Journal of Psychopathology and Behavioral Assessment, Vol. 15, No. 4, 1993

Discomfort with Space and Motion: A Possible Marker of Vestibular Dysfunction Assessed by the Situational Characteristics Questionnaire

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Accepted: September 20, 1993

Space and motion discomfort (SMD) refers to the situational specificity of symptoms occurring in some patients with vestibular dysfunction, such as those with balance disorders and some with panic disorder. SMD occurs in situations characterized by inadequate visual or kinesthetic information for normal spatial orientation. We report the results of two studies of the construct validity of the Situational Characteristics Questionnaire (SitQ), which has two subscales, both of which measure SMD: the SMD-I and SMD-II. In Study 1, the SitQ was administered to members of a self-help group for balance disorders, a psychiatric sample consisting of patients with panic disorder, nonpanic anxiety

Study 1 was funded by MH 40757. Study 2 was funded by a grant from the Upjohn Company and MH 19816.

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0882-2689/93/1200-0299$07.00/0

disorders, depression, and a sample of normals. SMD levels were the highest in the self-help balance group, next to the highest in the panic groups, and lowest in the remaining groups. In Study 2, the SitQ was administered to otolaryngological patients with vestibular dysfunction and to patients with hearing loss. SMD levels were higher in the vestibular patients. Data on internal consistency, test–retest reliability, and convergent and discriminant validity are presented. The SitQ, particularly the SMD-II, is recommended for quantifying space and motion discomfort in patients with anxiety and/or balance disorders.

KEY WORDS: space and motion discomfort; space phobia; vestibular dysfunction; panic disorder; anxiety disorders; depression; balance disorders.

INTRODUCTION

Space and motion discomfort (SMD) refers to symptoms elicited by a stimulus pattern characterized by inadequate visual or kinesthetic information for normal spatial orientation. This pattern elicits distress in some patients with vestibular dysfunction. SMD may contribute to promoting agoraphobic avoidance in patients with vestibular dysfunction. A review of the physiology of spatial orientation, or maintenance of balance, will provide a necessary context for understanding the mechanisms underlying SMD.

Spatial orientation involves an integration of input not only from the vestibular system but also of information from the pathways of vision and proprioception (Paulus, Straube, & Brandt, 1984; Paulus, Straube, & Brandt, 1987; Lackner & Graybiel, 1978; Yardley, Lerwill, Hall, & Gresty, 1992). The visual, proprioceptive and vestibular inputs converge at multiple levels in the central nervous system (Leigh & Zee, 1990; Brandt, 1991; Akbarian *et al.*, 1988; Waespe & Henn, 1977). As a result of vestibular processing, reflex activities are modified, including the vestibular-ocular, vestibular-spinal, and vestibular-autonomic reflexes (Leigh & Zee, 1990; Yates, 1992; Jacob, Furman, Clark, Durrant, & Balaban, 1993). This normally occurs without conscious awareness (Jongkees, 1974; Guedry, 1974). Vestibular sensations or "symptoms" arise only under certain conditions, including (a) intense vestibular stimulation, such as during abrupt head movements; (b) unfamiliar body accelerations; and (c) discordance or incongruence in the information among the three sensory channels (c.f. Brandt & Daroff, 1980; Jacob, Lilienfeld, Furman, & Turner, 1989; see also Yardley, 1992). In these circumstances, vestibular sensations are experienced even by individuals with normal vestibular function (physiological vertigo). For example, normal individuals exposed to heights combined with an absence of nearby objects in the peripheral visual field exhibit increased body sway and experience vertigo (Brandt, Arnold, Bles, & Kapteyn, 1980;

Bles, Kapteyn, Brandt, & Arnold, 1980). Similarly, extension of the head in the standing position, a behavior that can occur when one looks up at tall buildings, can result in head extension vertigo (Brandt, Krafczyk, & Malsbenden, 1981).

Initially, as a patient develops vestibular dysfunction, the symptoms may be quite pervasive and not particularly situation-specific [see J.C. (1952) for a personal account of severe vestibular dysfunction]. Persistence of vestibular dysfunction, however, sets in motion a series of adaptive processes called "central compensation," resulting in significant reductions in the pervasiveness of vestibular symptoms (Brandt, 1991; Rudge & Chambers, 1982). As a result of central compensation, information from the alternative sensory channels of vision and proprioception may be given greater weight (Courjon & Jannerod, 1979). Vestibular symptoms are therefore more likely to occur in situations in which vision or proprioception provide insufficient spatial information. In clinical otolaryngological terminology, such patients are often referred to as being visually or somaesthetically "dependent." Specifically, they develop subtle situationally specific symptoms in locales involving long visual distances (i.e., "space") or in situations involving complex movement in visual vs. proprioceptive fields (i.e., motion).

The literature describes a number of space and motion phobic patterns in patients with balance disorders. The "supermarket syndrome," or difficulty looking at the shelves while walking down the aisle in a supermarket, was observed by McCabe (1975) and Rudge and Chambers (1982). The "motorist vestibular disorientation syndrome," or difficulty driving over the crests of hills and on open, featureless roads, was reported by Page and Gresty (1985). "Space phobia," a term coined by Marks (1981) and Marks and Bebbington (1976), also includes the fear of driving over crests of hills. Fear of heights was the most common phobic symptom in the balance disorder patients examined by Hallam and Hinchcliffe (1991). Fear of heights and fear of darkness were observed in the patients with peripheral vestibular lesions followed by Eagger, Luxon, Davies, Coelho, and Ron (1992). Avoidance of dancing and bending over were reported by Yardley, Todd, Lacoudraye-Harter, and Ingham (1992). Leaning far back in a chair was one of the SMD symptoms reported by the patient described by Lilienfeld, Jacob, and Furman (1989).

