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CASE REPORT

Panic Disorder With Vestibular Dysfunction: Further Clinical Observations and Description of Space and Motion Phobic Stimuli

ROLF G. JACOB, M.D.,[1] SCOTT O. LILIENFELD, M.A.,[2]
JOSEPH M. R. FURMAN, M.D., PH.D.,[3] JOHN D. DURRANT, PH.D,[4]
SAMUEL M. TURNER, PH.D.[1]

[1]Western Psychiatric Institute and Clinic, Department of Psychiatry, Pittsburgh, [2]Department of Psychology, University of Minnesota, Minneapolis, [3]Vestibular Section, and [4]Section of Audiology, University of Pittsburgh School of Medicine

Abstract—The phenomenology of panic was examined in eight patients with panic disorder referred for vestibular and audiological testing due to symptoms of dizziness or imbalance between or during panic attacks. It was found that all patients had otoneurological abnormalities; half of the patients showed abnormalities consistent with dysfunction of the peripheral vestibular organ. An analysis of situations or activities that elicited anxiety and/or discomfort revealed a "space and motion phobic" stimulus pattern. Space and motion stimuli are characterized by one of the following attributes: (a) excessive vestibular stimulation; (b) lack of visual orienting or fixation cues; (c) unusual, incongruous, or complex movements of both the visual surround and self. A case description is included to illustrate the longitudinal development of panic vestibular symptoms. The relationship between panic disorder and vestibular disorders and its implications for treatment are discussed.

The relationship between anxiety or panic and vestibular dysfunction has been of interest since the turn of the century (see Gordon, 1986; Jacob, 1988, for reviews). In more recent times, Hallpike, Harrison, and Slater (1951) reported that subjects with neurotic anxiety had a higher than normal incidence of both hyperactive responses and directional preponderance in the caloric test, and Pratt and McKenzie (1958) reported

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Address correspondence and reprint requests to Rolf G. Jacob, M.D., Western Psychiatric Institute and Clinic, Department of Psychiatry, 3811 O'Hara Street, Pittsburgh, PA 15213, U.S.A.

several patients in whom anxiety disorders developed following symptoms implicating the vestibular system. Dix and Hood (1973) found a high prevalence of anxiety neurosis among patients with vestibular neuronitis who tended to visually suppress nystagmic responses, a finding consistent with the hypothesis that anxiety disordered patients with vestibular neuronitis rely on visual fixation to inhibit the effect of disordered vestibular input (Hood, 1975).

In a previous study, we found abnormalities on vestibular function tests in 14 of 21 panic patients with or without agoraphobia who had symptoms of imbalance during panic attacks or dizziness between attacks (Jacob, Moller, Turner, & Wall, 1985). These results suggested that vestibular dysfunction may be related to panic, at least in a subgroup of panic patients. Hamlin (1988) recently reported differences in the thyrotropin releasing hormone responses of panic patients without or with vertigo-like symptoms, suggesting that the subgroup of panic patients with vestibular dysfunction can be distinguished from other panic patients by neuroendocrinological parameters.

If abnormalities in the vestibular system are involved in some cases of panic disorder, one would expect these panic patients to report symptoms that implicate the vestibular system. Symptoms of vestibular dysfunction typically involve vertigo and nausea (Brandt & Daroff, 1979) but may be limited to more subtle and vague sensations, such as feelings of swaying, rocking, and unsteadiness (Hoffman & Brookler, 1978; McCabe, 1975). In addition, symptoms of ear fullness, headache, and visual disturbances, such as blurred or double vision, may occur.

Symptoms of vestibular dysfunction tend to be triggered in certain characteristic situations. For example, the "supermarket syndrome" is intolerance of looking up and down shelves or back and forth across aisles. The "motorist's disorientation syndrome" is intolerance to driving over the crest of hills and on open featureless roads (Page & Gresty, 1985). "Space phobia" involves fear of falling when no support is nearby and anxiety caused by a paucity of visual cues for orientation in space. The latter syndrome has been described in patients with neurological and vestibular disorders (Marks & Bebbington, 1976; Marks, 1981).

The main purpose of the present study was to further describe the symptoms of panic patients with complaints referable to the vestibular system. We focus on a pattern of stimuli or cues that tend to be associated with increased discomfort or prepanic sensations, a pattern we have labeled space and motion phobia. We also describe the vestibular and ear-related symptoms in these patients in some detail. We hope the results will alert clinicians to such symptoms and cues in their clinical evaluations of patients with panic disorder.

