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Mood, pattern sensitivity and headache: a longitudinal study

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SYNOPSIS Fifteen persons who admitted to chronic worry were asked to complete morning and evening diaries in which they reported the occurrence of headaches, assessed their mood, and observed a visually stressful pattern, noting the illusions it induced. Results showed an association between both trait and state measures of mood and headache occurrence, and between trait and state measures of headache occurrence and illusion susceptibility. However, mood and illusion susceptibility did not appear themselves to be associated either as trait or state variables. The implications of these results for remediation of headaches are discussed.

INTRODUCTION

There has been long an interest in the role that emotions play in the genesis and maintenance of headache. Headache appears to be one of the commonest forms of pain experienced by people who have a formally diagnosed depressive disorder (see review by Romano & Turner, 1985), a finding which has motivated the research for an emotional correlate of headaches in non-psychiatric patients. Yet when correlations between self-rated affect and the occurrence and severity of headaches have been investigated, they have not been strong. Porter *et al.* (1981) report correlations ranging from 0·15 to 0·35 between various indices of mood and headache (mixed diagnoses), assessed with daily diaries over a one month time period. Harrigan *et al.* (1984) also found relatively low correlations between the occurrence of migraine and mood, whether measured on the day before the headache or the day of the headache. Although Dalkvist *et al.* (1984) found some evidence of time-dependent variation in mood and headache occurrence (e.g. increase in altertness two or nine days prior to migraine), associations with tension headache were less evident. In a similar larger study Arena *et al.* (1984) examined the relationship between migraine and tension headache and mood (anxiety, depression, anger), rated daily. Affective disturbances were found, but only on the same day as headache and in only 23% of their sample. No relationship was found between the occurrence of headache and mood, rated one or two days prior to or after the headache. Thus although all studies have found some co-occurrence of mood and headache, the evidence for mood as an antecedent factor is relatively weak.

All the volunteers in the above research on mood and headache were recruited from headache or pain clinics and were consequently already diagnosed as suffering from migraine or tension headache. There is little information on the relationship between mood and headache in people whose primary problems are emotional. As part of a project on chronic worry we had the opportunity to study the incidence and correlates of headaches in people who have a range of sub-clinical emotional problems. We felt that these people were likely to be much more typical of those patients who commonly present to general practitioners with a mixed range of emotional symptoms including aches and pains. Pilot questioning had confirmed that headache was indeed commonly experienced by this group. We were interested in (a) the nature of the relationship between mood and headache for this group, and (b) the relationship between headache occurrence and a measure which has been associated with physiological (non-mood) headache, namely, pattern sensitivity. People

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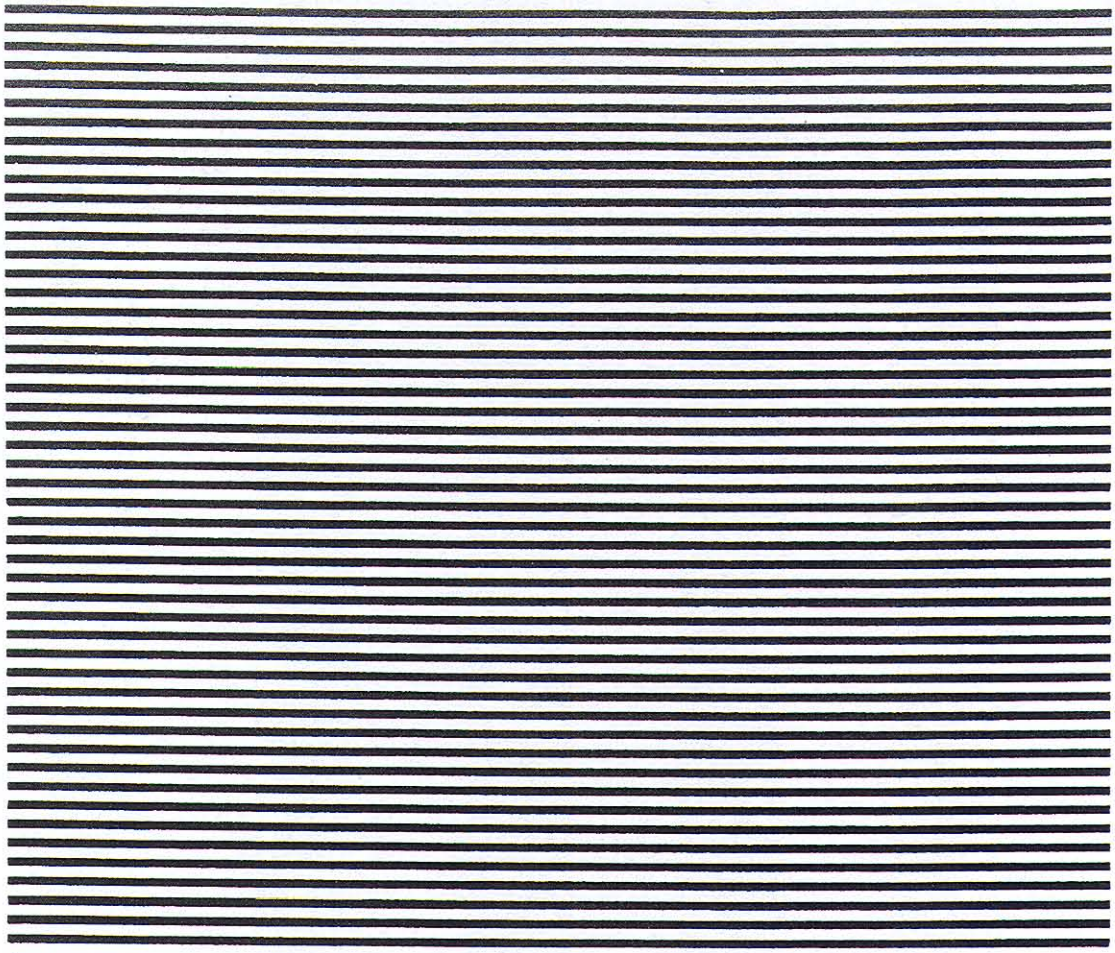

