PSYCHOLOGICAL ASPECTS OF TINNITUS: THE EFFECTS OF ATTENTIONAL FOCUS, ANXIETY AND FATIGUE.

By

LESLIE LEADER

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Department of Psychology

The University of British Columbia
1956 Main Mall
Vancouver, Canada
V6T 1Y3

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Abstract

This study examined the effects of attentional focus, anxiety, and fatigue on tinnitus distress, intensity and pitch in a group of 60 adults with tinnitus. Subjects were randomly allocated to one of three experimental groups or to a group performing a control task. In order to provide a naturalistic parallel to the laboratory manipulation, subjects kept a diary of similar variables for one week.

The experimental manipulations showed that an increase in attentional focus on tinnitus led to a significant increase in perceived tinnitus intensity. There was an indication that increased anxiety had a similar effect on tinnitus intensity. Interestingly, tinnitus pitch was relatively unaffected by manipulations compared to tinnitus intensity.

Naturalistic diary analyses indicated significant positive correlations between the mood variables, bored, anxious, and fatigue on the one hand and tinnitus distress, intensity and pitch on the other. The strongest correlation appeared to be between tinnitus distress and anxiety. A multiple regression procedure found that tinnitus distress was positively correlated with tinnitus intensity, age, and complexity of the tinnitus sound; and negatively correlated with duration since onset. There was a high degree of variability among subjects in range of tinnitus distress and its temporal patterning.

Implications for tinnitus treatment, measurement and a proposed model of tinnitus distress are discussed.

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I Introduction

Tinnitus is usually considered to be a symptom of an underlying somatic disorder but, increasingly, evidence suggests that psychological factors contribute to the distress associated with tinnitus and its sensory qualities. The proposed research investigates some of these processes.

Tinnitus may be described as internal sound or sounds localized in the head and occurring in the absence of external acoustic stimuli. They are generally experienced for prolonged periods and can be extremely distressing. A broad range of intervention strategies has been attempted, with none universally successful (McFadden, 1982). Medical treatment can occasionally silence the tinnitus, but, for the majority of cases, there is no known treatment to achieve this. In certain cases the masker, a prosthetic device which broadcasts a masking sound to the ear, has proven palliative (Vernon & Schleuning, 1978; Stephens & Corcoran, 1985) but, for the most part, tinniteurs are advised to "live with it." Although most adjust to the symptom over time, it can be distressing in varying degrees.

Until recently, judging by the number of psychological publications dealing with tinnitus, there has not been a great deal of research or clinical interest in the psychologically based treatments for distress from tinnitus. In the past few years, however, there has been a growing interest among psychologists in this problem. This might be due to the upsurge

of interest in medical psychology. Its widening scope has now included tinnitus and is reflected both in theoretical research (e.g. Hallam, Rachman, and Hinchcliffe, 1984) and treatment research (e.g. Scott, Lindberg, Lyttkens, & Melin, 1985).

Since it is unlikely that a cure for tinnitus is imminent (if this means silencing the tinnitus sound), it seems timely to conduct research to discover which factors exacerbate the distress that can follow tinnitus onset. A good starting point for this research might be the systematic investigation of factors which have been found to influence pain perception and which might be conceptually generalized to tinnitus. A second heuristic would be to test experimentally some of the personal hypotheses tinniteurs have about which factors exacerbate their tinnitus. This thesis will pursue experimentally certain aspects of these broad leads.

In this investigation tinniteurs will be exposed experimentally to conditions which systematically induce fatigue and anxiety; and which focus attention on and away from the tinnitus sound. The purpose of this thesis is to investigate whether these factors exacerbate distress felt from tinnitus. The ultimate usefulness of this research might be to determine whether these factors should be included in a psychological treatment protocol to alleviate this distress.

II Literature Review

A. Description of tinnitus

"I also experienced a strange acoustic hallucination, continuously hearing - probably because of nervous over-exertion - a duet of two male voices in D-major with a deep organ sound, which would stop only when I put my head out of the window, but immediately started again when I sat down." (Lowenbach, 1943, quoting from a letter written in 1862 by the Czech composer, Bedrich Smetana). Nineteen years later Smetana wrote: "The droning and violent buzzing in my head, as though I were standing under a huge waterfall, remained with me, and has gone on night and day without interruption, more strongly when my emotions are stirred up, and weaker on days when I am in a quiet affect. The buzzing grows stronger when I am composing." (Lowenbach, 1943). Smetana's vivid description of his tinnitus conveys the complexity of the sounds heard by some tinniteurs.

Initially in 1862 he described the two musical sounds superimposed on a lower, organ-like tone. Nineteen years later these became more a buzzing, rustling noise. Smetana provided an instance of how variable these sounds can be in pitch, loudness, and quality. He was also aware of how his emotional state might have influenced his perception of their loudness and of how an environmental factor and a postural adjustment could change his perception of the tinnitus sounds.

Tinnitus clearly can be a disturbing symptom and, although

the etymology of the word refers to a ringing tone, it can take many forms, as Smetana graphically describes. Tinnitus is the symptom of hearing a sound or sounds in the absence of external stimuli. By describing it as a symptom, the presence of a causal pathology is implied. As will be described later, with present knowledge causes are rarely identifiable so that most cases of tinnitus are of unknown etiology.

The purpose of the following literature review is to provide a background to the development of the present study. The emphasis, for the most part, is on the psychological implications of research into tinnitus thus far. Both the tinnitus and pain literatures are covered in the review with the aim of integrating aspects of each to yield ideas which may prove helpful in investigating the nature of tinnitus, distress from tinnitus, and its treatment.

Range and variation.

There is apparently no simple reliable relationship between self-reports of tinnitus and its physical characteristics. Graham and Newby (1967) reported that verbal descriptions used by subjects to describe their tinnitus were unrelated to pitch, loudness of the tinnitus sound, or to diagnostic category. In contrast to this Reed (1960) found that the descriptions offered by tinniteurs of their tinnitus corresponded with the measured frequency band width. Although not statistically validated, he reported that a broad band tinnitus was most often described as

"steam"; a medium band width as a "buzz"; and narrow band or pure tone tinnitus as a "ring". In Reed's (1960) sample of 200 tinniteurs, the distribution of the central frequency of the tinnitus sounds had a mode at between 3 and 4 kHz; about 90% of the frequencies effectively fell within a range of 0.5 to 8.5 kHz thus representing a positively skewed distribution with more cases in the lower frequencies. Vernon's (1975) sample of 513 tinniteurs had a distribution of tinnitus frequencies very similar to Reed's: 21% below 2 kHz, 63% between 2 & 7 kHz & 16% above 7kHz. Thus tinnitus has modal frequencies in the range between 2 and 7 or 8 kHz. Reed's (1960) data on the distribution of tinnitus frequencies did not correspond with the distribution obtained by Graham & Newby (1967). Unfortunately, the latter's report did not provide sufficient details of their findings to allow closer inspection.

Many tinniteurs report fluctuations in the pitch of tinnitus but systematic research into this topic is rare. Some variation has been reported. In a four week longitudinal study with three subjects whose tinnitus was related to noise exposure, it was found that matched frequencies varied by ranges as great as from 2 to 5 kHz (Penner, quoted in McFadden, 1982, p.36). This variation was also mentioned by Voroba (1979a), who suggested that it was caused by the method of measurement and instrumentation rather than by a fluctuation in the pitch of the tinnitus sound. The wide variation in pitch experienced by at least some tinniteurs and reported in these studies suggests that the procedure of a single measurement of matched pitch

might have only limited utility in these cases. To summarize, this variation may be explained in two ways: as being due to changes in the perceived sound, or to insufficiencies in measurement procedures. Problems in measurement will be described in more depth later.

In contrast to the fluctuation reported above, there have been studies which attested to the relative constancy of the tinnitus sound. In one study, test-retest reliability over four months was reported to be high, with retests typically falling within one-sixth of an octave of the first estimates (Tyler & Conrad-Armes, 1980). Also Malatesta, Sutker & Adams (1980) in a single-case study, reported almost complete consistency in the matching of a tone of 6 kHz to his subject's tinnitus in each of 220 trials over a two-month period. However, the tone generator was calibrated in discrete intervals of 1 kHz thus eliminating the possibility of finer discriminations and variations in the selected tone.

Graham & Newby (1967) compared acoustic characteristics of tinnitus sounds associated with various known etiologies of hearing loss. They found that the tinnitus pitches of sensorineural and sensorineural-conductive hearing-loss subjects were not significantly different. Overall they had the wide range of 40 Hz to 7.8 kHz. However a third group with conductive hearing loss had a significantly lower and more restricted pitch range than the other two groups (.12 to 1.4 kHz). The authors suggested that conductive hearing loss might

have a different physiological mechanism of tinnitus production than for other sources of the disorder.

Loudness and pitch.

Reed (1960) reported that pure-tone and narrow band tinnitus tended to be perceived as louder than broad band tinnitus. He also found that lower tinnitus frequencies tended to be reported as being louder than the higher frequencies.

The perceived loudness of the tinnitus has been repeatedly demonstrated to be of low intensity in most cases when measured objectively. Reed (1960) found that 69% of his sample matched their tinnitus to a tone of 10 dB SL or less and that only 5% needed a tone of more than 30 dB SL. These results have been broadly confirmed by Graham (1960) who found that, whereas 75% matched to 10 dB SL or lower, only 4% matched to more than 20 dB SL. Vernon (1975), after surveying 513 tinniteurs with severe tinnitus, reported that the loudness was usually 5 to 10 dB SL (although in a few cases it was 40 dB SL and as high as 70 dB for one patient). Most tinniteurs thus experience tinnitus at a level within 5 to 10 dB of their hearing thresholds and almost all within 30 to 40 dB of their thresholds.