Patients with panic disorder may have a high prevalence of vestibular dysfunction (Jacob, Moller, Turner, & Wall, 1985; Jacob, 1988; Sklare, Stein, Pikus, & Uhde, 1990; Jacob *et al.*, 1989), so one would expect SMD to constitute a theme in their situational symptomatology as well. On the other hand, not all avoidance behaviors in agoraphobics can easily be attributed to SMD. Increased anxiety might occur, for example, when an individual is seated in the middle of a row at a movie theater or standing in a crowded elevator, but these situations would not necessarily be predicted from the physiology of SMD.

Research on SMD requires the availability of a measure of this construct. A number of questionnaires are available to measure symptoms or impairments from balance disorders (O'Connor, Hallam, Beyts, & Hinchcliffe, 1986; Jacobson & Newman, 1990; Yardley & Putman, 1992; Yardley, Masson, Verschuur, Haacke, & Luxon, 1992) or elicitors of motion sickness (Reason, 1968; items provided by Yardley, 1990), but none of these would be expected to reflect adequately the more subtle situational distress of SMD. For this reason, we developed an instrument, the Situational Characteristics Questionnaire (SitQ), originally presented by Jacob *et al.* (1989). Using this instrument, we found that SMD occurred in patients with panic disorder and vestibular dysfunction (Jacob *et al.*, 1989). The SitQ contains two scales differing in item format, the SMD-I and the SMD-II, both designed to measure SMD. In addition, the SitQ contains a third scale, the Ag-I, which measures discomfort of agoraphobic situations not clearly related to SMD.

In the present paper we report two studies that prospectively examined the construct validity and other psychometric properties of the SitQ. We tested the assumption that SMD is related to vestibular dysfunction by examining SMD levels in patients with primary balance disorders. In addition, we examined whether SMD occurs in psychiatric patients with panic disorder, a group of interest because of the previously mentioned findings of vestibular dysfunction. Study 1 used two criterion groups, namely, (a) members of a self-help group for balance disorders and (b) psychiatric outpatients with panic disorder (with or without agoraphobia). Psychiatric patients with nonpanic anxiety disorders, depressives, and normals served as comparison groups. We predicted that SMD levels across these groups would covary with their presumed prevalence of vestibular dysfunction.

Although the criterion subjects in Study 1 reported that they had balance disorders, objective information concerning their vestibular functioning was not available. Study 2 took place in an otolaryngological clinic outpatient setting and examined patients with verified vestibular dysfunction. The SMD levels in these patients were compared with a diverse group of patients with primary complaints of hearing loss. We predicted that the vestibular group would show higher SMD levels than the hearing complaint group.

STUDY 1. SMD IN A SELF-HELP GROUP FOR BALANCE DISORDERS COMPARED WITH PSYCHIATRIC PATIENTS AND NORMALS

Method

Subjects

The SitQ was administered to a total of 208 individuals from one of the following three samples: (A) self-help group for balance disorders (N = 50); (B) psychiatric outpatients including those with panic disorder with and without agoraphobia, nonpanic anxiety disorders and depression (N = 113); and (C) normal comparison subjects (N = 45). The psychiatric and normal samples also received a set of additional questionnaires used for analyses of convergent and discriminant validity. A portion of the individuals in the psychiatric and normal samples completed the SitQ on two occasions, approximately 2 weeks apart (N = 70). The second administration occurred in conjunction with a scheduled physical examination approximately 2 weeks after the initial administration.

Members were eligible to be included in the balance disorder sample if they belonged to a community self-help group for balance disorders. The group had 231 members, 103 of whom participated in a related survey study (Clark, Leslie, & Jacob, 1992). A subset of the survey study participants received the SitQ. Questionnaires and return envelopes were sent to individuals on the group's mailing list. Three of the investigators (R.G.J., D.B.C., and G.D.K.) also visited the group during one of its regularly scheduled meetings and distributed questionnaires that were collected at the end of the meeting. Subjects were included if they had nonmissing scale scores (i.e., if at least 70% of the items were completed) on at least one subscale. Fifty-four questionnaires were received; four were excluded due to missing data on all three scales. Subject characteristics of the balance disorder sample are listed in Table I. Information concerning race was not elicited. The age distribution was bimodal, with 55 years forming a boundary between an older subgroup and a young to mid-adult subgroup.

Members of the psychiatric sample were recruited in a University outpatient anxiety disorders research clinic in Western Pennsylvania. The subjects fulfilled criteria for one of the following diagnostic labels: (1) uncomplicated panic disorder (N = 31), patients with no agoraphobic avoidance or very mild avoidance limited to one or two situations; (2)

Table I. Subject Characteristics of Study 1

	Sample						
	Balance disorder	Psychiatric					Normal
		Panic	Ag	NpA	Depr	Mixed[a]	
Age							
Mean	55.6	35.7	34.4	35.1	39.2	40.7	35.9
SD	15.7	7.3	7.9	8.9	10.2	7.2	8.4
Percentage female	77	48	57	44	55	70	49
N							
Total	50	31	30	18	11	23	45
Test–retest	0	11	14	7	3	15	20

[a] Mixed syndromes (e.g., anxiety and depression; see text) not used in criterion validity group comparisons.

panic disorder with agoraphobia, panic patients with widespread avoidance of at least three situations ($N = 29$); (3) nonpanic anxiety disorder ($N = 18$), patients with generalized anxiety disorder or social phobia who had neither agoraphobic avoidance nor histories of spontaneous panic attacks; and (4) depression without symptoms of anxiety ($N = 11$), patients with unipolar depression (single or recurrent) or dysthymia but only very low levels of anxiety and no history of panic attacks or agoraphobia.

In the psychometric analyses, but not in group comparisons involving criterion-related validity, a (5) "mixed syndromes" ($N = 23$) group was also included. This group was added in these analyses because they were available and led to an increased sample size, and because using these subjects might increase the generalizability of the psychometric data beyond the universe of diagnostically "clean" patients included in the normal sample and groups 1–4 of the psychiatric sample. This group consisted of 10 individuals with dual diagnoses of depression and nonpanic anxiety disorder, 5 individuals with agoraphobia without history of panic attacks, 3 individuals with concurrent medical disorders and relevant psychiatric diagnoses (migraine + agoraphobia with panic; adult-onset diabetes + panic disorder; allergies and dysthymia), 2 individuals with simple phobia, and 3 individuals recruited as normals but who had histories (but no current diagnosis) of nonpanic anxiety disorders.