METHOD

Eight patients were selected from outpatients evaluated for treatment at the Anxiety Disorders Clinic of Western Psychiatric Institute and

Clinic. These subjects were referred to undergo a battery of vestibular and audiological tests (to be described below) if they had (a) panic disorder or agoraphobia with panic attacks as the primary diagnosis, and (b) reported symptoms of imbalance between or during attacks or experienced dizziness between attacks. Psychiatric diagnoses were established according to DSM-III criteria and based on information elicited in a semistructured interview, the IEF (Initial Evaluation Form: Mezzich, Dow, Rich, Costello, & Himmelhoch, 1981). This interview was conducted by a psychology intern or a psychiatric nurse–clinician, and the diagnosis was confirmed in a second brief interview with the senior author, who also decided upon the need for vestibular evaluation.

The patient group consisted of 5 males and 3 females, with a mean age of 37.5 years (range 24–55). The mean duration of illness was 12.4 years (range 2–20). Five patients received DSM-III diagnoses of agoraphobia with panic attacks, and three, of panic disorder. Two of the patients also had secondary diagnoses of obsessive–compulsive disorder; the development of compulsive checking behavior followed the onset of panic attacks after two months in one patient and five years in the other patient. The latter patient also had a secondary diagnosis of social phobia. At the time of vestibular testing, none of the patients was taking antidepressants or minor tranquilizers. Vestibular testing was completed between 0 and 2 years before the assessment of eliciting stimuli; the latter assessment involved recontacting patients who had been previously tested.

Vestibular and Audiological Testing

The basic vestibular test protocol has been described earlier (Jacob, Moller, Turner, & Wall, 1985) and included posturography (computerized Romberg test), ocular motor screening tests, rotational testing, positional testing, and caloric testing. One difference between the current vestibular test battery and the one used by Jacob et al. (1985) was that the rotational, caloric, and positional tests were done with eyes open behind opaque goggles, rather than with eyes closed. This change was instituted due to recent findings of less variability and greater magnitude of the nystagmus when subjects are tested with opaque goggles (Wall and Furman, in press; Baloh, Solingen, Sills, & Honrubia, 1977). The audiological test battery included pure tone and speech audiograms, tympanograms, acoustic reflexes, and auditory brain stem evoked potentials.

After the vestibular and audiological tests, all patients received a careful neurological examination by one of the coauthors (JMRF). Of the eight patients, three had CT scans, all of them normal.

Assessment of Symptoms and Eliciting Stimuli

The patients completed three questionnaires designed to provide descriptive information concerning balance dysfunction, panic phenomenology, and elicitors of anxiety or panic. In addition, patients were interviewed to obtain information on idiosnycratic elicitors of panic not covered by the questionnaires, and to study the time sequence relating vestibular symptoms to panic symptoms.

The *Dizziness History Questionnaire*, a partially open-ended questionnaire, inquires about onset and characteristics of balance dysfunction, elicitors of dizziness, concomitant ear-related symptoms, potentially relevant medical disorders, and intake of coffee or alcohol.

The *Symptom Questionnaire* is a 25-item questionnaire for specific somatic panic symptoms. The questionnaire elicits ratings on these symptoms on a four-point Likert-type scale (never, sometimes, often, very often) and does this separately for panic attacks and intervals between panic. The items were classified into the following categories: (a) imbalance, for example,"veering to the right or left"; (b) nonspecific dizziness, for example "lightheadedness"; and (c) not related to dizziness, for example, "heart palpitations." In a group of 27 agoraphobics not assessed in this study, the test–retest reliability (indexed by the Spearman rank-order correlation) of a dizziness subscale, consisting of the ten vertigo and nonspecific dizziness items, was $r = .83$ for symptoms during attacks and $r = .89$ for symptoms between attacks (Jacob & Beidel, in preparation).