It was likely that these studies suffered from a ubiquitous problem in loudness-matching procedures. If the ear to which the variable tone is presented for matching to the intensity of the tinnitus sound suffers from loss of sensitivity, then measurements over the range of the reduced sensitivity would be

too high. In contrast to this explanation in terms of loss of sensitivity, Vernon (1976) has suggested an explanation of possible discrepancy in terms of a recruitment process. Low tinnitus intensities, when subject to the abnormally rapid growth of loudness characteristic of ears displaying recruitment, might sound abnormally loud and therefore be more distressing than the intensity of a matched sound might indicate.

In one of the few studies in the earlier tinnitus literature using control groups, Graham & Newby (1967) compared the acoustical characteristics of four groups totalling 100 subjects. Three of the groups (sensorineural, sensorineural-conductive and conductive hearing loss groups) consisted of subjects who had tinnitus, with the fourth group consisting of normal-hearing, tinnitus-free subjects. They found that there were no significant differences in reported loudness among the three groups with varying etiologies. More than half of the these subjects matched the tinnitus loudness to stimuli 5 dB SL or less above threshold. If decreased or enhanced sensitivity to stimulus loudness were systematically associated with characteristics of some or all of the hearing-impaired groups, significant group differences might have been found. The fact that this was not the case could be explained by the absence of clear intergroup differences in hearing sensitivities. Formby & Gjerdingen (1980) found that there was substantial variation between trials in masking intensities (typically 15-20 dB but as high as 40 dB) that were necessary to mask a tinnitus sound on

repeated testing. This confirms the generally-held assertion that tinnitus volume fluctuates over time and suggests another potential reason for the lack of association found between tinnitus loudness and reported distress: the use of single estimates of tinnitus loudness as data for analysis.

The discrepancy between the loudness of tinnitus sounds and the magnitude of resulting distress has long intrigued researchers in this field. Although louder tinnitus sounds might be expected to be associated with more distress, research reports have generally not supported this expectation. Hallam, Rachman, & Hinchcliffe (1984) compared patients who presented with tinnitus as the main complaint for consultation at an ENT clinic with those for whom tinnitus was secondary to other symptoms such as deafness or dizziness. They found no differences between tinnitus loudness estimates (measured by contralateral loudness balance) for the groups, nor for sound pressure levels required to mask the tinnitus. This suggested that the complainers, although more distressed by their symptoms, did not have more intense tinnitus as measured by these techniques. It was possible that other characteristics of the tinnitus sound or of the tinniteurs were responsible for the differential in distress found in tinniteurs, the authors suggested.

Otoacoustic emissions.

A phenomenon related to tinnitus but distinct from it in important respects is the otoacoustic emission (OAE). An OAE is detectable acoustic energy emitted by an ear. In some cases it can be heard by a listener placing an ear on the emitting ear, but in other cases instruments are needed to amplify the sound before it can be detected. The person emitting the OAE may or may not be able to hear it.

The technology for detecting acoustic energy in the external auditory meatus was developed recently (Kemp and Chum, 1980; Wilson, 1979, 1980; Wilson & Sutton, 1981; & Zurek, 1981). It was found, using a miniaturized microphone, that it was not unusual for a normal ear to have a spontaneous OAE at one or more frequencies which an examiner using only a stethoscope would not detect.

Certain attributes of OAEs have been described but at this stage these descriptions must remain tentative due to the small sample sizes used in the research, presumably as a result of the rarity of OAEs. It has been found that OAEs, rather than being described as pure tones, were rather like bands of noise (Kemp, 1981; Wilson & Sutton, 1981; Zurek, 1981), 1.2 to 4.7 kHz in width (Kemp, 1981). Volumes of OAEs are from about 0 to 30 dB SPL. They are generally believed to be cochlear in origin (McFadden, 1982).

Tyler & Conrad-Armes (1980) investigated 20 normal-hearing

subjects and found that while five had OAEs, none was audible to its owner. Sutton & Wilson (1981) tested 16 ears from nine tinniteurs and detected OAEs from seven ears. A major frequency component of these OAEs corresponded with a tinnitus frequency in four instances; ten ears with tinnitus produced no detectable OAEs; and in two ears with OAEs no tinnitus was perceived. Thus, it seems as though all combinations of the presence or absence of tinnitus and the presence or absence of OAE's are possible. Summarizing research on the occurrence of OAEs in humans reported in the literature to date, McFadden (1982) found that, whereas about six subjects had tones that corresponded to detectable OAEs (Kemp, 1981; Wilson & Sutton, 1981; Zurek, 1981), about sixty subjects with OAEs did not experience tinnitus. In addition there have been reports of numerous subjects who have multiple unheard OAEs accompanied in some by additional heard OAEs. Although Wilson (1980) found a limited correspondence between frequencies of OAEs and peaks or troughs in audiograms, the question of whether there is an association remains equivocal.

On the other hand, researchers have found a clearer association between frequencies at which hearing loss had occurred and the frequencies of OAEs (Glanville, Coles, & Sullivan, 1971; Huizing & Spoor, 1973). The question of whether various qualities of OAEs and tinnitus correspond or not adds complexity to the issue. That there is a relationship between OAEs and tinnitus in at least certain cases is suggested by the results of a manipulation in which airpressure in the outer-ear

canal was changed to produce an upward shift in the frequency of the OAE. In some subjects, the tinnitus pitch was correspondingly elevated (McFadden, 1982).

While it seemed that the OAE had offered great promise as a naturally occurring, objectively measurable, and to some extent manipulable, analogue to tinnitus, research has thus far not been able to produce reliable and predictable results describing the relationship between OAEs and tinnitus. Nor have the conditions been described under which OAEs are experienced as tinnitus and when they are not.

Characteristics of tinniteurs.

The phenomenology of tinnitus is not well understood despite the large volume of data on tinnitus cases that accumulates in many otolaryngological clinics. One approach to systematic investigation would be to analyze these data in order to discern whether there were aspects of the disorder which tended to co-occur. Hallam, Rachman, & Hinchcliffe (1984) endeavoured to systematize characteristics of tinniteurs without introducing preconceptions about etiologies, syndromes, or treatment response. They reported the results obtained from a cluster analysis using Ward's hierarchical method (Everitt, 1974) on measures of 74 variables supplied on self-report questionnaires. These were completed by 160 subjects with tinnitus who had attended an otolaryngology clinic for a variety of ear-related problems. The purpose of cluster analysis is to

determine profiles of scores on the variables considered which are typical of clusters of subjects. Their approach to using the profusion of data that many otolaryngology clinics collect is pioneering and heuristically fruitful.

The cluster analyses yielded 5 groups of tinnitus sufferers in this case. One group was almost exclusively male (87%), and tended to have right-sided tinnitus which was continuous for just over half the group-members. Dizziness tended to co-occur with the tinnitus sound and in 75% of cases deafness was the main complaint. The second grouping had the highest proportion of cases citing noise as a cause of the tinnitus, and stating that noise made the tinnitus worse. In addition a high proportion had noisy jobs and had fired guns and 46% were involved in medico-legal claims. Without exception, the subjects in this cluster were males, and had dizziness, balance problems and nausea with the lowest frequency. It had the highest proportion (90%) reporting deafness as the main complaint and the highest proportion of those who had a notch at 4 kHz on their audiograms were members of this group. Very few instances of mild hearing loss were found here, more severe deficits being more common. Additional support for an environmental cause of the symptoms was that only 6% of relatives were deaf (compared with 41% in the psychogenic group described below).

The third clustering reported dizziness as a symptom in 100% of cases and displayed high rates of balance problems and

travel sickness. There was a tendency for the tinnitus to have been longstanding (42% had had it for 10 years or more). Interestingly, there were no cases reported of tinnitus occurring solely in the left ear. No subject described the sound as a buzz, nor found that noise made it worse. Half of group members (more than any other group) had had allergic reactions to drugs or food. Even though about a quarter of the group found that the noises were getting worse, it had the lowest occurrence of tinnitus reported as the main complaint.

Another clustering of variables into what was described as a "psychogenic" group, consisted almost entirely of females and had the highest proportion of users of psycho-active medication. There was a high frequency too of somatic complaints, migraines, headaches, blurring of vision, palpitation, and weight gain. Vestibular problems occurred with the highest prevalence. Half of the group members had pain or headache as an additional main complaint. Whereas no subjects in this group described the tinnitus sound as high frequency tone, this group had the highest proportion of members choosing the descriptor "buzz". There was a clear tendency for the onset of tinnitus to be recent (1 to 2 years) rather than long-standing (10 or more years), and sudden rather that gradual. The tinnitus occurred intermittently (92%) rather than being present continuously. Every single group member reported having difficulty with balance and indeed one third had fallen to the ground without warning. The authors raised the possibility that these cases might be similar in some respects to chronic pain sufferers.

A final clustering was rather less discriminable descriptively than the others. Perhaps most noteworthy was the tendency for their hearing loss to be mild (71% under 20 dB) rather than severe (only 8% over 40 dB), a trend not displayed by any other group.

Whereas neither age nor annoyance level of the tinnitus discriminated well among the groups, laterality of the tinnitus, gender, and the length of time since onset were important discriminators.