The subjects in the psychiatric sample were included after two psychiatric diagnostic assessments and a physical examination. The first psychiatric assessment was a diagnostic interview performed by an experienced clinician using a semistructured 90-min psychiatric interview format, the "Initial Evaluation Form" (Mezzich, Dow, Rich, Costello, & Himmelhoch, 1981). Following the interview, the clinician discussed the case with a psychiatrist, who then interviewed the patient as well. Patients with a relevant disorder were referred to the study, at which time they received the second interview, the Anxiety Disorders Interview Schedule — Revised (ADIS-R, Di Nardo & Barlow, 1988; Di Nardo, Moras, Barlow, Rapee, & Brown, 1993). Patients were assigned to diagnostic groups based on the results of the latter interview. Exclusion criteria for subjects in the psychiatric sample were concurrent psychotic disorders, bipolar disorder, substance abuse disorders, and (except in the mixed syndrome group), medical disorders. The sex and age distribution of the psychiatric sample is specified by group in Table I. Two of the subjects were African-American (one in the Panic group, one in the mixed syndromes group); the rest were Caucasian.

The normal comparison sample consisted of psychiatrically and medically healthy individuals without current histories of anxiety disorders ($N = 45$). They were recruited from rosters of alumni of the University of Pittsburgh, from volunteers that had participated as normal comparison subjects in other research studies, through media advertisements, or through word of mouth. Candidates for inclusion in this group received only the ADIS-R. If they passed the ADIS, they received a physical examination. To be included, subjects could not have appeared at the clinic for evaluation of any complaint; they could not fulfill criteria for any current psychiatric or medical disorder or for histories of anxiety disorders, and their Hamilton Anxiety score (Hamilton, 1959) had to be less than 12 and their Hamilton Depression score less than 13. One subject was Hispanic; the rest were Caucasian.

The age and sex distributions of the balance, psychiatric, and normal samples were unequal. The ages of the psychiatric and normal samples were similar to that of the lower mode in the balance disorder sample. A one-way analysis of variance for age in the balance disorder sample, normal sample, and groups 1–4 in the psychiatric sample (i.e., the groups to be used for assessment of criterion-related validity; see below) revealed that the age differences among the groups were statistically significant [$F(5,176) = 24.458$; $p < .0001$]. The balance disorder group had a significantly higher mean age than the groups in the psychiatric and normal samples. A χ^2 test revealed significant differences in the sex distributions among the six groups [$\chi^2(5) = 11.3, p = .047$]; the proportion of females was larger in the balance group than in the combination of groups 1–4 and normals.

Measures

The SitQ. The SitQ items are listed in Tables III and IV. A copy of the questionnaire is given by Jacob and Lilienfeld (1990) and may be obtained upon request from the senior author. As discussed earlier, the SitQ yields two scales measuring space and motion discomfort, the SMD-I and SMD-II, and a scale measuring other agoraphobic avoidance, the Ag-I. Although the SMD-I and SMD-II were created to measure the same construct, the format of the items was different, as described further below. The Ag-I had the same item format as the SMD-I.

The item format for the SMD-I and Ag-I was chosen because it allowed comparisons of contrasting characteristics of a particular situation, e.g., being far vs. near the exit in a supermarket. Moreover, the format allowed us to control for an acquiescence response style that may characterize many patients with panic disorder, who frequently endorse diverse symptoms. Each item in the SMD-I and Ag-I consists of two subitems reflecting two contrasting characteristics or aspects of a situation. One of these subitems, the criterion item, is hypothesized to elicit more discomfort than the other. Each of the subitems is rated on a 0–3-Likert type scale. The score of the item is calculated as the difference between the two subitems. The order of appearance of criterion vs. noncriterion subitems is random. Unlike the SMD-I and Ag-I, the SMD-II consists of traditional Likert-type items that are rated from 0 to 3.

The items of the SitQ were derived or selected from a larger pool that had been developed from (a) theoretical notions based upon literature mentioned in the Introduction and/or (b) clinical experience with patients with panic disorder and vestibular dysfunction (e.g., Lilienfeld *et al.*, 1989). A larger pool of items in the current format was tested on a small group of panic patients with vestibular dysfunction. Based on the results, a number of items were excluded (Jacob *et al.*, 1989). The current study represents an evaluation of the scale as defined by the items remaining after this previous study.

Other Instruments. In addition to the SitQ, subjects in the psychiatric sample were given a battery of questionnaires that included measures of (a) agoraphobic avoidance, (b) fear of symptoms, (c) general anxiety, (d) neuroticism, and (e) depression. Avoidance was assessed using the agoraphobia subscale of the Fear Questionnaire (FQAG, Marks & Mathews, 1979), and the "avoidance alone" (AAL) and "avoidance accompanied" (AAC) subscales of the Mobility Inventory (Chambless *et al.*, 1985). Fear of symptoms was assessed with the Body Sensations Questionnaire (BSQ; Chambless, Caputo, Bright, & Gallagher, 1984) and the Agoraphobic Cognitions Questionnaire (ACQ; Chambless *et al.*, 1984). General anxiety was assessed using the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988). Neuroticism was assessed using the neuroticism scale of the Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1963). Levels of depression were assessed with the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961).

Statistical Analysis

Data from the balance disorder sample and normal samples and groups 1–4 in the psychiatric sample were used to examine criterion-related validity. Specifically, we examined whether the relative levels on each of the subscales fell in the predicted order alluded to in the Introduction and specified in the next paragraph. The appropriate planned three-level ordered contrasts in a one-way analysis of variance were examined. Effect size estimates were made using the η^2 statistic. The results by group were displayed as notched box plots. The "notches" represent the 95% confidence interval for the median.