FIG. 1 A pattern with spatial characteristics close to those for which illusions, visual discomfort and epileptic seizures are maximally likely.

who see many illusions in patterns such as Fig. 1 tend to suffer frequent headaches, and if the headaches are consistently unilateral the illusions predominate in one lateral visual field. The parameters of the patterns that induce illusions (including their shape, spatial frequency, duty cycle, contrast, and cortical representation) closely resemble those that elicit epileptiform EEG abnormalities in patients with photosensitive epilepsy (Wilkins *et al.* 1984).

The correlation between headache occurrence and pattern sensitivity found by Wilkins *et al.* (1984) was based on a subjective estimate of the number of headaches which people experienced per year. Although these investigators were able to confirm the validity of their estimate of headache occurrence, the study was cross-sectional and so could not specify the nature of the relationship between headache and illusion susceptibility over time. Furthermore, the relationship between mood and reports of illusions when looking at a striped pattern was not investigated. It remains unclear to what extent emotional disturbance may play a role in the association between sensitivity to the striped pattern and headaches. Since the strongest evidence for mood-headache association is that of co-occurrence, it is possible that the correlation between headache occurrence and visual sensitivity might simply be due to the third factor of mood disturbance. A longitudinal study examining daily exposure to a striped pattern and daily diaries of headaches and mood was thus needed.

Table 1. *Details of participants including age, headache incidence, severity (range 1–4), duration (hours), and location (Left, Right or Bilateral), together with Beck Depression Inventory (BDI), Spielberger Trait Anxiety Inventory (STAI)*, and illusion test scores. On the BDI scores of 0–4 are normal and scores of 5–7, 8–15 and ⩾ 16 indicate respectively mild, moderate or severe depression. STAI scores of 49 and above can be taken as indicating high anxiety (Williams, 1979)*

Subject	Age	No. headaches/ week	Severity		Duration		Location		BDI	STAI	Illusions	
			Worst	Mean	Worst	Mean	Worst	Predominant			Non headache days	Headache days
1	44	3·3	2	1·4	10	3·2	L	L	8	65	2·0	2·17
2	52	2·2	2	1·3	6	2·7	B	B	13	57	0·06	0·15
3	39	4·2	3	1·6	10	4·3	B	B	7	57	2·23	2·30
4	48	1·8	2	1·6	5	2·9	B	B	2	50	1·77	2·70
5	45	0·2	3	—	3	—	B		5	43	1·03	(0)
6	57	2·7	2	1·7	10	6·7	B	B	8	43	0·33	0·31
7	32	4·3	2	1·3	10	1·7	B	L or R	10	45	1·18	1·46
8	41	1·0	3	1·5	5	2·1	B	B	4	66	1·02	0·33
9	38	0·3	2	1·5	6	3·5	B	—	7	53	0·19	(0)
10	37	5·2	4	2·3	10	2·4	B	B	12	56	3·00	4·00
11	44	2·0	3	2·1	10	4·4	B	B	0	52	1·91	1·76
12	41	3·3	4	2·0	12	7·1	B	B	3	47	2·17	3·78
13	27	1·8	2	1·3	12	5·6	R	R	7	66	2·64	3·69
14	59	0·7	1	1·0	10	7·6	B	B	2	40	1·42	1·75
15	56	0·7	1	1·0	0·5	0·33	L	L	0	38	1·39	1·25
Mean (S.D.)	44 (9·5)	1·9 (1·6)		1·5 (0·38)		3·9 (2·2)			5·9 (4·1)	51·9 (9·6)	1·49 (0·88)	1·97 (1·31)