Hallam, Rachman, & Hinchcliffe (1984) found that there were significant differences on other variables too. Subjects with tinnitus as the target complaint, compared to tinniteurs with other target complaints reported that the persistence of the tinnitus was the main reason for its objectionable nature; were more aware of the noises; were more affected in their working lives by the tinnitus; were more likely to have consulted a doctor about it; tended to have taken more psychotropic medication; had more trouble falling asleep; and were more depressed. The authors suggested that one way of investigating the association between loudness of tinnitus and distress levels would be for tinniteurs who had fluctuations in the loudness to record repeated ratings of this, as well as of distress levels. With one exception (the single-case study of Malatesta, Sutker, & Adams, 1980), naturalistic monitoring has not been reported in the literature to date. It might also be necessary to do repeated loudness-matching estimates spaced over hours, days and

weeks in order to elucidate the phenomenology of tinnitus.

B. Definitional Issues

The following definition of tinnitus was used in this project: tinnitus is the perception of internal sound localized in the head in the absence of external acoustic stimuli. This sound must be consciously experienced and not voluntarily producible. It may or may not be accompanied by otoacoustic emissions. Traditionally the distinction between objective and subjective tinnitus has been based on whether the examining professional could or could not objectively detect a head-sound either with or without a stethoscope. As McFadden (1982) noted, this dichotomy has been named variously: vibratory/nonvibratory (Fowler, 1939,1941), objective/subjective, extrinsic/intrinsic (Atkinson, 1947), pseudo/true (Jones & Knudsen, 1928). However, this division does not fully cover the phenomenology of head sounds. That the definition of tinnitus demands "a conscious experience of a sound that originates in the head" is emphasized by McFadden (1982, p.19).

As described above, with sophisticated detection equipment now available, otoacoustic emissions previously unknown are now discernible. Thus the sensitivity of instrumentation has become an important factor in nomenclature, blurring the dichotomy between objective and subjective tinnitus. McFadden (1982) also listed other uncontrolled variables which might affect diagnostic decision-making: "the intensity of the sound source [in the tinniteur's ear], the amount of attenuation from source

to receiver, the examiner's own hearing level in the frequency region of the source, and the ambient noise level in that frequency region" (p.18).

Clearly excluded from our definition of tinnitus, are such sounds as neck-clicks and sounds heard when the jaws are manipulated, since these can be voluntarily produced.

McFadden (1982) reviewed the four logical possibilities generated by the presence or absence of objective concomitants to head-sounds and the presence or absence of the conscious perception of these sounds by the person producing them. These are represented diagrammatically in Figure 1. The definition of tinnitus above covers only cell 1, objective tinnitus (OAE detected and experienced), and cell 3, subjective tinnitus (no OAE detected but head sound experienced). The "unheard OAE" of cell 2 falls outside the scope of the definition of tinnitus as there is no perception of the OAE by its owner and our definition of tinnitus requires this perception to be present.

C. Measurement of Tinnitus

The measurement of tinnitus can be broadly divided for clinical research purposes into two aspects: the physical attributes of the tinnitus sound e.g. sound quality, pitch, magnitude; and those directed towards its psychological concomitants e.g. distress level, interference with daily functioning, and effect on affect.

Spectral location procedures attempt to determine by

Figure 1

Combinations of the presence/perception interaction for head sounds.

		Head-sound perceived by its producer	
		Yes	No
Presence of objectively detected head-souund	Yes	1. Heard OAE (objective tinnitus)	2. Unheard OAE
	No	3. Subjective tinnitus	4. No head-sound perceived or detected

Note OAE otoacoustic emission.

objective procedures what the pitch of the tinnitus is (McFadden, 1982). There are two methods of accomplishing this. In pitch-matching the subject indicates when a match has been achieved between the pitch of the tinnitus and a sound which is varied by the examiner in response to verbal feedback from the subject. The sound is usually presented to the contralateral ear (for unilateral tinniteurs) after it has been equated for loudness with the tinnitus sound. Although pitch-matching might appear to be the most direct way of determining the pitch of a tinnitus sound, in practice it presents problems. Octave errors can occur in which the matched sound is judged to match the tinnitus in pitch but is in fact twice or half the frequency of the sound being matched (Vernon, 1977). The examiner should be vigilant for these. The matching task has proven to be difficult for many novice and experienced testees alike (McFadden, 1982). Hazell (1981a) reported similar difficulties, and frequently tinniteurs are unable to find a match.

As an alternative to pitch-matching, a masking procedure has been used in which a narrow-band sound is presented to the ear with the tinnitus and its intensity increased until the subject reports that masking has been achieved. This is repeated in successive steps with increasing or decreasing frequency of the presented tone. The tinnitus pitch is taken to be the one requiring the least intensity to mask the tinnitus.

Voroba (1979a) reported that when ascending or descending pitch was used, the test-retest reliability for pitch-matching

procedures was quite low with differences ranging from 4 kHz to 9kHz between pairs of trials. However, when the method of adjustments, in which the testee controls the test tone frequency, was used, the variability decreased. Masking procedures have also been used to estimate the magnitude of tinnitus. The assumption was that the greater the magnitude required of the presented sound to mask the tinnitus, the greater the magnitude of the tinnitus. As McFadden (1982) has pointed out, there is not a clear relationship between the two intensities. The relative widths of the noise band and of the tinnitus sound would affect masking intensity. Some tinniteurs have found masking to be equally effective at almost any frequency whereas others have tinnitus sounds which cannot be masked regardless of masking tone frequency. Feldmann (1971) termed this group as having "resistance-type tinnitus."

The "subjective" methods of reporting tinnitus pitch have shown poor correlations with the pitch determined objectively (Hazell, 1981a). A higher correlation has been reported between self-ratings of the subjective loudness of tinnitus and a free field synthesis matching procedure, than with masking intensity level (Hazell, 1981a). Free field synthesis involves exposing the subject to a sound as close as possible in pitch to the tinnitus sound, and then adjusting the intensity of this synthetic sound until it is impossible for the tinniteur to determine whether the sound originated internally or from the synthesiser.

Another technique in magnitude estimation is loudness matching. A sound which is matched as closely as possible in pitch and quality to the tinnitus is presented to the contralateral ear. The subject either adjusts the intensity of the synthesized sound or instructs the examiner to do so, until the intensities of the two sounds are judged to be equal. Although Vernon, Johnson, Schleuning, and Mitchell (1980) reported high test-retest reliability (within 1dB in most cases) in loudness matching, McFadden (1982) reported considerably lower reliability with even normal-hearing subjects. This method has its own problems (McFadden, 1982):

1. There is an interdependency between quality, pitch, and loudness judgement. Thus the choice of a matching loudness might be rendered less accurate because the pitch had not been accurately matched.

2. When the tinnitus is binaural, the ear to which the matching sound is presented might be an imperfect instrument for judging loudness.

3. When a subject has tinnitus binaurally, the problem arises as how to combine the measurements of both ears so as best to represent the overall experience of the tinniteur.

4. Feldmann (1971) has found that contralateral masking is possible. In loudness matching, therefore, it is possible that some masking of the tinnitus can occur. Thus the very target of measurement could be affected by the technique used.

5. If there was recruitment or hearing impairment in the ear to which the external tone was presented, an incorrect

estimate of the tinnitus magnitude could result.

Goodwin and Johnson (1980) tested the Vernon recruitment hypothesis and found support for it. They compared loudness matching when performed by the traditional method of presenting comparison tones to the ear contralateral to the tinnitus, with an ipsilateral method in which loudness matching judgements were made for tones presented to the ear with tinnitus. Without exception every comparison of the two methods found higher estimates from the ipsilateral method. This could well be because tinnitus magnitude tended to be underestimated by the traditional binaural method due to recruitment effects.

6. Procedural differences could lead to different magnitude estimates. A series of tones with descending intensities might well cause some residual inhibition. The initial high intensity tones could therefore result in an underestimate of the tinnitus magnitude. For this reason, an ascending series protocol might be preferable (Vernon et al., 1980).

Hallam, Jakes, Chambers, & Hinchcliffe (1985) investigated the relationship between different ways of measuring tinnitus intensity (including subjective ratings and audiological measurement) and psychological aspects of tinnitus complaint (including distress and intrusiveness). Audiological measurement based on threshold estimation, loudness matching, or masking levels were found not to be significantly correlated with psychological scales. Measurements based on personal loudness units (PLUs) were significantly correlated with these

scales. PLUs were derived by transforming sound levels which corresponded to various multiples of the "most comfortable loudness level" by a function describing growth of loudness for an individual. PLUs were all significantly correlated with subjective ratings of tinnitus loudness whereas audiological estimates of tinnitus loudness were not. Recently, Jakes, Hallam, Chambers, and Hinchliffe (1986) investigated the reasons for the generally low correlations found between self-reported and matched loudness. They attributed this to measurement problems of two types: subjects who did not understand the self-report scales and poor choice of self-report scale type. Guttman and adjectival scales yielded highest correlations with loudness match values.

Rather than attempting to measure the pitch objectively, tinniteurs might be asked to describe verbally the characteristics of the sound they heard. In a variation of this approach, the examiner presents a list of descriptors and asks for the word which most closely represents the tinnitus sound heard. Descriptors provided by tinniteurs have not proved useful in providing clues as to the etiology of the tinnitus present. This might be because there is no reliable correspondence between the reported characteristics of tinnitus and its pathology; or because the verbal skills of the tinniteur might preclude an accurate description (McFadden and Wightman, 1983).

Cross-modality matching, as a method of measuring the

loudness of tinnitus, has not been reported in the tinnitus literature. In this method the subject expresses the intensity of a target sensation by adjusting the intensity of a measurable aspect in a different sensory modality. Thus in pain research, the intensity of pain has been measured by the strength of grip exerted on a dynamometer (Gracely, 1979).