Specifically, we expected the balance patients to show the highest SMD-levels, patients with panic disorder with or without agoraphobia the next to highest (because of the reports of vestibular dysfunction in these disorders), and the remaining groups the lowest levels. Conversely, for the Ag-I, we predicted that panic patients with agoraphobia would show the highest levels, panic patients without agoraphobia and balance patients the next to highest, and the remaining groups the lowest. The reason for expecting some "other" agoraphobic avoidance in the balance patients was that space and motion discomfort and "other" agoraphobic avoidance were not expected to be completely independent constructs.

Convergent and discriminant validity was assessed by examining differences among Pearson product-moment correlations (a) among the three SitQ subscales (all subjects) and (b) between the SitQ subscales and other criterion instruments (psychiatric and comparison sample). The two SMD scales were expected to show higher correlations with each other than with the Ag-I. Furthermore, because the structure of the SMD-I was thought to control for acquiescence response tendencies, the correlations between the SMD-I and criterion scales reflecting neuroticism or depression were expected to be lower than the corresponding correlations with the SMD-II. In addition, the criterion scales reflecting agoraphobic avoidance were expected to show higher correlations with the Ag-I than criterion scales reflecting neuroticism or depression. Differences between related correlations were evaluated using the procedure described by Steiger (1980).

Internal consistency was assessed with Cronbach's (1951) alpha. Test–retest reliability was examined by calculating the Pearson product-moment correlations between the test and retest scores.

Because the distributions of the scores of the SitQ were skewed, supplementary analyses (not presented here) were performed using nonparametric statistics, when feasible. For example, a Kruskal–Wallis analysis of variance was done for group comparisons, and the Spearman rank order coefficient was examined for the stability measures. Nevertheless, we present the parametric analyses to facilitate comparisons with other published psychometric data. Moreover, the results of these nonparametric analyses were, without exception, very similar to those reported here.

Results and Discussion

Reliability

Test–retest reliabilities (based on the pooled psychiatric and normal comparison samples only) were $r = 0.66$ for the SMD-I, $r = .87$ for the SMD-II, and $r = 0.80$ for the Ag-I. These results suggest that the SitQ subscales possess adequate stability.

Cronbach's alpha for the SMD-I was 0.74. Two of the twenty SMD-I items had low item-total correlations (riding in a car, downhill vs. uphill, $r = .07$; fields, open vs. enclosed, $r = .05$). The item-total correlations for the remaining items ranged between .13 and .64. For the SMD-II, Cronbach's alpha was $r = .88$. The range of item-total correlations was $r = .32–.77$. For the Ag-I, Cronbach's alpha was $r = .67$. One item had a poor item-total correlation (buses, aisle vs. window seat, $r = –.01$). The item-total correlations of the remaining six items ranged from $r = .20–.59$.

Criterion-Related Validity

Main Results. Figure 1 shows the distribution of scores for the three subscales by diagnostic group in the form of notched box plots. Nonoverlapping notches in two boxes indicate a significant difference between the medians of the group. The scores for the SMD-I and SMD-II by group fell in the predicted order, *viz.*, (1) balance disorder, (2) panic disorder with or without agoraphobia, and (3) the remaining groups. For the SMD-I, the three-level planned ordered contrast was statistically significant [$F(1{,}175) = 35.003, p < .0001$]. The effect size of the group contrast was $\eta^2 = 0.17$, indicating that 17% of the variance was explained by the planned contrast. For the SMD-II, the planned ordered contrasts were also statistically significant [$F(1{,}173) = 81.698, p < .0001, \eta^2 = 0.32$].

For the Ag-I, agoraphobic patients had the highest levels, as predicted, followed by the combined uncomplicated panic disorder and balance disorder groups and, finally, the other psychiatric groups and normals. The planned three-level ordered contrast was statistically significant [$F = 47.76, p < .0001, \eta^2 = 0.21$].

Additional Analyses Related to Age and Sex Differences Among Samples. Because the balance disorder sample differed from the other groups with respect to sex, we further examined the possibility of a confounding sex effect. Two-way (sex × group) analyses of variance were performed for each scale in the five groups of the psychiatric and normal samples. Neither the main effect of sex nor the sex × group interactions were significant for any of the scales. Because there was no main effect of sex, we concluded that further analyses with covariance adjustment for sex were not necessary.

Because the balance disorder sample members included more subjects aged 55 years or older than the psychiatric and comparison samples, we also investigated the possibility of a confounding age effect. We first considered using analysis of covariance with age as a covariate. The homogeneity of covariance assumption for this analysis was violated

