at another. In anticipation of the CO_2 inhalation test, patients did not report the thought that they had indicated during the telephone interview as most troublesome at times of anxiety. The same result occurred in anticipation of the cold pressor test. These data suggest that the 'most important thought' varies from one situation to another, either because thoughts are situationally specific or because an underlying anxious state of mind may predispose to anxious thoughts (Horowitz *et al*, 1983).

Finally, the physiological aspect of this study showed us that the reactivity to physical stressors (cold water and CO_2) did not correlate significantly with an increase in troublesome thoughts either in anticipation of or during these stress tests. The stressors may have produced as yet undefined non-stress-related physiological changes which overrode whatever effect cognitions had in producing physiological change. The only significant correlation between change in physiology in response to a stressor and intensity of troublesome thoughts was found in anticipation of and during the mental arithmetic test. Thus the intensity of cognition was only significantly related to physiological change in the condition where there was no external stimulus, such as cold water or inhaled CO_2, driving the physiology.

The results of our work have several implications for the assessment and treatment of panic disorder. First, a paper and pencil test, the SPAI, can be used

to differentiate between patients with high anxiety and controls, and presumably would serve as a good outcome measure of changes in cognition in appropriate populations. Second, a focus on security and control issues in the context of therapy might have significant impact on reducing anxiety states which, left to escalate, can and do culminate in panic attacks. These findings are consistent with the cognitive interventions suggested by Beck and Emery (Beck *et al*, 1985) and with the psychophysiological model which suggests that a positive feedback loop, with thoughts as one component of the loop, is responsible for culmination of an anxiety state in a full-blown panic attack. Third, more studies are needed to delineate the phenomenology of anxiety states as they develop over time. Specifically, chronological monitoring of behaviour, physiology, cognition and bodily symptoms might reveal patterns representing discrete panic attacks and anxious states of mind. Further, this kind of monitoring might elucidate whether or not there is a predictable sequence among these anxiety components.

References

AMERICAN PSYCHIATRIC ASSOCIATION (1987) *Diagnostic and Statistical Manual of Mental Disorders* (3rd edn, revised) (DSM-III-R). Washington DC: APA.

BECK, A. T., EMERY, G. D. & GREENBERG, R. (1985) *Anxiety Disorders and Phobias, a Cognitive Perspective*. New York: Basic Books.

——, LAUDE, R. & BOHNERT, M. (1974) Ideational components of anxiety neurosis. *Archives of General Psychiatry*, **31**, 319–325.

BROUILLARD, M. (1988) Effects of behavioral, cognitive behavioral, and drug treatments on the catastrophic fears of agoraphobics. Unpublished dissertation, Stanford University.

CLARK, D. M. (1986) A cognitive model of panic. *Behaviour Research and Therapy*, **24**, 461–470.

EHLERS, A., MARGRAF, J. & ROTH, W. T. (1988*a*) Interaction of expectancy effects and stressors in a laboratory model of panic. In *Neurobiological Approaches to Human Disease* (eds D. Hellhammer, I. Florin & H. Weiner). Toronto: Huber.

——, MARGRAF, J. & ROTH, W. T. (1988*b*) Selective information processing, interoception, and panic attacks. In *Treatment of Panic and Phobias* (eds I. Hand & H. U. Wittchen). Berlin: Springer.

GOLDSTEIN, A. J. & CHAMBLESS, D. L. (1978) A reanalysis of agoraphobia. *Behavior Therapy*, **9**, 47–59.

GORMAN, J., ASKANAZI, J., LIEBOWITZ, M., *et al* (1984) Response to hyperventilation in a group of patients with panic disorder. *American Journal of Psychiatry*, **141**, 857–861.

HAMILTON, M. (1959) The assessment of anxiety state by ratings. *British Journal of Medical Psychology*, **32**, 50–55.

HIBBERT, G. A. (1984) Ideational components of anxiety. *British Journal of Psychiatry*, **144**, 618–624.

HOROWITZ, M. J., SIMON, N., HOLDEN, M., *et al* (1983) The stressful impact of news of risk for premature heart disease. *Psychosomatic Medicine*, **45**, 32–40.

LADER, M. (1975) *The Psychophysiology of Mental Illness*. London: Routledge and Kegan Paul.

LEY, R. (1985) Agoraphobia, the panic attack and hyperventilation syndrome. *Behaviour Research and Therapy*, **23**, 79–81.

MARGRAF, J., EHLERS, A. & ROTH, W. T. (1986) Biological models of panic disorder and agoraphobia: a review. *Behaviour Research and Therapy*, **24**, 553–567.

MATHEWS, A. M., GELDER, M. G. & JOHNSTON, D. W. (1981) *Agoraphobia: Nature and Treatment*. New York: Guilford Press.

OTTAVIANI, R. & BECK, S. T. (1987) Cognitive aspects of panic disorders. *Journal of Anxiety Disorders*, **1**, 15–28.

RAPEE, R. (1985) Distinction between panic disorder and generalized anxiety disorder: clinical presentation. *Australian and New Zealand Journal of Psychiatry*, **19**, 227–232.

SPEILBERGER, C. D., GORSUCH, R. L. & LUSHENE, R. E. (1970) *State-Trait Anxiety Inventory*. Palo Alto: Consulting Psychologists Press.

SPITZER, R. L. & WILLIAMS, J. B. (1983) *Structured Clinical Interview for DSM-III*. New York: New York State Psychiatric Institute.

TELCH, M. J. (1984) Stanford Panic Appraisal Inventory. Unpublished scale, Stanford University.

VAN DEN HOUT, M. A. (1988) The explanation of experimental panic. In *Panic: Psychological Perspectives* (eds S. Rachman & J. D. Maser). Hillsdale, N. J.: Lawrence Erlbaum.

WARD, M. M., MEFFORD, I. N., PARKER, D., *et al* (1983) Epinephrine and norepinephrine responses in continuously collected human plasma to a series of stressors. *Psychosomatic Medicine*, **45**, 471–486.

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