It has been well documented that tinnitus fluctuates over time both in pitch and intensity. Hazell (1981c), for example, found that 8% of his sample of tinniteurs reported that its presence/absence fluctuated at about hourly intervals and a similar proportion experienced cycles with a period of one day. About 8% had a continuously changing pitch with about the same percentage reporting more intermittent pitch variability. This variability in the temporal aspects of tinnitus has important implications for its measurement. Nevertheless, a survey of the literature yielded only one report, the single-case study of Malatesta, et al., (1980), that comprehensively documented intrasubject variability of tinnitus intensity. In this case the intensity was highest late at night, lowest early in the morning, with afternoon at an intermediate level. This pattern is probably idiosyncratic since, in a study cited earlier (Tyler and Baker, undated), 16.6% of members of a self-help group reported that the tinnitus was most troublesome in the morning. Forty-one percent of Hazell's subjects found that tinnitus intensity was not associated with time of day. The issue of periodic fluctuation in tinnitus intensity has not been experimentally investigated. Hallam et al. (1985) reported

test-retest correlations of between .57 and .75 over 1-6 months for audiological loudness matching and tinnitus frequency. Research reported to date has not isolated the effect of time of day from other potentially significant factors such as arousal level, level of fatigue, and presence of distracting activities. These might covary with each other and with time of day. Fluctuations in the attributes and effects of tinnitus should be taken into account as design factors in tinnitus research.

D. Epidemiology

The epidemiology of tinnitus has been researched using four different samples: demographic surveys, otolaryngology clinic patients, normally-hearing non-clinic adults, and hearing-impaired children.

In a well-designed demographic study, a survey of a random sample of voters in four British cities was undertaken (Medical Research Council's Institute of Hearing Research, 1981). Tinnitus was operationally defined for participants for participants as "ringing or buzzing noises in your head or ears. The occasional whistling or ringing in the ears of less than five minutes duration should not be counted. Also do not count those times when this happens after very loud sounds, e.g. discos, shooting or noise at work." When tinnitus was defined in this way it was found that the mean prevalence of self-reported tinnitus across the sample was 17.5% (range across cities 15.5% to 18.6%). About 9% (range 8.3% to 9.6%) of respondents reported tinnitus without accompanying hearing

impairment and 8.5% (range 7.2% to 9.4%) had both. The relative stability across cities of the statistics obtained was noteworthy. The study also showed the effect that varying the operational definition of tinnitus had on prevalence estimates. In the pilot survey of this study 39% of the sample reported the presence of tinnitus when spontaneous, short-duration (less than five minutes) head or ear noises were not excluded. The authors advise this exclusion to arrive at a clinically relevant definition which would not include "normal" tinnitus and temporary tinnitus following noise exposure.

Hinchcliffe (1961) did not specify how tinnitus was defined in his random sampling of rural populatious in Great Britain and obtained an overall prevalence across all ages of 29%, probably because of a looser definition.

Hearing impairment in the MRC study was operationally defined as a negative response to the question: "Can you usually hear and understand what a person says to you in a quiet room, if he whispers to you?" This sample yielded a mean rate of hearing impairment with no tinnitus present of 17.6% (range 15.2% to 18.9%). About two-thirds of the total sample were neither hearing impaired nor had tinnitus. Rates for the aspects of hearing and tinnitus measured were consistent across the four cities surveyed. A survey of U.S. adults found that 32% reported having had tinnitus at least once during their lives (Vital and Health Statistics, 1968). No demographic survey of tinnitus prevalence has been carried out in Canada

(Statistics Canada, personal communication, August, 1983).

It is clear that the prevalence of tinnitus is substantial and that estimates of its occurrence are affected by the stringency of criteria in defining it.

Otolaryngology clinic patients have been the subject of a number of studies: 85% of a sample of 2000 consecutive patients with various presenting problems had tinnitus (Fowler, 1944); 73% of 100 consecutive "hard of hearing patients" were tinniteurs (Heller & Bergman, 1953); 83% of 500 consecutive patients with acoustic neuromas complained of tinnitus (House & Brackmann, 1981); and 79% of 190 patients with otosclerosis had tinnitus (Glasgold & Altmann, 1966). In one report (Singerman, Riedner, & Folstein, 1980) otolaryngology clinic patients were grouped according to hearing deficit level as determined by pure-tone audiological testing and also by speech discernability scores. Of the normal-hearing clinic subgroup, 17% had tinnitus alone and 48% had tinnitus with accompanying vestibular problems (a total prevalence of tinnitus of 65%). An analysis of the data from this study showed that 24% of the total sample reported having tinnitus with no vestibular problems (although no operational definition for tinnitus was published) and 44% had tinnitus with vestibular problems. Thus 68% of the full sample had tinnitus as a symptom. These findings suggest that for otolaryngology clinic populations, while there is a high prevalence of tinnitus, increasing levels of hearing impairment are not associated with increasing prevalence of tinnitus.

Overall, between 68% and 85% of otolaryngology clinic patients in the studies cited had tinnitus as the primary symptom or secondarily to otolaryngological problems.

Heller & Bergman (1953) found that, of a sample of 80 normal hearing healthy adults, 94% reported detecting some tinnitus-like sound in the ears while placed in a sound-proof room for five minutes. It could well be that, although these sounds are present continually, they are masked by ambient noise and are only noticed in an environment where the ambient noise level is reduced. The age-range of the sample was from 18 to 60 years and the possibility that the prevalence of ear-sounds heard was age-related was not discussed. In contrast to Heller & Bergman's report, Graham & Newby (1967) found that only 40% of their normally-hearing subjects reported hearing tinnitus sounds in a sound-attenuated room. Graham & Newby pointed out that Heller & Bergman did not test their "normally-hearing" subjects audiometrically but rather relied on self-report with respect to hearing ability. Graham & Newby suggested that their estimate was more accurate because 44% of their subjects who reported having normal hearing, did not meet their criteria for normal hearing when tested audiometrically. They found that normal-hearing subjects who could detect tinnitus sounds only in a sound-treated room, subjectively reported significantly quieter tinnitus than tinniteurs with hearing-loss.

McFadden (1982) pointed out that it was very common for mild tinnitus to be experienced occasionally and that this was

not necessarily associated with auditory pathology. It was therefore important for researchers to define tinnitus unambiguously so as to include only those cases of clinical significance. Graham (1981b) surveyed hearing-impaired children aged 12-18 years in two locations: partial-hearing units (PHUs) and at schools for the deaf (attended by children who were more seriously hearing-impaired). Sixty-six percent of children surveyed at PHUs reported having had tinnitus confirming an earlier study (Graham 1981a) and 29% of those at the schools. Unlike the MRC survey, however, Graham did not exclude fleeting, occasional episodes from his study thus leaving the uncertainty as to whether these high prevalences resulted from the more encompassing definition of tinnitus, or as a result of the fact that the sample consisted of hearing-impaired children, or for both reasons. If a group of normal-hearing children had been included, there would be less uncertainty in this regard. However, Graham's report was sufficiently detailed for some approximate adjustments to be made in a reanalysis of his data, so that his definition of tinnitus might correspond more closely with the MRC definition. Calculations were made to exclude children who reported tinnitus occurring monthly or less frequently, or whose tinnitus had a duration of less than 5 minutes per episode. Estimated prevalences of tinnitus then dropped to 10% of the children in the PHUs and 6% of those in the schools for deaf children. These rates of occurrence were more in keeping with the postulation that prevalence of tinnitus is lower for younger age groups (whether or not one assumes that

hearing-impaired children have a higher likelihood of having tinnitus). It was noteworthy that in both the reported and reworked prevalences, there was a higher probability for tinnitus to occur in the PHUs than in the schools for the deaf; and also for it to occur in the better-hearing ear. No clear explanation has been possible for these findings which run counter to the generally-held belief that tinnitus is closely associated with ear pathologies, and support the findings of Singerman, Riedner, & Fostein (1980) referred to above.

Although it suffered from a number of methodological and reporting problems, the study by Nodar (1972) is the sole example of a longitudinal study in the tinnitus literature. He followed over 2000 normal-hearing school children aged 10-18 years for three years and found the following: the prevalence of tinnitus is approximately normally distributed over the time period of the study with the prevalence at 13-15 years (44%) almost double that at ages 10-11 years (23%) and at 17-18 years (14%); overall prevalence was 15.2% over all ages and over the three years of conducting the study; four times as many children who were found to have hearing problems (as indicated by audiometric testing in the course of the survey) reported having tinnitus compared to those with better hearing ability. This study used the broader definition of tinnitus (without exclusions of temporariness of tinnitus occurrences), and the estimates of tinnitus prevalence were therefore likely to be overstated to include fleeting and occasional noises commonly heard but not included in a more rigorous definition.

The MRC study of the general population found more left-sided tinnitus (4.6%) than right-sided tinnitus (3.4%) and 9.7% reported tinnitus bilaterally or in the head. Hazell (1981b) and Reed (1960) also found a higher proportion of left-sided tinnitus. Studies where lateralization data are presented or where data could be reanalyzed to yield information on lateralization, are presented in Table 1. The consistency of the approximately 50% higher prevalence of left-sided compared to right-sided tinnitus in adults despite the diversity of the samples used is striking. The notable exception in adult data is the Hallam, Rachman, & Hinchcliffe study where right-sided exceeded left-sided tinnitus by about 50%. No confident explanation for this could be offered. In contrast to the adult sample, in children tinnitus seemed to occur with approximately equal probability in left and right ears.