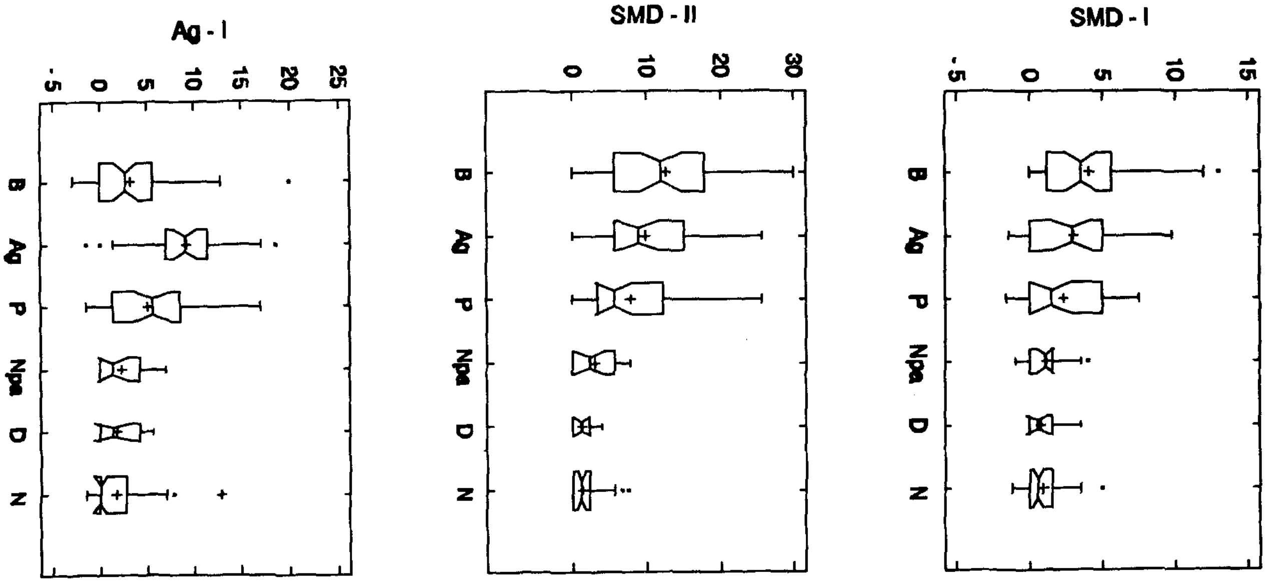

Fig. 1. Notched box-and-whisker plots of space and motion discomfort (SMD-I, SMD-II) and agoraphobic discomfort (Ag-I) scales by group: B, balance disorder sample; Ag, *panic* disorder with agoraphobia; P, uncomplicated panic disorder; Npa, nonpanic anxiety disorders; D, depression; N, normal controls. Box contains middle 50% of the data. Width of box is proportional to $N^{1/2}$. Center of notch = median; length of notch = 95% confidence interval of median. Nonoverlapping notches in two boxes suggest *significant* differences between the medians. Whiskers connect the *highest* or *the lowest* point within 1.5 × interquartile range above or below the box, respectively. Datapoints outside the "whisker" are plotted individually. A + within a box designates mean; a + outside the whiskers designates "outlier."

because the balance disorder sample showed negative correlations with age (r = –.53 and –.57 for the SMD-I and SMD-II, respectively), whereas the psychiatric and normal comparison samples did not. Instead of covariance analyses, we recalculated the ordered three-level contrast but only with subjects less than 56 years of age. For the SMD-I, the planned ordered contrast was associated, with $F(1,149) = 54.0$ ($p < .0001$, $\eta^2 = .27$). For the SMD-II, $F(1,145) = 141.8$ ($p < .0001$, $\eta^2 = .49$). Finally, for the Ag-I, $F = 46.2$, ($p < .0001$, $\eta^2 = .24$). Thus, excluding the older subjects in the balance disorder sample resulted in an increase in the effect sizes of the three-level contrasts.

Convergent and Discriminant Validity

Correlations Among the Three SitQ Scales. The Pearson product-moment correlation between the SMD-I and the SMD-II was $r = .57$. On the other hand, the correlations between the Ag-I and the SMD-I and SMD-II were $r = .36$ and $r = .37$, respectively. The correlation between the SMD-II and the SMD-I was significantly larger than that between the SMD-II and the Ag-I (Steiger test, $z = 3.10$; $p < .001$, one-tailed). The comparison of these correlations is not confounded by differences in item format. These results suggest that the two SMD scales measure constructs that overlap only partially with that measured by the Ag-I.

Correlations with Other Instruments. Table II shows the correlations between the SitQ scales and other criterion scales. Because the members of the balance disorder sample did not complete these scales, the results are based on the psychiatric and normal samples only. First, within each criterion scale, the correlations of the criterion scale with each of the three SitQ scales were compared. The differences between the following pairs of correlations with criterion scales were assessed: (a) the SMD-I vs. the Ag-I and (b) the SMD-I vs. the SMD-II.

(a) The Ag-I showed higher correlations than the SMD-I with the following criterion scales: AAL and ACQ ($p < .01$) and the FQAG and BAI ($p < .05$). This suggests that the Ag-I, more than the SMD-I, measures the agoraphobic constructs assessed by the criterion scales.

(b) The SMD-II had higher correlations than the SMD-I with the AAL, AAC, ACQ, BSQ, and BAI ($p < .01$) as well as the FQAG, EPI, and BDI ($p < .05$). This result suggests that the SMD-II is more closely related to constructs measured by traditional agoraphobia scales than the SMD-I. Furthermore, the difference between the SMD-I and the SMD-II in their correlations with BDI and EPI neuroticism scales is consistent with our hypothesis that the SMD-I controlled for acquiescence response

Table II. Correlations with Other Instruments[a]

	SMD-I	SMD-II	Ag-I
Fear Questionnaire–AG (f) (n = 141)	.43 (—)	.58* (—)	.60* (d,e)
Avoidance Alone (n = 137)	.40 (—)	.68** (d,e)	.61** (d)
Avoidance Accompanied (n = 137)	.43 (—)	.71** (d,e)	.52 (d)
Agoraphobic Cognitions (n = 154)	.30	.63**	.57*
Body Sensations (n = 151)	.27	.57**	.38
Beck Anxiety (n = 138)	.39	.69**	.55*
EPI Neuroticism (e) (n = 140)	.33	.49*	.37
Beck Depression (d) (n = 155)	.28	.46*	.30

[a] Within-criterion scales comparison: The correlation is significantly greater than the one between the criterion scale and the SMD-I (Steiger test), (** designates $p < 0.01$; * $.01 < p < .05$). Within-SitQ scale comparison: The correlation is greater than ($p < .05$) the correlation with the BDI (d) or the EPI Neuroticism scale (e). (—) The correlation is not greater than the one for the EPI or BDI ($p > .05$).

tendencies better than did the SMD-II. The significant difference in correlations involving the BAI may indicate that the SMD-I, but not the SMD-II, is relatively independent from the effect of high anxiety levels. Alternatively, all these differences are consistent with the explanation that the higher correlations involving the SMD-II are related to its smaller error of measurement, as evidenced by its superior stability and internal consistency.