The *Situational Characteristics Questionnaire* was devised for this study to assess the effect of certain aspects of common phobic situations thought to elicit vestibular sensations. The items of the questionnaire were derived from the literature (e.g., Marks, 1981; Page & Gresty, 1985; Hoffman & Brookler, 1978), and our own experience with panic patients with vestibular disorders. The questionnaire involves ratings of discomfort or anxiety in response to two or three specific aspects of a particular phobic situation on a four-point Likert-type scale. For example, for the *situation* of "riding as a passenger in a car," subjects are asked to rate the anxiety or discomfort associated with the *characteristics* of "changing speed" and "traveling at steady speed." The questionnaire consists of "vestibular items" and "validity items." Each "vestibular" item compares a situational characteristic predicted to elicit vestibular sensations with one not thought to elicit vestibular sensations. The "validity" items assess dimensions expected to be endorsed by most agoraphobics (e.g., being "near" vs. "far" from an exit in a supermarket).

RESULTS

Vestibular and Audiological Findings

Two of the patients experienced panic attacks during vestibular testing, in both cases necessitating termination of the procedures. Both were able to complete the tests on a later occasion.

Table 1 lists the results of the vestibular and audiological test battery. Posturography was associated with the highest frequency of abnormal

TABLE 1
RESULTS OF VESTIBULAR TESTS

Subject	Positional test	Caloric test	Rotational test	Posturography	Audiometric findings	BSER
S1	N	↓R	N	Abn	N	. . .
S2	N	↓R	N	N	N	N
S3	N	N	N	Abn	HL1	CP
S4	N	↓L	N	Abn	N	N
S5	N	N	N	N	HL2	RP
S6	N	N	DP	Abn	N	N
S7	N	N	DP	Abn	HL3	N
S8	N	↓L	N	Abn	HL4	CP

N = Normal test result.
Abn = Abnormal.
↓L = Left reduced vestibular response.
↓R = Right reduced vestibular response.
DP = Directional preponderance.
HL1 = Bilateral high-frequency loss, mild–moderate degree.
HL2 = Bilateral mild 4 KHz "notch," or "noise" audiogram; some noise exposure history.
HL3 = Unilateral mild 4 KHz "notch," or "noise" audiogram; denies significant noise history.
HL4 = Similar to HL1, but 4 KHz "notch" and significant noise history.
CP = Cochlear pattern, findings consistent with hearing loss on audiogram.
RP = Retrochochlear pattern; could not rule out retrocochlear pathology.

responses; six of the eight patients receiving the test had abnormal responses (75%). In all the cases, performance on the posturography test relative to laboratory norms was poorer when the test was done with the subject's eyes closed, whereas performance with eyes open was normal in most cases. The caloric test was abnormal (defined as unilateral reduced vestibular response of more than 25% or directional preponderance by more than 30%) in four of the eight patients tested (50%). In all the abnormal cases, the testing indicated a unilaterally reduced vestibular response. Such abnormality usually is thought to indicate dysfunction in the vestibular nerve or peripheral vestibular organ. The rotational test was abnormal in two patients, showing a directional preponderance.

The audiograms showed varied abnormalities in four of the cases; most of the abnormal audiograms were suggestive of noise damage. The acoustic (middle ear muscle) reflexes were elicited at acceptable levels of stimulation in all but one patient in whom the tympanogram showed slightly reduced mobility of the right tympanic membrane/ossicular chain. The brain-stem auditory evoked response showed changes consistent with hearing loss ("cochlear pattern") in two cases. One patient demonstrated a questionable finding. With stimulation of the left ear, as compared to the right ear, the wave forms were less well defined, and there was a somewhat prolonged I-V interpeak interval. This finding did not permit the examiner (J.D.D.) to rule out retrochoclear dysfunction unequivocally.

Examination of the overall pattern of findings revealed that seven of the eight patients (88%) had at least one vestibular test abnormality. The one subject with normal vestibular findings was the one noted above who had questionable findings on the test of the brain-stem auditory evoked response. No formal comparison group of normal subjects was included in this study, but it is worth noting that a normal group of subjects, reported by Jacob (1988) showed a much lower rate of abnormalities.

Phenomenology and Eliciting Stimuli

On the *Dizziness History Questionnaire,* four of the eight patients reported experiencing dizziness upon head motion (i.e., turning the head to the left or right or bending the head forward or backward). Four patients stated that they often experienced motion sickness while riding in automobiles. Six patients reported persistent feelings of pressure in at least one ear, and six patients reported tinnitus. Four patients reported headaches; two patients reported ear pain. No patients reported double vision. Only one patient reported a history of earaches or ear infections in childhood.

On the *Symptom Questionnaire* for "between panic attacks," four of the eight patients reported that they at least "sometimes" had sensations of "veering to the left or right" and "tendency to lose balance." Three patients reported spinning sensations inside their heads. In addition, five patients reported heart palpitations and feelings of pressure in the chest.