* Spielberger *et al.* (1970)

Measures of mood, headache occurrence and illusion susceptibility were taken twice daily over a period of six weeks, yielding 84 data points for each subject on each variable. It was predicted that headache occurrence would be associated with increased illusions and associated mood disturbance for at least some volunteers. The point of interest was whether increased mood and increased illusions would correlate with headache occurrence separately or together, between or within subjects. In addition to daily mood ratings, trait levels of depression and anxiety were assessed. The association between these trait variables and headache occurrences was of interest since Martin (1972) has suggested that tension headache may be precipitated by more prolonged emotional tension, but not substantially affected by short-term variation in mood state. The relationship between trait and state emotional disturbance and illusion susceptibility has not previously been examined.

METHOD

Subjects

Fifteen women were recruited from a panel of people who had volunteered to take part in experiments on worrying. The characteristics of the sample are described in more detail elsewhere (Williams & Nulty, 1986), but briefly these subjects are a predominantly female population in the age range 30–60 who have high levels of trait anxiety and depression compared to age-matched controls. Over half the panel have had previous psychological or medical treatment for their worries. They are therefore best characterized as 'chronic worriers'. Pilot data had suggested that headaches were a common problem for this group. Owing to the visually stressful nature of the pattern three patients who volunteered but who suffered from migraine headaches were excluded from the study for ethical reasons. None of the subjects had consulted a doctor specifically about their headaches or attended a headache clinic, so formal 'diagnosis' of headache was not appropriate (such diagnostic systems having been developed using populations suffering headache severe enough for them to seek medical advice). For these reasons, the exclusion of subjects with self-reported 'migraine' need not imply that the sample comprised only subjects with classical tension headaches. However, information which would normally be relevant to diagnosis is presented in Table 1. This shows the age of the participants together with the average incidence of their headaches and the location and severity of the pain. Owing to the exclusion of subjects with migraine, details as to warning symptoms were not elicited. Since the main interest of the study was to examine day to day fluctuations (within individuals) of variables associated with headache incidence, data were not collected on more chronic factors which are sometimes implicated in high frequency headache occurrence – e.g. chronic use of drugs, hypertension, or the menopause. The headache frequency shown in Table 1 confirms the impression that this group suffers from more frequent headaches than normal. Wilkins *et al.* (1984) found a number of 2·4 headaches (S.D. 3·15) over a one month period in which 54 normal volunteers from the Applied Psychology Unit's subject panel kept headache diaries. The average incidence of 1·9 headaches per week in the group of worriers studied here is more than three times that observed in the sample of normal volunteers.

The mean number of illusions reported by the current group was not, however, different from previously obtained data from normal volunteers (mean = 1·86, S.D. = 1·43; $N = 80$; Wilkins *et al.* 1984).

Materials

Beck Depression Inventory (short-form) (Beck & Beck, 1972).

This is a 13-item questionnaire derived from the 21-item version (Beck, 1967) by reference to the item-whole scale correlations. Subjects check one item out of four statements which refer to how they feel today. Beck & Beck (1972) report a correlation between the short and full versions of the BDI of 0·96 and give cut-off scores of 0–4 (no or minimum depression), 5–7 (mild depression), 8–15 (moderate depression), ⩾ 16 (severe depression).

State Trait Anxiety Inventory (Trait) (Spielberger et al. *1970).*

This is a 20-item inventory where subjects answer questions about how they generally feel, each on a four point scale. A cut-off score of 49

on this scale represents 2 standard deviations above the mean for non-anxious subjects (Williams, 1979).