Second, the correlations with criterion measures of agoraphobic avoidance vs. neuroticism or depression were compared within each of the SitQ scales. The Ag-I showed higher correlations with the FQAG, AAL, and AAC than with the BDI and a higher correlation with the FQAG than with the EPI. These results suggest that the Ag-I has convergent validity for agoraphobia-related constructs.

The SMD-II showed higher correlations with the AAL and AAC than with the EPI and BDI. This finding suggests that the SMD-II had convergent validity for agoraphobic constructs.

The correlations between the SMD-I and the EPI or BDI were not significantly different from those with the criterion scales measuring agoraphobia. This suggests that the SMD-I does not have discriminant validity for agoraphobic constructs. Although this finding might suggest that the SMD-I measures a construct separable from agoraphobia, it could also be attributable to its higher error of measurement, as noted earlier.

STUDY 2. SMD IN OTOLARYNGOLOGICAL PATIENTS EVALUATED FOR BALANCE COMPLAINTS OR HEARING LOSS

Study 2 was performed entirely in an otolaryngological outpatient clinic setting. The groups were (1) a vestibular group — chief complaint of dizziness or imbalance and vestibular abnormalities detected on vestibular testing and/or physical examination; and (2) a hearing complaint group — complaint of hearing loss with no complaints of dizziness. As a result of these definitions, all patients in the vestibular group were assured to have abnormal vestibular function. Because patients in the hearing group did not have any vestibular symptoms, vestibular testing was not clinically indicated and it was assumed that the prevalence of vestibular abnormalities in this group would be lower than in the vestibular group. Therefore, we expected SMD levels to be lower in the hearing complaint group than in the vestibular group.

Method

Subjects

Subjects were recruited from consecutive cases presenting to a tertiary otolaryngology clinic in Western Pennsylvania for evaluation of dizziness or hearing loss. They also participated in a related study that focused on panic and anxiety symptoms (Clark, Hirsch, Smith, Furman, & Jacob, in press). All patients received clinical evaluations that included neurotologic histories and otological examinations. Laboratory tests were performed as clinically indicated. Those with dizziness complaints received a set of vestibular tests (see below).

Patients were included in the vestibular group (N = 32) if there was evidence of vestibular abnormalities in the test findings or on physical examination. The vestibular group consisted of 12 males and 20 females with an average age of 49.8 years (SD = 15.3 years). Information concerning race was not available. In 23 of the patients (73%), the vestibular test results and physical findings were consistent with a peripheral (inner ear or eighth nerve) location of the vestibular abnormality; in 7 patients, with a central location (i.e., within the central nervous system); and in 2 patients the abnormalities could not be attributed to any specific anatomic location. The main diagnoses in the peripheral patients were endolymphatic hydrops (Meniere's disease) and benign paroxysmal positional nystagmus. Diagnoses in the central patients included multisensory deficits, migraine, microvascular disease, and multiple sclerosis.

Patients were included in the hearing complaint group ($N = 31$) if hearing loss was one of the chief complaints and if they did not have concomitant current symptoms of dizziness or imbalance. The hearing loss group consisted of 12 males and 20 females, with an average age of 44.6 years (SD = 14.9 years). The age difference between the groups, 4.9 years, equivalent to an effect size of $d = .33$, was not statistically different [$t(61) = 1.33$; $p = .19$]. The etiology of the hearing loss was quite diverse. Diagnostic impressions included congenital hearing loss, presbyacusis, noise damage, serious otitis, complications from mastoidectomy, otosclerosis, and status post skull fracture. In all but four patients, the hearing losses exceeded 25 dB on at least one frequency on pure tone audiograms or tests of speech reception threshold.

Measures

About half of the patients completed the SitQ in the waiting area of the otolaryngological clinic, and the other half, at home. Patients in the hearing complaint group received a standard audiological examination, consisting of pure tone and speech reception thresholds and speech discrimination scores. Patients in the vestibular group received a battery of vestibular tests which included (a) dynamic posturography — the Equitest protocol including six "sensory" conditions and four "motor" conditions (Nashner, Black, & Wall, 1982); (b) rotational testing — sinusoidal stimuli administered at the frequencies of 0.05, 0.1, 0.5, and 1 Hz at 50°/sec; (c) ocular motor screening — electronystagmographic recordings of spontaneous and lateral gaze nystagmus, smooth pursuit eye movements, and optokinetic nystagmus; (d) positional testing — recording of nystagmus in five body positions; and (e) alternate binaural caloric testing — recording of nystagmus during stimulation of each ear with cool and warm temperatures for a total of four caloric irrigations. Two patients did not receive vestibular tests but had vestibular abnormalities on physical examination, *viz.*, nystagmus in the Hallpike positions in one "peripheral" patient and abnormal Romberg's test in one "central" patient.

Statistical Analysis

Criterion-related validity was examined by comparing the SMD levels in the two groups. Examination of the distribution of the scores revealed the presence of several "outlying" data points in the SMD-I scores in the hearing complaint group (see Fig. 2). Inspection of the results for these individuals in the parallel study (Clark *et al.*, in press) suggested that these individuals were agoraphobics. One of these two individuals also had unusually high scores on the SMD-II. Because these outlying individuals would have had disproportionate influence on the results of parametric tests, the Mann–Whitney *U* test was chosen to compare the groups in the criterion validity analysis.

Item analyses were done in two ways. Cronbach's alpha was calculated to assess internal consistency. In addition, the item-total correlations were calculated, and the mean for each group, the group difference, and the effect size (*d*) of the group difference were calculated. The two subjects that were atypical for the hearing group were excluded from the latter analyses, which are considered descriptive in nature. The effect size (*d*) was calculated by dividing the difference with its standard deviation (Cohen, 1988).