Several explanations have been offered as to why tinnitus in adults was found to be more prevalent in the left ear (Reed, 1960; Vernon, 1977; Hazell, 1979; MRC, 1981). Davis & Weiler (1978) found that there is superior auditory adaptation to pure tones in the right ear compared to the left ear. Hallam, Rachman, & Hinchcliffe (1984) compared characteristics of 160 left-sided, right-sided, and bilateral tinniteurs. Those sufferers lateralized to the left were less likely to have had a noisy job, to have experienced gunfire, or to have had hearing loss as a main complaint, and they were more likely to have had more years of education. Those lateralized to the right were less likely to have reported that noise made the tinnitus worse

Table 1

Summary of Sidedness of Tinnitus from Literature

Sample	Reference	n	Ratios		
			B	L	R
Hearing-impaired children	Graham, 1981a	74	1.7	0.8	1
Hearing-impaired children	Graham, 1981b	78	1.6	0.9	1
Otolaryngology clinic (General)	Hallam, Rachman, & Hinchcliffe, 1984	160	2.3	0.7	1
Otolaryngology clinic (Adult-tinnitus primary symptom)	Hazell, 1981b	131	0.9 1.8	1.6 1.5	1[a] 1[b]
Random survey (General Adult Population)	M.R.C., 1981	5,000	2.9	1.4	1
Otolaryngology clinic (General Adult Population)	Reed, 1960	200	2.1	1.4	1
This study (General Adult Population)		60 60	3.9 0.7	1.8 1.1	1[c] 1[d]

Note. B bilateral tinnitus (includes head as site)
L left-sided tinnitus
R right-sided tinnitus
a calculation from data supplied
b calculation from bar chart
c bilateral but mainly one-sided included in B
d bilateral but mainly one-sided included in L or R

and more likely to have had an ear operation. Bilaterality was associated with noise-exposure at work, onset of tinnitus accompanied by hearing loss, noise making tinnitus worse, and noise suspected as cause of the tinnitus. The hypothesis that the noise from left-sided rifle-fire contributed to more left-sided tinnitus was not supported but there was support for an association between noise exposure and bilateral tinnitus. The authors propose that, since left-sided tinniteurs tended to form a normally-hearing, higher occupational group with little exposure to job noise, it might be that an auditory diathesis explanation was appropriate.

There has been no research reported on whether there are reliable structural differences between the left and right hearing apparatuses. However, although externally the body is generally perceived to be symmetrical, it is true that internally symmetry seems to be more the exception than the rule. While there have been no systematic attempts to link somatic asymmetry with the differential prevalence between left and right sided tinnitus, this is an area which might profitably be explored. It has also been suggested that, at a higher cortical level, the combined perception of bilateral tinnitus sounds might be attended to on the left. This might be because the left sound might be louder in bilateral tinnitus (Hallam, Rachman, & Hinchcliffe, 1984). It might be important to note that for children, tinnitus appeared with approximately equal prevalence on the left and right sides and that the left predominance was more prevalent in adults. This would suggest

an environmental exposure factor of either singular or cumulative effect, or an aging factor associated with the appearance of the lateral differential. A finer-grained, long-term longitudinal study might shed more light on these possibilities.

The MRC Institute of Hearing Research (1981) study found that significantly more right-handed than left-handed people reported tinnitus (17.9% and 14.8% respectively). The authors pointed out that this effect may be confounded with a tendency for probability of right-handedness to increase with age (Fleminger, Dalton, & Standage, 1977).

The MRC study also found that the prevalence of tinnitus increased with increasing age. While 14.5% of the sample under 40 years reported tinnitus, this increased to 22.2% of the age group above 60 years. Hinchcliffe (1961) found a similar trend with aging in his sample drawn from a rural population. Reed (1960), working with a clinical sample, found comparable prevalences and reported that tinnitus was most prevalent between the ages of about 50 and 75 years. The clinical sample in Hazell's (1981a) study had a modal prevalence in the 50 to 60 year range.

There are limited data on the prevalence of tinnitus and gender. From a survey of members of a tinnitus self-help group it was found that the mean ages of onset for males was 51.9 years (s.d.=9.3 years) and for females 44.9 years (s.d.=15.3 years) with range (across both sexes) 9-73 years (Tyler & Baker,

undated). These results should be interpreted with caution since these subjects might not be representative of tinniteurs in general.

Tinnitus has been found to occur with approximately equal prevalence in males and females in the general population (MRC Institute of Hearing Research, 1981). A clinical sample of patients whose primary symptom was tinnitus was similarily found to have equal proportions of males and females (Hazell, 1981a). As might be expected, given the preponderance of males exposed to high levels of noise in their occupations, Hallam, Rachman, & Hinchcliffe found that their medico-legal claim group was entirely male.

E. Factors Influencing Onset and Distress Levels

Since the mechanism by which tinnitus sounds are produced is not well understood, a discussion of the etiology of this symptom must, for the most part, be tentative. Confident specification of etiology of tinnitus in particular cases is relatively rare and for the majority of cases the cause is not known (McFadden, 1982). This has implications in the approach to treatment which for most cases largely consists of relieving distress caused by the symptom. McFadden (1982) defines "unequivocal sources of tinnitus" as frequent synchronous occurrences of tinnitus and its cause; or disappearance of tinnitus following removal of the causatory agent or treatment of its effects. Examples of unequivocal sources are severe blows to the head (Shucart & Tenner, 1981); ototoxic drugs

including anesthetics (Brown et al., 1981); immobilization of the middle-ear structures caused by otosclerosis, impacted cerumen; and anomalies of the vasculature or musculature of the head, neck, and jaw (McFadden, 1982). In the Hazell, Wood, et al. (1985) study the causal etiology was deemed unknown in 44% of 472 cases of tinnitus. Of the other causes considered (e.g. drugs, Meniere's disorder, otitis, otosclerosis) most fell with a 2% to 6% prevalence range with noise-induced hearing loss and acoustic trauma the cause of 27% of cases of tinnitus.

Tinnitus distress has been analysed in a factor analytic study by Jakes, Hallam, Chambers, & Hinchcliffe (1985) on 82 patients with tinnitus as the presenting problem. The factor analysis was conducted on self-rated complaints about tinnitus and related symptoms, and audiological measurements of tinnitus intensity. Two general tinnitus complaint factors emerged: intrusiveness of tinnitus, and distress due to tinnitus. These seemed to refer to sensory and affective components of the data. It is significant that three separate and specific tinnitus complaint factors were found: sleep disturbance, medication use, and interference with passive auditory entertainments. Audiological measurements did not load on these factors. These findings indicated that complaints about tinnitus are not unidimensional (i.e. tinnitus is not only more or less distressing) but rather multidimensional. Similar results have been reported for pain complaints (Crockett, Prkachin & Craig, 1977).

Clear etiologies have not been established for most instances of tinnitus and therefore a good heuristic to adopt might be one in which operationally defined and logically coherent groupings are formed, fed by an information base widely dispersed through the disciplines of otolaryngology, audiology, surgery and, more recently, psychology. Evans (1981, p.232) has proposed a useful framework for considering factors associated with the presence of tinnitus. He listed four groups: predisposing factors, revealing factors, exacerbating factors, and unassociated factors and gave examples for each but did not define the factors rigorously. Definitions are proposed in the ensuing pages for three of these groupings but the content and usefulness of the "unassociated factors" grouping is not clear and it will not be included here.

a. Predisposing Factors.

Among "predisposing factors" are noise, age, use of toxic drugs, middle-ear problems, head injury, and more general somatic dysfunction including thyroid problems, anaemia and hypertension. When these factors are present, they may contribute to the occurrence of tinnitus. For the purpose of this thesis a predisposing factor is defined as follows: a factor whose presence is associated with an increased probability of tinnitus but whose absence does not preclude the possibility of tinnitus. An example of a predisposing factor is the occurrence of unilateral tumours of the eighth nerve, a disease state accompanied by tinnitus in 83% of 500 patients described by Brackman (1981) and in 92% of Ronis's sample

(1981). However, surgical removal of the tumour improved the tinnitus in only about half of the cases. There is some evidence for the presence of tinnitus in non-hearing-related disorders. Multiple sclerosis patients may have an increased prevalence of tinnitus (Schleuning, 1981; Shucart & Tenner, 1981) but the evidence for this is not very strong. Schleuning (1981) suggested that certain metabolic disorders might be associated with tinnitus: hypertension, hypothyroidism, and diabetes.

Extreme physical exertion and environmental pressure changes have been reported to have caused tinnitus in a small series of case histories (Katsarkas & Baxter, 1976). Exposure to occupational noise has been found to be associated with increased occurrence of tinnitus by both the MRC Institute of Hearing Research survey (1981), and Hinchcliffe (1961). The former study found that the prevalence of tinnitus increased from 14.4% in the "no noise" group to 24.0% in the "noise" group. These groups were defined by tinniteurs replying negatively or positively to the question: "Have you ever worked in a place for more than six months where you had to raise your voice to be heard?". However, Hinchcliffe (1961), using a similar criterion for occupational noise exposure but for a period of more than a year, found no correlation between presence of tinnitus and noise exposure. No objective measurements of occupational environmental noise were made in these studies. Until such measurements are included in future studies, no confident conclusion can be reached about the

association between tinnitus and occupational noise. Hazell (1981b) found that 55% of his sample of otolaryngological clinic patients with tinnitus as the primary symptom, reported some exposure to noise with 17% having had "significant" noise exposure (e.g. unprotected exposure to loud industrial or to firearm noise).

b. Revealing Factors.

Evans (1981, p.232) proposed a second category termed "revealing factors" which has been defined for the purposes of this thesis as having the attribute of changing an individual's focus on pre-existing tinnitus from being unaware to being aware of it. Examples of revealing factors supplied by him are audiometric testing, life crises, and sleep disturbance. Other instances gleaned from the literature follow.