Profile of Mood Scales – short-form (POMS)

This is a 25-item state-mood questionnaire (right now form) used to assess level of fatigue, tension/anxiety, vigour, anger, depression and confusion/bewilderment, derived from the 65-item version (MacNair *et al.* 1981) by selecting the items which correlated most highly with the total scores in previous research with emotionally disturbed groups (Williams & Broadbent, 1986). The short-form/complete form correlations for each scale for the previously studied group were: fatigue, $r = 0{\cdot}97$; tension, $r = 0{\cdot}96$; vigour, $r = 0{\cdot}93$; anger, $r = 0{\cdot}96$; depression; $r = 0{\cdot}95$; and confusion, $r = 0{\cdot}91$.

Headache questionnaire

This questionnaire (completed twice daily) asked how many headaches, if any, had occurred since the last assessment (period of 12–15 hours), their duration (in hours) and severity (a four point scale from 'noticeable but not distracting' to 'almost unbearable'), and the location of the pain.

Illusion sensitivity instrument

Each subject received a packet containing a grating (circular in outline, diameter 20 cm, with a square-wave luminance profile, spatial frequency 4 cycles/cm, Michelson contrast 0·7) and a piece of string 40 cms long to standardize the viewing distance. Subjects were instructed to examine the pattern (with stripes horizontal) for five seconds and then report on a check list which illusions (if any) occurred (red, orange, green, blue, yellow, blurring, bending of stripes, shimmering, flickering, shadowy shapes or any other). All of these materials, including questionnaires, are available on request.

Procedure

The Beck Depression Inventory and Spielberger Trait Anxiety Inventory had been completed prior to the start of the longitudinal study. During the study proper subjects completed the questionnaire in the morning, soon after getting up, and in the evening, soon before going to bed. The order of the questions on the daily diary was kept constant throughout: questions about headache occurrence, frequency, severity, duration and location of pain; adjectives from the Profile of Mood Scale; and finally illusion reports.

Batches of diaries were sent out and returned by subjects weekly. All subjects received a letter at the end of the study explaining the purpose of the investigation. No subject dropped out or complained about any ill effects of the procedures.

RESULTS

Table 1, in addition to summarizing for each subject the number of headaches reported, their severity, duration and predominant location, also shows the level of depression and trait anxiety together with the mean number of illusions seen on headache and nonheadache days.

The central point of concern was whether increased mood or increased illusions would correlate with headache occurrence separately or together, between or within subjects.

Correlations between subjects

Pearson product-moment correlations were computed between the characteristics of headaches and trait mood measures. The total number of reported headaches correlated significantly with Beck Depression scores ($r(13) = 0{\cdot}54$; $P < 0{\cdot}05$), but not with Spielberger Trait Anxiety scores ($r(13) = 0{\cdot}23$; NS). Neither depression nor anxiety significantly predicted mean duration or severity of headaches.

There was no significant correlation between the number of illusions reported on non-headache days and either depression ($r = -0{\cdot}11$) or anxiety ($r = 0{\cdot}31$).

There was a significant correlation between number of illusions reported on non-headache days and total number of headaches ($r(13) = 0{\cdot}51$; $P < 0{\cdot}05$), suggesting that greater pattern sensitivity was associated with more headaches. The correlation between the mean number of illusions and overall mean severity of headache fell short of significance ($r(13) = 0{\cdot}40$). There was no association between number of illusions reported and mean duration of headache ($r = 0{\cdot}08$), which suggests that the correla-

Table 2. *Deviations above (+) or below (−) each subjects own baseline level of illusion and mood reports on headache periods (H), and up to 24 hrs before (B) or after (A)*

Subject	Illusions	Tension	Depression	Anger	Vigour	Fatigue	Confusion
1	—	+H	+H	−B+H	−A	—	—
2	—	+H	+H	+H	—	—	—
3	—	+H	+H	+H	—	—	+H
4	+H	—	—	−B+H	−H	—	—
5	—	—	—	—	(−H±A)*	(+B+H)*	—
6	—	+H	+H	+H	−H	+H	+H
7	+H	+H	—	—	—	—	—
8	—	+H	+H	—	+H	—	+H
9	—	+A	+A	—	—	—	—
10	+H	+H	+H	+H−A	−H	+H	+H
11	—	—	+H	−H	−H	+H	+H
12	+H	−H	−B−H	+B+H	—	—	+H
13	+H	+H	+H+A	+H	−B−H	+H−A	+B+A
14	—	—	—	—	—	+H	—
15	—	—	−B+H+A	+H	+B+H+A	—	−A

* These data are based on only one headache.

tions between illusion susceptibility and number of headaches was not simply due to reporting bias.