Results and Discussion

Internal Consistency

For the SMD-I, Cronbach's alpha was 0.76. Item-total correlations ranged from $r = .04$ (movie, wide vs. narrow screen) to .60 (riding in a car, front vs. back seat). For the SMD = II, Cronbach's alpha was 0.84, with item-total correlations ranging from $r = .43 - .75$. For the Ag-I, internal consistency was poor: Cronbach's alpha = 0.04. Three of the seven items had negative item-total correlations. Two items were negatively correlated with a majority of other items (riding, limited vs. unlimited access roads; and buses, window vs. aisle seat). These findings suggest that the two SMD scales had an acceptable internal consistency but that the Ag-I did not assess a unitary construct in this otolaryngological population.

Scores on the SMD-I, SMD-II, and Ag-I

Notched box plots for the three scales appear in Fig. 2. The vestibular group had higher scores than the hearing complaint groups, particularly on the SMD-II. The difference between the vestibular and the hearing complaint groups was significant for the SMD-I and SMD-II (Mann–Whitney

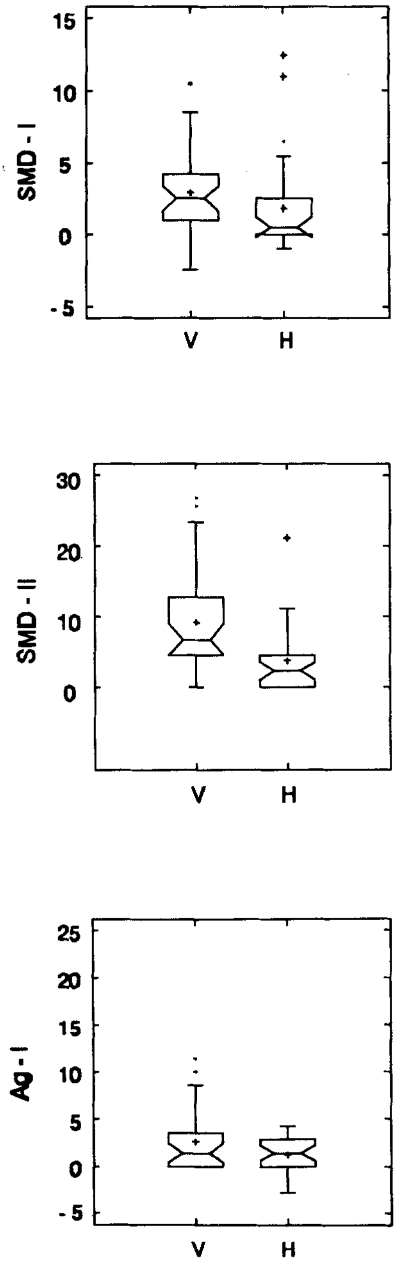

Fig. 2. Notched box-and-whisker plots of the SMD-I, SMD-II, and Ag-I scores for the vestibular group (V) and hearing loss group (H). For further explanation of plots see the legend to Fig. 1.

U test, $p = .0213$ and $p = .00014$ for the SMD-I and SMD-II, respectively). On the Ag-I, the vestibular group also had higher scores than the hearing complaint group, but the difference between the groups was only marginally significant ($p = 0.094$). These results confirm our hypothesis that SMD is related to vestibular dysfunction, although this conclusion must be tempered by the results from the two "outliers" in the hearing complaint group.

Scores on Individual Items by Group

The item averages by group, as well as the differences between the groups and their effect sizes, appear in Table III (SMD-I and Ag-I) and Table IV (SMD-II). On the SMD-I, 19 of the 20 items showed higher scores in the vestibular group than in the hearing loss group, but some items showed only minimal group differences. On the other hand, seven of the items were associated with effect sizes greater than .4. Among these are "riding as a passenger in a car: reading vs. looking out of the window," "elevators: moving vs. stationary," "tunnels: looking at the lights on the side of the tunnel vs. looking at the light at the end of the tunnel," and "buses: moving vs. standing still."

For the Ag-I, the vestibular subjects showed higher scores than the hearing complaint subjects on six of the seven items. Nevertheless, only one item was associated with an effect size of more than .4: "movies: sitting in the middle of the row vs. the aisle."

The SMD-II items were associated with the highest between-group differences of the three scales. Each of the nine items showed higher averages in the vestibular group and all except one were associated with effect sizes greater than .4. The two most discriminating items were "looking up at tall buildings," and "closing eyes in the shower." The "roller coaster" item discriminated relatively poorly, as roller coasters were rated as highly discomfort-eliciting among hearing loss patients as well.

GENERAL DISCUSSION

In two studies, we tested the hypothesis that patients likely to have vestibular dysfunction, i.e., those with primary balance disorders, had high levels of SMD. This hypothesis was confirmed in Study 1, using a criterion group of members of a self-help group for balance disorders. The hypothesis was also confirmed in a more rigorous test in Study 2 using a criterion group of otolaryngological patients with verified vestibular abnormalities. Nevertheless, the conclusions from Study 1 must be tempered

Table III. Average Item Scores on the SMD-I and Ag-I by Group, Ordered by Group Difference[a]

Situation	Criterion	Alternate	V	H	Difference	Effect size
SMD-I						
1. Riding	Reading	Looking out window	12.5	3.8	8.7	.73
2. Riding	Winding	Straight roads	6.9	3.1	3.8	.43
3. Elevators	Moving	Stationary	4.4	.7	3.7	.53
4. Riding	Back seat	Front seat	5.0	1.4	3.6	.55
5. Elevators	Glass	Standard	3.8	.7	3.1	.53
6. Tunnels	Lights flashing	Looking at light at end	2.2	–.3	2.5	.55
7. Buses	Moving	Standing still	1.6	–.7	2.3	.41
8. Elevators	Stopping	Moving at steady speed	2.8	1.5	1.4	.32
9. Fields	Open	Enclosed	.0	–1.4	1.4	.27
10. Movies	Wide screen	Narrow screen	.0	–1.0	1.0	.17
11. Riding	Narrow road	Wide road	2.2	1.4	.8	.11
12. Riding	Changing speed	Steady speed	3.1	2.4	.7	.12
13. Supermarkets	Look at shelves	Looking at end of aisle	.6	.0	.6	.17