For "during panic attacks," four patients reported that they "often" or "always" had tendencies of veering to the left or right or of falling or losing balance. Three patients reported spinning sensations in the head; however, no patient reported the type of vertigo in which the environment is perceived as spinning. The patients also had other somatic panic symptoms such as pressure in the chest and dry mouth (five patients), and heart palpitations (four patients).

The results of the *Situational Characteristics Questionnaire* are presented in Table 2. Two situations, "airplanes" and "escalators," were excluded from the table. Escalators was excluded because this situation was problematic for only one of the patients; "airplanes" was excluded because three of the patients did not fly and had missing data for this item.

As can be seen in Table 2, concerning the *tunnels* situation, seven of the eight patients reported more discomfort when looking at the lights moving by at the side of the tunnel as opposed to fixating on the end of the tunnel. Concerning *riding in a car,* seven of the patients reported more anxiety or discomfort on winding versus straight roads; six reported more discomfort when changing speed versus riding at steady speed; and five, when riding downhill versus uphill. Similarly, concerning walking down an aisle in a *supermarket,* four patients reported that looking at the items on the shelf was worse than looking at the end of the aisle; thus, the "supermarket syndrome" (McCabe, 1975) was present in half of the patients. Further inspection of Table 2 reveals that, in most cases, the char-

TABLE 2
RESPONSES TO THE SITUATIONAL CHARACTERISTICS QUESTIONNAIRE[a]

			Item causing the most discomfort (# of subjects)		
Situation	First Dimension	Second Dimension	First Dimension	Second Dimension	No difference
Riding as passenger in a car					
	Back seat	Front seat	4	1	3
	Reading	Looking out window	4	0	4
Roads:	Winding	Straight	7	1	0
	Narrow	Wide	4	1	3
	Bumpy	Smooth	4	1	3
Speed:	Changing	Steady	6	0	2
Hills:	Down	Up	5	2	1
Riding on a Bus[b]					
	Standing on platform	Sitting	5	1	1
	Standing still	Moving	4	2	1
Supermarkets[b]					
	Looking at items on shelf	Looking at end of aisle	4	1	2
Tunnels					
	Curved	Straight	3	0	5
	Looking at lights on side	Looking at light at the end	7	0	1
Large Fields or Squares					
	Open	Enclosed (trees, fences)	3	1	4
	Middle	Edge of field	3	1	4
Movie Theaters					
	Sitting far in front	Sitting in back	5	1	2
	Wide screen	Narrow screen	4	1	2
Elevators					
	Stopping[b]	Moving at steady speed	5	1	1
	Moving	Stationary	4	1	3
	Stopping	Starting	3	1	4
	Glass[b]	Standard	4	0	1

[a] Most frequently endorsed item listed first; only vestibular items are listed.
[b] Responses do not add up to 8 due to subjects not responding to this item.

acteristic thought to produce vestibular sensations produced more discomfort than did the contrasting characteristic (see Discussion).

Direct Interviews

Direct interviews yielded a number of other interesting eliciting stimuli. One patient (S6) reported anxiety when the floor of his mobile home was moving while his wife was walking in it; he also reported anxiety when riding in a car as a passenger, if the car was coming to a halt at a traffic light and he was uncertain whether the car had completely stopped. S2 similarly experienced anxiety during sudden changes in head position while in cars.

Even more idiosyncratic triggers were described by several other patients; S7, for example, noted that vibrations from his automatic toothbrush often produced discomfort. S4 became anxious while looking at moving ceiling fans. Two patients reported remarkably similar elicitors of anxiety that occurred while watching television. S4 stated that she was bothered by program or movie credits scrolling down the screen, and by watching the picture move horizontally during a football game as the camera followed players running down the field. S8 told us that he was made uncomfortable by vertical instability or interference on his television screen.

Case Illustration

The data on the phenomenology of panic presented thus far are cross-sectional in nature. The case description below of patient S2 is included to illustrate the development of panic and vestibular symptoms over time.

The patient, S2, was a 36-year-old female with a 15-year history of panic disorder involving four separate episodes. The first episode of panic attacks occurred during high school while the patient was receiving driving instructions. The second occurred at age 21 and resulted in inpatient psychiatric hospitalization; this episode began with a panic attack that occurred while she was riding on a bus. Subsequently she almost fainted while visiting a supermarket. The third episode occurred at age 29; panic attacks were reported to be triggered by dizziness. She developed fears of leaving her house that she was able to overcome by "pushing" herself.