Correlation within subjects

The ratings of mood and illusions from diaries completed 12 and 24 hours prior to and 12 and 24 hours after the diary entry in which a headache was reported was identified for each subject. Mood and illusions ratings falling outside these periods were treated as baseline data. For each headache occasion for each subject five data points were derived (−2, −1, headache, +1, +2). The mean rating for each data point for each subject could thus be compared with baseline. (If another headache occurred within the period −2 to +2, then that data point and two points on either side were omitted when calculating the mean rating for each data point). Mean ratings for each position were transformed to z scores (or t values where the baseline values were derived from fewer than 30 observations for that subject – this occurred in three subjects). This transformation meant that mood and illusion levels could be expressed as deviation from the baseline for each subject. This within-subject analysis revealed that five subjects showed significant deviations from baseline in number of illusions reported, all at the time of the headache. For these subjects, z scores of 3·67, 2·80, 3·71, 9·09 and 3·10 were observed for the number of illusions reported on a headache occasion. In no case, however, did the number of illusions exceed baseline on the rating occasion prior to or following a period in which a headache occurred (see Table 2).

Table 2 also shows a summary of occasions in which mood levels were significantly above or below any subject's baseline level. This illustrates two main points. First, that *all* subjects showed some mood disturbance (contemporaneous with the headache) in an least one of the six self-rated moods. Depression and anger were most consistently raised in the same 12 hour period as the headache (nine subjects). Eight subjects showed raised tension levels, six subjects showed raised confusion and lowered vigour, and five subjects showed increased fatigue. The second point illustrated by Table 2 is that no two subjects showed the same pattern of mood disturbance. For example, one subject showed a significant pattern of decreased depression and tension levels but increased anger and confusion in the headache period. Another subject showed reduced anger on the headache occasion despite increased disturbance in other moods. Although there was no overall tendency for mood to precede headaches consistently or to regularly follow a headache occasion, examination of Table 2 shows that several individuals showed their own distinctive pattern. In the period prior to a headache one subject showed increased anger and decreased depression, a second subject also showed decreased depression along with increased vigour. A third subject showed increased confusion, another two showed de-

creased anger levels. Thus a total of five subjects showed pre-headache changes which were large enough to differ significantly from baseline levels.

Five subjects showed significant mood changes in the aftermath of the headache. In the 24 hour period following headache, one subject showed increased vigour, a second showed increased vigour and increased depression, a third showed increased tension and depression, a fourth decreased anger, and a fifth increased depression, fatigue, and confusion. Note that these reflect changes from non-headache baseline, and not changes from the level of ratings on headache occasions.

Correlations were computed between z scores of illusion reports for headache days and the corresponding z scores for disturbances of mood. Somewhat unsurprisingly, given the large individual differences in mood, there were few significant correlations with illusion reports. Only changes from baseline in self-rated anger correlated significantly with illusion reports ($r(13) = 0{\cdot}68$; $P < 0{\cdot}01$). Correlations with other moods were low and non-significant (vigour, $r = 0{\cdot}33$; confusion, $r = 0{\cdot}03$; tension $r = -0{\cdot}11$; depression, $r = -0{\cdot}33$; fatigue, $r = -0{\cdot}001$). This suggests that the factors affecting day to day fluctuation in illusion susceptibility and those affecting day to day mood levels are independent of each other, even though both show some relation to headaches.

DISCUSSION

The purpose of this study was to examine the relationship between affect, visual sensitivity and headache in a group of chronic worriers. Mood factors had hitherto been more commonly examined with populations of patients who had been diagnosed as having specific problems with headaches. We felt it important to study similar factors in people who might more commonly present to general practitioners with symptoms of chronic worry as primary complaint. In these patients the headache may well not be treated because it is assumed to be a peripheral aspect of a more central worry component. We do not deny that the primary problem for many patients may lie elsewhere, but the advantage of investigating the headache component in its own right is that alleviation of this problem may itself make other problems more soluble. Importance of assessing pattern sensitivity as a possible exacerbating factor can therefore be seen more clearly. Sensitivity of this kind has been linked with headache occurrence, but has not been studied in relation to mood. By studying pattern sensitivity, mood and headache occurrence longitudinally we aimed to investigate the co-occurrence of these factors in each case, thus avoiding the problems associated with cross-sectional designs.

There were three ways in which affect was seen to be involved in headache occurrence. First, trait levels of depression, as assessed by the Beck Depression Inventory several months before this study, predicted the number of headaches over the six weeks of the study itself. This appeared not to be an artefact of depressed subjects' differential sensitivity to pain, since depression did not correlate with ratings of either severity or duration of headache.