16. Elevators	Stopping	Starting	1.3	.8	.6	.19
17. Buses	Standing	Sitting	2.2	1.7	.5	.09
18. Movies	Far in front	Sitting far in back	2.8	2.4	.4	.04
19. Riding	Bumpy roads	Smooth roads	5.0	4.8	.2	.02
20. Tunnels	Curved	Straight	.3	1.4	–1.1	–.32
Ag-I						
1. Movies	Middle of row	Aisle	4.1	1.0	3.0	.49
2. Supermarkets	Crowded	Empty	5.9	3.1	2.8	.37
3. Elevators	Crowded	Empty	5.0	2.4	2.6	.37
4. Buses	Window seat	Aisle seat	–.63	–1.7	1.1	.30
5. Riding	Limited access	Unlimited access	1.3	.0	1.3	.17
6. Buses	Crowded	Empty	3.8	3.1	.6	.11
7. Supermarkets	Far from exit	Close to exit	–.9	.7	–1.6	–.49

[a] Item scores are multiplied by a factor of 10. Items are by order of their V–H difference. Criterion item listed first V, vestibular group (N = 32); H, hearing loss group excluding 2 outliers (N = 29). Riding: riding as a passenger in a car. 6: SMD aspect of tunnels: looking at lights on side of tunnel. 13: Supermarkets — looking at shelves while walking straight down the aisle vs. looking at end of aisle while walking straight down the aisle. 9: SMD aspect of fields: open, i.e., without nearby boundaries (trees, fences, hedges).

Table IV. Group Differences by Item on the SMD-II[a]

	V	H	Difference	Effect size
1. Looking up at tall buildings	11.9	1.7	10.2	1.14
2. Closing eyes in shower	9.1	0.7	8.4	0.99
3. Leaning far back in chair	9.1	2.1	7.0	0.78
4. Aerobic exercise	9.4	3.1	6.3	0.66
5. Rolling over in bed	6.6	0.4	6.2	0.87
6. Dancing	6.6	1.0	5.5	0.69
7. Discomfort incr. during the day	7.2	1.7	5.5	0.64
8. Riding on roller coasters	15.3	11.0	4.3	0.33
9. Reading newspaper close to face	7.2	3.4	3.7	0.44

[a] Item scores are multiplied by a factor of 10. Items appear by order of their V–H difference. V, Vestibular group ($N = 32$); H, hearing loss group excluding two outliers. Effect size: difference/pooled standard deviation.

by the relative lack of information concerning the vestibular status of the members of the self-help group as well as the possibility of self-selection biases for more "help-seeking" types of balance patients. Similarly, the conclusions from Study 2 must be tempered by the unusual SMD scores from two members of the comparison group.

In Study 1, we also tested the hypothesis that SMD would occur in panic disorder, a prediction based on the reported high prevalence of vestibular dysfunction in these patients. Indeed, patients with panic disorder showed SMD levels second only to those of the balance self-help group members. In our view, it has not been generally appreciated that patients with panic disorder would score highly on a homogeneous scale that includes items such as "leaning far back in a chair," "closing eyes in the shower," and "rolling over in bed." A question remaining for future research is whether differences in SMD within groups of panic patients can serve as a marker of vestibular dysfunction in these patients. That is, would a high score in a panic patient signify the presence of vestibular dysfunction?

In neither Study 1 nor Study 2 was consideration given to what specific balance disorder the patients were experiencing. Nevertheless, symptom patterns may vary among different types of balance disorders. Considering the mechanisms for SMD discussed in the Introduction, SMD would be expected particularly in individuals with compensated vestibular abnormalities and no other sensory deficits. Patients with acute balance disorders may be symptomatic at all times, i.e., without situational specificity, because central compensation has not yet developed. Similarly, patients with balance disorders related to multiple sensory deficits (e.g., cataracts or neuropathies) may not develop the visual and somaesthetic dependence that underlies SMD, because these alternative sensory modes are impaired. Further studies are needed to examine SMD profiles in specific balance disorders.

Both Study 1 and Study 2 prospectively examined the properties of two parallel scales for SMD that differed in item design, the SMD-I and SMD-II and a scale for non-SMD agoraphobic discomfort, the Ag-I. In Study 1, the Ag-I showed good reliability and validity, especially considering its brevity. In the otolaryngological setting of Study 2, however, the Ag-I was not a homogeneous scale. The near-zero internal consistency in this population may have been due to restriction of range, which is readily apparent in a comparison of Fig. 2 with Fig. 1. Of interest, however, was the fact that some of the items in the Ag-I did discriminate between the groups. Two of these involved exposure to crowds. Avoidance of non-SMD-related situations such as social activities was noted in the interview study by Yardley, Todd, LaCoudraye-Harter, and Ingham (1992). These interview data suggest that there are other psychiatric consequences of balance disorders besides SMD-related agoraphobic avoidance.

Of these two scales measuring SMD, the SMD-II clearly was superior. In both studies, it possessed the highest internal consistencies. In both studies, it showed better discriminant power in separating the study groups. Furthermore, in Study 2, the effect sizes for each item separating the groups were larger for the SMD-II than for the SMD-I. The SMD-II can be recommended for continued research use. As a measure of SMD, it may ultimately prove useful in the otolaryngological and psychiatric settings. The status of the SMD-I, on the other hand, still should be regarded as "experimental." An improved version might be developed by selecting, for example, the items associated with the greatest effect sizes in Study 2. Such a revision would need to be tested in a new validation sample. In its current form, however, the SMD-I might be a useful supplement to the SMD-II in patients in whom response acquiescence is suspected on clinical grounds.

ACKNOWLEDGMENTS

The authors would like to acknowledge the assistance of Sue Russell, M.F.A., and Melinda Smith, B.S., in the preparation of the manuscript.

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