The last episode began four weeks prior to our initial diagnostic evaluation. The first panic attack in this episode occurred one morning when she noted, upon awakening, that she was unable to lift her head from the pillow without experiencing vertigo (environment spinning). The panic attack was accompanied by shortness of breath, sweating, palpitations, fear of dying, derealization, and depersonalization. Two months prior to this episode, she had almost lost her balance when leaving an elevator. There was no hearing loss or tinnitus, but there was a sense of fullness and pain in her right ear.

After the onset of the last episode, the patient developed a rather narrow profile of phobic avoidance, with driving through tunnels being the most consistently avoided situation. She also intermittently avoided crowded stores, malls and churches. Her panic-related cognitions centered around fears of medical illness, particularly of having a stroke or brain tumor. She reported that her anxiety in tunnels increased when her view of the light at the end of the tunnel was blocked or when she allowed herself to pay attention to the lights moving into the periphery of her visual field. She could control the anxiety by focusing her gaze on the end of the tunnel.

Comment This patient's latest two panic episodes were preceded by symptoms of dizziness. The last episode began with an episode of vertigo. Her earlier episodes showed evidence of elicitation by movement (driving, riding in a bus). A review of the temporal relationship between panic and symptoms of vestibular dysfunction in the other patients in this study indicated that three of the other seven patients showed similar histories of close temporal relationships between episodes of vestibular symptoms and onset of panic episodes (patient S4, S6, S7). One patient had vestibular symptoms during childhood and onset of panic in young adult life (patient S1); one patient had anxiety symptoms preceding the vestibular symptoms (patient S5).

DISCUSSION

In this paper we have described the vestibular function and phenomenology of eight patients with panic disorder. The patients were selected for vestibular testing because they reported symptoms attributable to the vestibular system during their initial psychiatric evaluations. Many of the patients reported tendencies to lose balance and of veering to the right or left. Some of the patients reported spinning sensations inside their heads; however, none reported true sensations of the environment spinning. The high prevalence of such "vestibular" symptoms in our patients obviously is a reflection of our selection procedure. Nevertheless, similar symptoms have been observed in panic patients by others (e.g., Hamlin, 1988; Pratt & McKenzie, 1958).

The neuro-otological test battery revealed abnormalities in all of the patients. The results of the vestibular tests implicated the peripheral vestibular organ in half of the cases. Although the otoneurological test battery includes sensitive indicators of vestibular dysfunction, these tests by themselves do not permit the confirmation of specific structural abnormalities in the vestibular system. The audiological evaluation was included to further localize and specify the nature of the vestibular abnormalities. The patients had either normal audiograms or audiograms not characteristic of classic Meniere's disease (i.e., low-frequency hearing loss). Furthermore, all the patients had normal otoscopic evaluations and, with one exception, normal tympanograms, thus making it unlikely that they had significant middle ear disease. In general, we believe that the constellation of vestibular and audiological findings are not consistent with a *generalized* inner ear disorder (i.e., one that involves both the vestibular and audiological system); rather, the abnormalities found appear to be limited to the vestibular system per se.

The symptoms of these patients also included a number of ear-related symptoms, such as ear fullness and tinnitus. Gordon (1986) had prompted us to look for the ear fullness symptom; it was reported by six of the eight patients. Ear fullness is a nonspecific symptom occurring in both middle ear disease and labyrinthine disease. The normal tympanograms and otoscopic evaluations make middle ear disease an unlikely cause for the ear fullness symptom in our patients. Gordon (1986) hypothesized that this sensation is due to altered labyrinthine pressure; indeed, fullness is commonly reported by patients with endolymphatic hydrops (Meniere's disease). Tinnitus was also commonly reported, but none of our patients presented with the full Meniere's syndrome, which includes significant mid-frequency hearing loss and covariation in time between the symptoms of dizziness and tinnitus.

In addition to having vestibular and ear-related symptoms, most of our patients reported that their discomfort increased during certain activities or in certain situations characterized by movement, by complex interactions between movements of self and the visual surround, or by a paucity of visuospatial cues. This stimulus pattern is similar to that of the space phobic patients reported by Marks (1981); however, because the stimulus pattern not only included "space" but also "motion" cues, we will label this class of stimuli as "space and motion phobic" stimuli.