Secondly, there was a strong tendency for state mood to co-occur with headache. No subject failed to show some mood changes which significantly exceeded baseline for the period in which a headache occurred. This is in contrast to Arena *et al.*'s (1984) finding that only 23% of their sample showed such contemporaneous mood disturbance. A possible explanation for this discrepancy is that their sample consisted entirely of people who had attended headache clinics for treatment of headache.

A feature of the current results which may partly explain the ambiguities in the literature on mood and headaches is that no two individuals showed the same pattern of mood in relation to a headache. Larger group studies (especially cross-sectional, or sampling shorter time intervals) are therefore likely to produce inconsistent results. The inconsistencies will be compounded if, as has been typical, only one or two mood measures are taken.

Thirdly, and illustrative of the importance of examining individual cases, mood appeared to play a role in the period before and after a headache for some subjects. These changes were often in different directions from one subject to another, and perhaps as a result, grouped data showed no overall effect. Nevertheless, six of the fifteen subjects showed pre-headache changes which significantly diverged from their own baseline levels. Unlike other investigators (e.g.

Arena *et al.* 1984) we are not suggesting that such pre-headache phenomena demonstrated a causal role for mood in the genesis of headaches for these patients. Arena *et al.* suggest that cross-lagged panel correlation analysis is a relevant means of testing a causal hypothesis in this respect, but this is not the case (see Rogosa, 1980, Williams, 1985). Pre-headache changes may indeed play a causal role, but they may also reflect prodromal features of the syndrome (Blau, 1984). Much more intensive work will be necessary before it will be possible to come to definite conclusions on this issue.

In contrast to mood, pattern sensitivity did not feature for any subject in the immediate pre-headache phase. Like mood, however, two aspects of pattern sensitivity appeared to be important. First, mean levels of illusion susceptibility at times more than 24 hrs from a headache were significantly associated across subjects with the average incidence of headaches. This parallels the association between Beck Depression levels and number of headaches, but mean pattern sensitivity and Beck Scores were not themselves correlated ($r = -0{\cdot}11$). This suggests that trait levels of pattern sensitivity and depression are independent in their association with headache occurrence and that the association found by Wilkins *et al.* (1984) between illusion sensitivity and headaches were not due to both being mediated by mood.

Secondly, there was a contemporaneous relation between headache and illusion susceptibility for five of the fifteen subjects. There was some evidence that these subjects were also those who became most angry during a headache period, but tendencies to exceed baseline in the illusions reported correlated with no other mood. Indeed, deriving a 'total mood disturbance index' from the individual mood z scores for each subject showed that deviation from baseline in overall mood on a headache occasion had very low correlation with deviation from baseline of illusions on the same occasions ($r = 0{\cdot}16$, NS). Thus the five subjects showing acute pattern sensitivity during a headache period were *not* the subjects who were most disturbed in their mood. This is consistent with the conclusion from the trait measure of depression and pattern sensitivity – that they appear to be independently associated with headache occurrence.

These results encourage us to look more extensively at the relations between illusion susceptibility and headache. Because of the intensive nature of the study, the small numbers preclude us from placing too much weight on the between-subject analyses of trait correlations. Further research will be needed to determine the extent to which other factors may be involved in the link between illusion sensitivity and headache. It might be interesting, for example, to compare the current groups of subjects with chronic worriers who do not have headache, and with non-worriers who do. Our conclusions may only relate to chronic worriers. Nevertheless, because of the repeated sampling of mood and pattern sensitivity variables which preceded, co-occurred and came after each headache episode we are relatively confident in predicting that we will continue to find a significant proportion of people suffering from headaches as a feature of chronic anxiety in whom an association between headache and pattern sensitivity is present. Our informal enquiries suggest that people are only barely, if at all, aware of this aspect of their problem. Yet there are many situations (e.g. reading) which may tend to exacerbate the problem of those subjects whose headaches are related to pattern sensitivity, and there are remedial measures which can easily be taken by such people (Wilkins & Nimmo-Smith, 1984). The results of this study suggest that these subjects are not the most disturbed in their mood (either trait or state), so their problem is not merely a reflection of reporting bias, or acute bodily sensitivity to any internal stimuli. As for the remainder of the subjects, mood was a more common correlate than might have been expected on the basis of earlier research, but the particular pattern differed from person to person. Remedial measures for such people may well include helping them to predict their oncoming headaches by making them more aware of pre-headache mood changes, but these changes, where they occur, will need to be assessed for each individual separately over at least a six week period.

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