The Hallam, Rachman, & Hinchcliffe study of 80 tinniteurs reported two cases for which onset of tinnitus occurred during or immediately after viewing a T.V. programme on tinnitus. They also reported that, for a series of tinniteurs attending an ear clinic, onset of tinnitus was associated to varying degrees with the occurrence of stressful life events. Fifty percent of the so-called psychogenic group in their study reported some psychological stressor at onset of tinnitus. This was by far the highest proportion of any group reporting this. In contrast, the medico-legal group had a rate of only 6%. This suggested that tinnitus symptom reporting was linked, at least for some tinniteurs, with a precipitating stressor.

Stacey (1978) described how, while fitting a deaf patient with a hearing aid, she became aware of tinnitus in the fitted ear for the first time in her life. She termed this "latent tinnitus" and expressed concern that the procedure of fitting aids could cause tinnitus to become patent. Heller & Bergman (1953) explained that the reason why 94% of a sample of normally-hearing, healthy adults heard ear sounds only when placed in sound-proof chamber was that "subaudible" ear sounds were constantly being masked by ambient noise. Removal of ambient noise thus can function as a revealing factor. These examples seem to cover events of two types: firstly those which bring a pre-existing tinnitus into awareness e.g. audiometric examination or diagnostic questioning; and secondly traumatic events e.g. death of a spouse (Hazell, 1981c, p233), or results of a cold (Wilson & Sutton, 1981, p99). However there is no published research to document the course of the "revealed tinnitus."

c. Exacerbating Factors.

An exacerbating factor is taken to mean one whose presence is associated with increased distress from tinnitus. Exacerbating factors are neither sufficient nor necessary for tinnitus to occur. Examples of exacerbating factors that have been suggested in the literature are: psychological factors such as affect, attentional focus, and arousal; chemical factors such as nicotine use and ingestion of certain medications; and dietary factors such as salt or caffeine intake and food

additives. At this time, the link between most of these and tinnitus is speculative and anecdotal, although case study evidence suggests that they are worth considering as contributory to the etiology of tinnitus.

In view of the scant information on exacerbating factors in the tinnitus literature, research from related fields was examined. Pennebaker (1982) made a pioneering step by integrating literature on psychological mechanisms related to physical symptoms and by providing a framework within which the perception of these symptoms can be considered. He distinguished between pain and non-pain symptoms and focussed on the latter. Tinnitus could be considered to be a non-pain symptom. The consideration of cognitive factors was important from his analysis and these potentially have relevance for tinnitus research. The research on psychological concomitants of pain on the one hand, and of aversive non-pain stimuli (particularly noise) on the other, will be briefly surveyed.

The pain literature is generally rich in describing psychological factors which influence the experience of pain. Turk, Meichenbaum, & Genest (1983) reviewed psychological and other influences on pain such as early pain experiences, socio-cultural background, and anxiety surrounding noxious stimulation. They concluded that pain experience could not be adequately accounted for by sensory and physiological theories but rather it was a subjective experience involving other factors as well. In essence, an adequate conceptualization of

pain should be multi-dimensional incorporating cognitive and affective aspects with physical stimuli and sensory physiology (p.81). Consideration of these might provide valuable information for understanding tinnitus distress and suggest analogues for research that needs to be done. House and Brackmann (1981) suggested that tinnitus might be similar to pain in some respects. Both are subjective phenomena and factors which influence pain severity, such as anxiety level, also appear to affect the distress associated with tinnitus.

1. Cognitive factors - control

Cognitive factors have been demonstrated to play an important role in the response of subjects to pain. For example Kanfer and Goldfoot (1966) and Kanfer and Seidner (1973) found that, when exposed to cold pressor pain, subjects who had control over the noxious stimuli could use self-control techniques more effectively than those who had no control over stimuli. The more strongly subjects believed in the usefulness of coping strategies, the more effective was the strategy.

In a laboratory setting, Bowers (1968) found that subjects who were told that shocks were to be administered to them on a random schedule, had lower pain thresholds than those who were told that they were able to avoid shocks in the experiment. This suggested that lack of control over a painful stimulus led to higher levels of perceived pain. In a related experiment Jones, Bentler, and Petry (1966) found that information reducing

the degree of uncertainty about receipt of electric shocks served as a strong positive reinforcement for most subjects. The authors theorized that the reduction of uncertainty about the scheduling of aversive stimuli permitted subjects to make responses which minimized pain and anxiety.

In the case of chronic pain patients, the amount of perceived control that chronic pain sufferers feel may be an important factor in determining how they cope with pain (Weisenberg, 1984). Roskies & Lazarus (1980) have suggested that how a person copes in general, is dependent on appraisal of the threat involved, perceived consequences of the threat, and personal resources available to cope. Thus, beliefs about symptoms (including pain and tinnitus) and perception of personal control over them may importantly determine ability to cope (Girodo & Wood, 1977).

The research on aversive (but non-pain) stimuli would also appear to be of relevance to tinnitus research. An analogue study by Corah and Boffa (1970) investigated the effects of allowing some normal-hearing subjects the opportunity of turning off the sound of aversive white noise. Another group did not have this choice. Both self-ratings of discomfort and measurement of skin conductance showed that subjects who were given the choice felt less discomfort than those who were not. The authors concluded that the sense of control afforded by the choice was an important determinant of the cognitive appraisal of the aversive stimulus.

In research more closely related to clinical symptoms, Pennebaker, Burnam, Schaeffer, and Harper (1977) found that subjects who had little control over the termination of blasts of white noise, reported a higher incidence of physical symptoms than subjects who were allowed to control the noise. In the broader context of environmental noise, Glass and Singer (1972) have shown that, over the longer term, uncontrollable environmental noise could have such negative consequences as lowered tolerance for frustration and reduced persistence in completing assigned tasks. Untreated tinniteurs who are experiencing distress report that they believe they have no control over their tinnitus and that this is extremely disturbing to them.

2. Cognitive factors - attentional focus

It is evident that for a person to be aware of a physical symptom, he or she must have directed attention to the sensation associated with the symptom. It is likely that environmental variables which focus attention on the body would tend to increase the perceived intensity of symptoms, and that those which distract attention would tend to decrease the perceived intensity (Pennebaker and Skelton, 1978).

Promoting attentional focus on pain has been shown to decrease pain tolerance as measured by the time subjects were able to endure cold-pressor pain (Kanfer and Goldfoot, 1966). Also, when subjects were told to watch the mirror-image of their hand submerged in cold water, the pain threshold was found to

have been lowered when compared to a distraction task group. Blitz and Dinnerstein (1971) concluded that attentional mechanisms played an important role in determining pain thresholds in a cold pressor task. The group of subjects which was instructed to focus on the cold aspect of the stimulus and to dissociate it from the pain felt, as well as the group asked to interpret it as pleasant, both experienced significant elevations in pain thresholds when compared to a control group. Other cognitive factors which have been associated with reduced tolerance to pain include reduction of perceived control over noxious stimulus, lack of cognitions to attenuate intensity (Weisenberg, 1977); perceived lack of self-efficacy in controlling pain and the presence of catastophizing cognitions (Rosenstiel & Keefe, 1983); the reduced perceived ability by subjects to control parameters of painful stimuli (Staub, Turskey, and Schwartz, 1971). Once again, it remains to be established whether these results can be generalized to tinnitus as the target symptom.

3. Cognitive set and informational factors

It has been found that a stimulus intrinsicaly neutral on the pain-pleasure continuum (mechanical vibrations applied to a fingertip) could be interpreted as having either a positive valence (pleasurable) or a negative valence (painful) depending on the prior set offered to subjects by verbal information (Pennebaker and Skelton, 1978). This study indicated that expectations regarding a neutral stimulus can be manipulated.

In extending this basic research to somatic symptoms, Pennebaker and Skelton (1978) found that when a negative set was induced for a symptom, nasal congestion, already present in normals, this resulted in increases in reported symptom severity. When subjects were to rate nasal congestion after being asked to attend either to "disruption and blockage" of nasal passages or to "free passage of air", the latter group gave a lower rating of congestion. The authors concluded that for painful symptoms there is a built-in negative interpretation. "For nonpainful symptoms, however, the interpretive context determines whether the experienced sensations are defined as symptomatic at all (p. 528). Research has recently been focussed on a better understanding of how symptomatic people interpret symptoms and attempts have been made to construct models which describe cognitive processes and structures in this regard (Mechanic, 1976; Leventhal, Meyer, and Nerenz, 1980; Pennebaker, 1982). It is likely that certain schemata of pain sufferers for interpreting, monitoring, and reacting to symptoms affect the action they take to obtain relief (Pinsky, 1979). Tinniteurs may respond similarly to tinnitus as pain sufferers respond to their symptom. In the realm of the tinnitus symptom and its evaluation by sufferers, the question arises how the information about tinnitus, initially supplied to tinniteurs by health care professionals, influences future distress and attitudes to tinnitus.

This question has important implications for the psychological management of tinniteurs as it would indicate how

clear information about the implications of having tinnitus might be an important inhibitor of a negative ideation spiral and accelerating distress. On the other hand, it is likely that tinniteurs with generally positive attitudes (whether spontaneous or assisted) would tend to feel less distressed over time than sufferers with unfounded negative beliefs, all other circumstances remaining the same. This being the case, an early promotion of positive attitudes might produce ongoing dividends.

It is important to know whether generalization of effect across physiological systems (e.g. digestive and respiratory) is valid and whether different systems are subject to the same psychological processes. Pennebaker (1977) found that manipulation of attentional focus produced similar results for nasal congestion, cold-pressor pain, and muscle fatigue. This suggested that a technique that affected one symptom would likely change the perception of the non-target symptoms.