The space and motion phobic stimuli can be classified into one of the following three categories:

1. Situations characterized by few or confusing visual stimuli suitable for fixation or orientation in space, e.g., standing in an open field or viewing a wallpaper with certain patterns such as vertical stripes;
2. Excessive vestibular stimulation such as that during vigorous head movement; and
3. Unusual, incongruous or complex information from combined visual and vestibular motion cues. The latter class of stimuli includes (a) situations in which head motion is sensed by the vestibular system but not by the visual system, for example, riding in the back seat of a car or being in a mobile home in which the floor is moving; (b) sensations in which motion is sensed by the visual system but not the vestibular system, e.g., looking at wide screen movies or observing moving optokinetic stripes; (c) combined visual and vestibular sensations that are incongruous or complex, for example, walking down supermarket aisles while looking at the shelves, watching the lights at the side of a tunnel pass, or riding in glass elevators. Interestingly, stimuli involving unusual and incongruous vestibular–vestibular interactions are known to elicit motion sickness in normals (Money, 1970).

As mentioned earlier, similar discomfort-eliciting stimuli were described by Page and Gresty (1985) in patients with vestibular dysfunction and by Marks and Bebbington (1976) in their report on "space phobia." Marks (1981) considered space phobia to be caused by neurological or vestibular disorders and distinct from agoraphobia. Our study suggests that "space-phobic" symptoms also occur in primary panic disorder and agoraphobia. Hence, we have used the term "space and motion phobia" to describe a specific stimulus pattern rather than a separate syndrome.

Space and motion phobic stimuli may be quite subtle and easily overlooked, unless specifically investigated. For example, one of the patients described by Barlow and Cerny (1988, p. 161) showed a mystifying pattern of panic always occurring during the third-hour class in his job as a high school teacher. Only after further observations that included the patient tape-recording this class did it become apparent that the panic symptoms always occurred while the patient was taking attendance, an activity associated with frequent backward and forward head movements. It was found that these head movements generated prepanic sensations of dizziness and anxiety. Although it is not known whether this patient had vestibular dysfunction, the panic elicitor of head movements fits quite nicely into our schema for space and motion phobic stimuli.

The neurological basis for the complaints engendered by space and motion phobic stimuli may relate to the fact that the activity of the vestibular nuclei is affected both by self-motion and movement of the visual surround (Waespe & Henn, 1977). That is, at subcortical levels, self-motion and movement of the visual surroundings would be expected to induce comparable changes in neural activity. Vestibular dysfunction may lead to a mismatch of vestibular and visual sensitivities. Such a mismatch could be particularly symptom-provoking during movement in a lighted visual surround wherein the patient is experiencing both self-motion and movement of the visual surround (e.g., looking at lights at the sides of tunnels while driving).

Although this study demonstrated a high prevalence of vestibular abnormalities in panic patients who had been preselected for symptoms characteristic of vestibular dysfunction, it does not demonstrate a definite relationship between panic disorder and vestibular dysfunction. This conclusion would require data on the prevalence of vestibular dysfunction in unselected cases of panic disorder in comparison with patients with other psychiatric disorders and normals. We are currently in the process of conducting such a study. We also do not know if the intolerance to space and motion phobic stimuli found in our patients is specific to those with vestibular dysfunction, because we have not yet examined this pattern in panic patients with normal vestibular test findings. For example, Marks (1987) describes the "visual cliff" as representing a normal innate fear in land-dwelling animals, an exaggerated version of which can be observed in height phobia and agoraphobia.

Furthermore, the exact nature of the relationship between vestibular dysfunction and panic is still unclear. Both somatopsychic and psychosomatic relationships are possible (Jacob, 1988). With respect to *somatopsychic relationships,* the panic-generating effect of vestibular dysfunction may be mediated by cognitive mechanisms. According to the cognitive model of panic disorder (Clark, 1988), panic attacks can arise from the catastrophic misinterpretation of unexplained bodily sensations. Wolpe (1982) similarly proposed "misinformation" as one mechanism in the development of maladaptive anxiety. Thus, panic may arise as a result of catastrophically misinterpreting abnormal vestibular sensations. Experience with patients with a primary complaint of dizziness indicates that they often show increased levels of anxiety (Crary & Wexler, 1977; Hallam, 1985; Rigatelli, Casolari, Bergamini, & Guidetti, 1984); however, not all patients with vestibular disorders develop panic disorder. Further research will be necessary to elucidate the psychological factors, such as anxiety proneness, that might render certain individuals with vestibular dysfunction susceptible to panic.

With respect to *psychosomatic* (as opposed to somatopsychic) relationships between panic and vestibular dysfunction, there is the possibility that anxiety, hyperventilation, or panic alters the characteristics of the vestibular system. Such psychosomatic relationships have been demonstrated by Theunissen, Huygen, and Folgering (1986), who found that hyperventilation increased the sensitivity of the vestibular system. Finally, there is the possibility that somatopsychic and psychosomatic mechanisms mutually enhance each other in a positive feedback loop (Jacob, 1988).

The treatment implications of vestibular dysfunction in some patients with panic disorder are unknown. To speculate, however, there may be several ways in which current treatment could be modified or in which additional treatments might be applied. First, in the behavioral analysis of panic it may become important to consider the possibility of space and motion phobic stimuli; the importance of such cues was illustrated in the case described by Barlow and Cerny (1988) discussed earlier. Furthermore, introducing the concept of space and motion phobic stimuli to these patients may help them to understand their reaction patterns and thus lessen their fears of "unpredictable" panic. We also have noted that many of our panic patients expressed a sense of relief upon learning that their sensations of dizziness or imbalance were not "all in their mind," and some experienced an actual reduction in panic (Lilienfeld, Jacob & Furman, 1988).

Second, special techniques might be incorporated in those behavioral treatments of panic that rely on the controlled elicitation of panic or prepanic sensations as a treatment component. Interestingly, this has already been done in the program described by Barlow and Cerny (1988). Among a large number of different maneuvers to induce prepanic sensations, these therapists include spinning the patient in a chair.

Third, presence of vestibular dysfunction may have implications for the success of behavioral treatment programs. Informally, we have observed that some patients, after completing a behavioral treatment program experience a reduction of panic but still experience dizziness. In other words, the patients seemed to have "uncoupled" the experience of dizziness from that of panic. Further treatments might need to be designed to reduce the residual dizziness in these patients.

Besides adapting existing treatments to the possibility of vestibular dysfunction, new treatments could be developed that specifically focus on the vestibular sensations. Anti-motion-sickness agents, such as meclizine, may reduce dizziness in some patients, although in our clinical experience, this approach has not been highly successful. Interestingly, the benzodiazepines are known not only to reduce anxiety, but also to suppress the vestibular system (Barmak & Pettorossi, 1980; Blair & Gavin, 1979). While this dual effect may be fortunate for the panic patient with vestibular dysfunction, it is unfortunate for researchers wishing to untangle the benefit from reducing vestibular sensations from that of reducing anxiety directly.

Vestibular habituation training represents a method of reducing vestibular sensations directly (Norre & Beckers, 1986). Vestibular habituation training involves physical exercises designed to provide a high degree of vestibular stimulation, for the purpose of producing central compensation of the disordered vestibular input. These exercises include head movements and changes in body positions, such as abruptly lying down in bed. Patients undergoing such training might also be taught strategies for selecting visual orienting cues to compensate for or suppress disordered vestibular input, similar to the techniques employed by ballet dancers. They may be encouraged to engage in sports involving frequent "stop and go" movements, such as racquet ball or volley ball. If controlled studies confirm the existence of a subgroup of panic disorder characterized by vestibular dysfunction, further research on vestibular habituation training would be warranted.

REFERENCES

Baloh, R. W., Solingen L., Sills, A. W., & Honrubia, V. (1977). Caloric testing: Effect of different conditions of ocular fixation. *Ann Otolology Rhinology and Laryngology*, 86(Suppl. 43), 1–6.

Barlow, D. H., & Cerny, J. A. (1988). *Psychological treatment of panic*. New York: Guilford Press.

Barmak N., & Pettorossi, V. V. (1980). Vestibular reflexes in rabbits: Reduction by intravenous injection of diazepam. *Archives of Neurology*, 37, 718–722.

Blair S. M., & Gavin M. (1979). Modification of vestibular reflexes induced by diazepam: Experiments in the macaque. *Archives of Otolaryngology*, 105, 698–701.

Brandt, T., & Daroff, R. B. (1980). The multisensory physiological and pathological vertigo syndromes. *Annals of Neurology* 7, 195–203.