4. Affective factors

Pain can be exacerbated or attenuated by affective processes (Craig, 1984). Increased emotional distress has been associated with heightened anticipation and vigilance of pain, and increased monitoring of pain (Craig, 1984). Horan & Dellinger (1974) have reported that for experimentally induced pain, when subjects were engaged in positive emotive imagery, pain tolerance increased. On the other hand when anxiety was increased by experimental manipulation, pain tolerance was reduced (Nisbett and Schacter, 1966). It has been reported in

research on chronic low back pain patients, that dysphoric affect was associated with dysfunctional cognitive appraisal and maladaptive coping style (Lefebvre, 1981). While depression has commonly been associated with chronic pain, research on the relationship has yielded unequivocal results. Pilowsky, Chapman, and Bonica (1977) found that only about 10% of chronic pain patients were depressed whereas others (e.g. Lindsey and Wykoff, 1981) have estimates as high as 85%. In reviewing research on depression and pain, Romano & Turner (1985) found that, because many studies were inadequately controlled, it could not be concluded that depression was more prevalent in chronic pain patients than in comparable control populations.

Rachman & Hodgson (1974) characterized affect as a loosely coupled, partially independent, system that interacted with cognitive, behavioural, and physiological processes. In the case of pain, it has been suggested that it was important to recognize the independent and interactive functioning of these systems since they may or may not covary (Leventhal & Everhart, 1979, Melzack & Wall, 1983). No research investigating the relationship between tinnitus and affect has been reported.

5. Circadian factors

It has been found that some physiological functions vary according to time of day. Healthy volunteers have been found to display a circadian rhythm in their sensitivity to electric shock pain. As the day progressed from morning to evening, sensitivity increased (Procacci, 1972). This observation has

been repeated with chronic clinical pain patients. One study required 54 clinical subjects with intractable pain to monitor and record pain intensity at two-hourly intervals (Glynn, Lloyd, and Folkard, 1976). It was found that there was a trend for pain intensity to increase from morning to night; and for those subjects who remained at home all day to report more intense pain than those who worked.

A thorough single-case study, using an alternating baseline design to track tinnitus, found that for the subject concerned, circadian rhythms seemed to be similarly implicated. The tinnitus was more intense at night and least intense in the early morning (Malatesta, Sutker, and Adams, 1980). In this study the subject's self-report of tinnitus intensity corresponded well to audiologically measured tinnitus intensity.

Only 41% of Hazell's (1981a) hearing-clinic patients found that time of day was not associated with worsening of the tinnitus. Of the remainder, only 3% reported that afternoon was the worst period, with morning awakening time and evening about equally nominated as worst (26% and 29% respectively). In the Tyler and Baker (undated) survey of self-help group members, 16.6% found that tinnitus was more troublesome in the morning than at any other time of the day. From this slim evidence about diurnal fluctuation of tinnitus distress, one might suggest that tinnitus intensity was higher at times of the day with the least distraction. This might be the reason that people with intractable pain who went to work each day, had

lower pain intensity ratings than the comparison group that did not (Glynn, Lloyd, and Folkard, 1980). What was more, pain ratings by the working group in the evening maintained a lower level compared to the other group.

6. Arousal

In a study in which the level of arousal of experimental subjects was chemically manipulated by the administration of caffeine to experimental but not to control subjects, Haslam (1967) found that pain threshold was slightly but significantly lowered by caffeine consumption. Control subjects did not show this effect. Unfortunately the experimental design did not provide control subjects with a comparable but caffeine-free beverage and this finding therefore should be interpreted cautiously. In an ABAB single subject study Malatesta, Sutker, and Adams (1980) similarly found that the intensity of tinnitus increased for about 45 minutes after ingestion of caffeine. After this, tinnitus intensity of this subject decreased.

Haslam (1967) suggested that the relationship between arousal and pain perception might follow an inverted-U function with higher pain threshold levels associated with what she termed profound anesthesia; decreasing levels associated with natural sleep through to normal wakefulness; and then higher thresholds again in extreme arousal states (e.g. in military combat and in contact sports, where it is well known that quite severe injuries can go unnoticed in the heat of the game). In this context it is possible that caffeine, a stimulant to the

central nervous system, might increase arousal from a normal level and result in a lowered pain threshold; and, in the case of tinnitus, possibly result in increased tinnitus intensity. A problem with this hypothesis is that there is no method of determining a priori which position on the U-curve a given arousal state would occupy. Its utility is therefore limited to descriptive and conceptual uses.

7. Fatigue

Fatigue is reported by tinniteurs to be one of the factors which influence their experience of tinnitus and is therefore of interest in this project. Fatigue has been of interest to researchers in the fields of work study, kinesiology, and perception and cognitive psychology and their applied aspects (Holding, 1983). However, it has not been extensively pursued as a factor affecting disorders in the medical psychology domain.

To examine the possibility that fatigue might influence symptom perception of tinnitus, a series of 46 files of general otolaryngological patients was analysed at the Vancouver General Hospital tinnitus clinic. Percentage endorsements of 43%, 27%, 25%, and 5% respectively for feeling tired, tense, relaxed, and after use of alcohol, were obtained on a survey of factors which might exacerbate tinnitus. A verbal survey of about 50 members of the Vancouver Tinnitus Self-Help Group confirmed this finding: fatigue and stress were given most frequently as factors increasing distress from tinnitus.

Physiological parameters which might be used as cues for the perception of effort were reviewed by Mihevic (1981). In this type of research the focus has often been on physiological correlates of exertion and fatigue e.g. heart rate, oxygen consumption, respiration rate, and lactate concentration. Kinsman, Weiser, and Stamper (1973) identified by multidimensional cluster analysis three subjective clusters associated with strenuous bicycle exercise: fatigue, task aversion, and motivation. The fatigue dimension could be further analysed into three components: general fatigue, leg fatigue, and cardiopulmonary distress. It was not clear whether this finding could be extended to other forms of physical exercise.

In summarizing the research on physical fatigue, Holding (1983) found that psychological factors such as expectancy and motivation affected performance. Such central factors tended to override fatigue in terms of performance. However, there was likely to be a point of peripheral exhaustion beyond which continuing performance was exceedingly difficult or impossible because of the effects of accumulating lactic acid. A fairly consistent finding has been that even under conditions of extreme physical fatigue, subjects were still able to perform adequately on motor and cognitive tasks (Warren and Clark, 1937; Chiles, 1955).

The complexity of the fatiguing task was seen as a factor in determining performance (Holding, 1983). Activities which

involved simple, repetitive tasks generally resulted in a performance decrement over time (Gagne, 1953). When tasks were more complex (and therefore possibly more arousing) the effect on performance was also more complex. Thus McFarland (1953) did not find clear evidence of operational fatigue in long hours of flying, and Brown (1967) failed to find deterioration in a vigilance task secondary to a fatiguing prolonged car driving task. On the contrary, vigilance scores improved. He noted that the best assessment of fatigue might be given by subjective rating and not by performance scores on behavioural tasks.

Holding (1983) described the difficulties researchers in this field have encountered in trying to define fatigue. It has been operationally defined in terms of number of hours of sleep lost, or by the number of hours of fatiguing work performed. This approach has generally not been successful in predicting outcome at tasks subsequent to fatigue induction. It has been found that task demands may well result in normal levels of performance despite the purported fatigue.

It seems then that defining fatigue simply by the duration of the fatiguing task may not be useful. Bartley and Chute (1947) suggested that there were three main effects of fatigue: "fatigue proper" (subjective feelings of bodily discomfort and aversion to effort), work output (performance data), and impairment (physiological changes at the tissue level). Holding (1983) pointed out that many studies have failed to find covariation among these aspects of fatigue (e.g. Pierson and

Rich, 1967), whereas fewer results have shown an association (e.g. Dureman and Boden, 1972). The factors involved here appear to be similar to the components of the three-systems model of fear suggested by Lang (1971). He postulated that "all emotional behaviours are multiple systems - verbal-cognitive, motor, and physiological events - that interact through interoceptive (neural and hormonal) and exteroceptive channels. All systems are controlled or influenced by brain mechanisms, but the important centres of influence (cortical or sub-cortical, limbic or brain-stem) are varied and, like the resulting behaviours, partially independent" (Lang, 1971, p. 108).

The relatively loose coupling among these three systems has been extended to and incorporated in models of other aspects of behaviour e.g. the cognitive-behavioural conceptualization of pain (Turk, Meichenbaum, and Genest, 1983), and of anger (Novaco, 1981). It might be helpful for researchers to extend this model to the study of fatigue.

Results obtained from a pilot study (see Appendix A) indicated that it was feasible to use a number vigilance task experimentally to induce fatigue in order to investigate its effects on tinnitus.

Thus it is apparent from considerable research evidence that the presence of symptoms was not the sole determinant of the level of distress expressed or the intensity felt. Rather, cognitive, affective and other aspects of these distressing

states were important factors in determining response to them. This section, which covered what the tinnitus literature has termed exacerbating factors, indicates a wide range of possible influences on tinnitus distress largely unresearched to date.

F. Treatment of Tinnitus

This study is not prima facie concerned with treatment outcome for tinnitus but it does have potential relevance for research in this area and for the design of tinnitus treatment programmes. It was important to review the tinnitus treatment literature in order to provide a perspective on the relative lack of success of these treatments. Against this background, the rationale for this study and its findings might assume more clinical relevance.

Tinnitus has proven to be singularly difficult to relieve for the majority of sufferers. The challenge this has presented to health professionals, and the urgency experienced by distressed tinniteurs, has resulted in a multiplicity of treatment methods. Many of them have persisted in the absence of empirical support.