Clark, D. M. (1988). A cognitive model of panic. In S. Rachman & J. D. Maser (Eds.), *Panic—Psychological perspectives*. Hillsdale, NJ: Lawrence Erlbaum Associates Inc.

Crary, W. G., & Wexler, M. (1977). Meniere's Disease: A psychosomatic disorder. *Psychological Reports*, 41, 603–645.

Dix, M. R., & Hood, J. D. (1973). Vestibular habituation, its clinical significance and relationship to vestibular neuronitis. *Laryngoscope*, 80, 226–232.

Gordon, A. G. (1986). Otoneurological abnormalities in agoraphobia. *American Journal of Psychiatry*, 143, 807.

Hallam, R. S., & Stephen, S. D. G. (1985). Vestibular disorder and emotional distress. *Journal of Psychosomatic Research*, 29, 407–413.

Hallpike, C. S., Harrison, M. S., & Slater E. (1951). Abnormalitites of the caloric test results in certain varieties of mental disorder. *Acta Otolaryngology*, 39, 151.

Hamlin, C. L. (1988). Panic disorder, vertigo, and the protirelin test. *Psychiatry Research*, 23, 349–350.

Hoffman, R. A., & Brookler, K. H. (1978). Underrated neurotologic symptoms. *The Laryngoscope*, 88, 1127–1138.

Hood, J. D. (1975). The definition of vestibular habituation. In R. F. Naunton, (Ed.), *The vestibular system*. New York: Academic Press.

Jacob, R. G. (1988). Panic disorder and the vestibular system. *Psychiatric Clinics of North America*, 11, 361–374.

Jacob, R. G., Moller, M. B., Turner, S. M., & Wall C. (1985). Otoneurological examination of panic disorder and agoraphobia with panic attacks: A pilot study. *American Journal of Psychiatry*, 142, 715–720.

Lilienfeld, S. O., Jacob, R. G., & Furman, J. M. R. (1988). *Vestibular dysfunction followed by panic disorder with agoraphobia: Case report*. Manuscript submitted for publication.

Marks, I. (1981). Space "phobia:" A pseudo-agoraphobic syndrome. *Journal of Neurology, Neurosurgery and Psychiatry*, 44, 387–391.

Marks, I. M. (1987). *Fears, phobias and rituals. Panic, anxiety and their disorders*. New York: Oxford University Press.

Marks, I., & Bebbington, P. (1976). Space phobia: Syndrome or agoraphobic variant? *British Medical Journal*, 2, 345–347.

McCabe, B. F. (1975). Diseases of the end organ and vestibular nerve. In R. F. Naunton (Ed.), *The vestibular system*. New York: Academic Press.

Mezzich, J. E., Dow, J. I., Rich, C. L., Costello, A. J., & Himmelhoch, J. M. (1981). Developing an effective clinical information system for a comprehensive psychiatric institute: II. Initial evaluation form. *Behavior Research Methods and Instrumentation*, 13, 464–478.

Money, K. E. (1970). Motion sickness. *Physiological Review*, 50, 1–39.

Norre, M. E., & Beckers, A. (1986). Vertigo training. Rehabilitation treatment of vertigo by physical exercises. *Medica Physica*, 9, 209–211.

Page, N. G. R., & Gresty, M. A. (1985). Motorist's vestibular disorientation syndrome. *Journal of Neurology, Neurosurgery and Psychiatry*, 48, 729–735.

Pratt R. T. C., & McKenzie, W. (1958). Anxiety states following vestibular disorders. *Lancet*, 2, 347–349.

Rigatelli, M., Casolari, L., Bergamini, G., & Guidetti, G. (1984). Psychosomatic study of 60 patients with vertigo. *Psychotherapy and Psychosomatics*, 41, 91–99.

Theunissen, E. J. M., Huygen, P. L. M., & Folgering H. T. (1986). Vestibular hyperreactivity and hyperventilation. *Clinical Otolaryngology*, 11, 161–169.

Waespe, W., & Henn, V. (1977). Neuronal activity in the vestibular nuclei of the alert monkey during vestibular and optokinetic stimulation. *Experimental Brain Research*, 25, 523–538.

Wall, C. W., & Furman, J. M. R. (In press). Eyes open versus eyes closed: Effect on human rotational responses. *Annals of Otology, Rhinology and Laryngology*.

Wolpe, J. (1982). *The practice of behaviour therapy* (3rd ed.). (p 31). New York: Pergamon Press.