Treatment approaches might be broadly divided into passive and active treatments. The former are characterized by the use of a device, medication, or surgery to eliminate or reduce the tinnitus sound. An identifying characteristic of these treatments is that the patient is relatively passive and does not purposefully utilize learned cognitive or behavioural

techniques for relief. The therapeutic task largely requires compliance with the prescription of the therapist. By this definition, for example, diet change regimens are classified as passive. All tend to be characterized by therapeutic effort directed at changing the organic basis for the tinnitus sound itself. Subjective distress associated with tinnitus is largely ignored. This approach would be deficient if psychological processes were found to be important influences of tinnitus distress.

The active treatments, in contrast, aim to impart cognitive and behavioural skills which the tinniteur would purposefully exercise throughout the therapeutic process and use thereafter. These would be used independently of, or in conjunction with, medication, apparatus, or surgery. The aim of the active treatments is not necessarily the elimination of the tinnitus symptom, but rather to relieve distress felt by the tinniteur.

One of the most widely used and studied of the passive treatments is masking. The premise has been that an external sound, either naturally-occurring or synthesised, can be superimposed on the tinnitus sound to bring relief. Originally Jones and Knudsen (1928) suggested that the presentation of masking sounds might provide tinniteurs with some relief. Indeed many tinniteurs have experimented autonomously with environmental sounds, e.g. noise and music, in attempts to cover the tinnitus in some way.

It has been found that tinnitus sounds have different

masking characteristics than externally presented sounds (Penner, Brauth, & Hood, 1981). When one group of subjects was instructed to adjust the intensity of a masking sound so that it just masked their tinnitus, they typically required a rapid increase in intensity during the first 10 or 15 minutes followed by a levelling off of the required intensity. In contrast, when subjects were required to mask a synthesized tone superimposed on the tinnitus of 10 dB sensation level (SL) above the subject's own absolute threshold at a given frequency, 90% required essentially the same intensity over time to mask the tone. The authors postulated that this differential effect between tinnitus and external tones was because each might not affect primary nerve fibres in the same way or possibly because the tinnitus originated at a higher level central site rather than in the peripheral auditory system.

The adventitious use of naturally occurring background sounds was systematically developed into a treatment mode in the mid-1970's by a research group at the University of Oregon Medical School. Their invention, the masker, is a miniaturised device which is worn behind the ear and which broadcasts a masking sound into the ear (Vernon, 1977; Vernon and Schleuning, 1978). In addition to these synthetically produced masking sounds, there is at least one case study reported of a tinniteur with debilitating tinnitus who used a transistor radio with a miniature ear-speaker to produce masking music. This brought considerable relief (Cassel, 1978).

In certain cases, amplification of ambient sound by wearing a hearing aid can bring relief from tinnitus (Vernon and Meikle, 1981). A variant of the masker, called a tinnitus instrument, combines a masker and hearing aid in one apparatus (Vernon and Meikle, 1981). It might be that the higher level of ambient noise heard by the wearer would assist the masking process. In the Hallam, Rachman, and Hinchcliffe (1984) study it was noteworthy that the members of the two empirical clusters with the least hearing loss reported most masking effect from environmental sounds. In contrast, the two clusters with highest proportion of severe hearing loss in their members had the largest ratio of members reporting the absence of environmental masking effects. This suggested that improvement in the hearing of environmental sounds might well be associated with increases in their masking effect.

The sounds produced by the masking device are either pure tones or noise. It is not clear how closely the sounds emitted must match the pitch of the tinnitus sound in order to gain maximum effect (McFadden, 1982). Formby and Gjerdingen (1980) found in a case study that the more the masking sound frequency departed from the tinnitus pitch, the greater the intensity of masking required to mask the tinnitus sound. Masking sounds do not mask the tinnitus sounds in every case. Feldmann (1971) reported that masking was unsuccessful in 11% of severely affected cases. However, he reported that any sound (and not only a carefully matched sound) had successfully masked tinnitus in 23% of the sample. Moreover he found that a masking sound

presented contralaterally to the unaffected ear in unilateral tinnitus successfully masked the tinnitus in certain cases. This suggests that the effects of masking are central rather than in the peripheral auditory apparatus; a position consistent with efforts to intervene by psychological means.

When tones with frequencies other than the frequencies of otoacoustic emissions (OAE) were broadcast to ears with OAEs, the OAEs were often found to be suppressed (Kemp and Chum, 1980; Wilson and Sutton, 1981; Zurek, 1981). OAEs presented a more objective way of investigating the impact of masking sound but generalization to tinnitus has not been clearly established.

Evaluative studies of the degree of success these masking devices achieve have indicated that there has been considerable non-compliance with professional advice regarding their use. Various studies showed that between 46% and 79% of the recommendees purchased maskers and at one year follow-up only between 30% and 71% were still using them (Vernon and Meikle, 1981, Sweetow, 1985). These authors indicated that trial fitting of the units with non-occluding ear-moulds and careful counselling about their purchase and use might increase acceptability and utilization. In general, these evaluative studies have been loosely structured surveys; they relied exclusively on self-report data with little or no objective measurement of treatment effects and had no control groups. Therefore, the results should be regarded as preliminary to fully controlled experimental investigations. Recently Hazell

et al. (1985) found that tinniteurs who were fitted with maskers gained more relief than those wearing tinnitus instruments (combination maskers/hearing aids). This may have reflected the fact that combination instrument users were prone to turn off the masking sound and to use the instrument primarily as a hearing aid. Overall Hazell et al. (1985) found that maskers and combination instruments were helpful to many tinniteurs. They were not able to specify which subject attributes predicted successfully whether masking would be successful.

Hazell, et al. (1985) summarized the deficiencies in extant masker research and emphasized the importance of using placebo control groups. They cited Erlandsson (1983) who found that eight out of 17 subjects benefitted from masking devices, but that six of a control group of 17 who were fitted with placebo maskers, reported significant improvement.

An evaluation of the efficacy of maskers and tinnitus instruments would depend on how circumscribed a definition was used in defining the group to which masking was applied. The most conservative estimate of compliance rates could be based on a denominator which included all tinniteurs seen at a clinic. Apparently higher success rates could be obtained by excluding the following categories of clients: those who were prejudged by a clinician not to be suitable for masking; those who, although recommended for maskers, did not acquire the device after a short period of trial use; and users who, although owning

maskers, stopped using them before the final measurement of efficacy was made.

There are also questions about the generalizability of the studies that are available. Subjects in the Oregon masking treatment trials were unlikely to be representative of tinniteurs in general but rather could be a select subset of the population which was motivated to attend the clinic, had severe distress, and who could afford the fees. Another reason for caution in evaluating the masking data in this study would be that it was based on reports from one prestigious clinic, the Kresge clinic in Portland, which might have evoked situation-specific effects from its clients.

To summarize: the outcome data on the use of maskers have yielded results which show some limited success in relieving distress from tinnitus. The studies, however, have problems with experimental design, definitional issues, and generalization from the particular setting and subjects. Masking remains one of the most intensively investigated treatments for tinnitus and research into masking is proceding.

McFadden (1982) cautioned that many maskers and tinnitus instruments (which typically have maximum outputs between 85 and 110 bBA) could exceed the most widely used safety guideline for exposure to sound: a maximum of 90 bBA for no more than 8 hours a day and for no more than 5 days a week. Voroba (1979b) pointed out that, whereas excessive exposure to environmental noise had been linked causally to ear pathology, too little

caution had been exercised in prescribing tinnitus maskers which broadcasted a sound for long periods. He suggested that there were potential risks to hearing and possibly to overall health from such exposure and that this needed to be examined (Voroba, 1979a). However, Hazell et al. (1985) found that there were no significant deleterious effects on hearing caused by wearing of maskers or combination instruments for a period of about six months. Although the long-term use of maskers might have undesirable side-effects, it does not follow that they should not be used. What is important is that there should be a net gain to the user when comparing risks to benefits.

It has been observed that, following a period of masker use, some tinniteurs reported that there were times when the tinnitus sound was absent for several seconds before reappearing. This silencing effect has been termed "residual inhibition." Feldmann (1971) reported a single-case study in which a half-second burst of masking sound inhibited the tinnitus sound for periods of between one-half and one and one-half seconds approximately. Sound presented to the contralateral ear increased inhibition times by 59% compared to ipsilateral presentation. The period of inhibition increased with increasing sound intensity but this period was not associated with the frequency of the sound presented.

The fact that residual inhibition occurred for varying lengths of time, and that in some patients there was a seemingly permanent absence of tinnitus after exposure have led certain

researchers to believe that this phenomenon might have promise as a treatment for at least some cases (Vernon, Johnson, Schleuning, and Mitchell, 1980). Feldman (1971) suggested that, if an underlying neural mechanism which might be blocking the tinnitus activity, "could be trained or activated, there might be a way to cure patients of their distressing tinnitus" (p. 143).

This optimism has been tempered by McFadden (1982) who pointed out the many unknowns in using residual inhibition as a treatment. There is the finding that about one-third of patients given residual inhibition treatment experienced increased tinnitus (Vernon and Meikle, 1981). These authors saw a possible parallel between the residual inhibition, which in some cases follows the use of maskers, and the temporary relief from pain after electrical stimulation of certain nerve sites by a process termed transcutaneous electrical nerve stimulation (TENS), (e.g. Wolf and Rao, 1983).

Numerous classes of drugs have been used in attempts to allay tinnitus. They range from vitamins, local anesthetics and anticonvulsants to barbituates and vasodilators. The research findings on their effectiveness were reviewed by McFadden (1982). In summary these were:

1. While certain drugs have produced temporary and occasional long-term decreases, or even elimination of tinnitus, their effectiveness is unpredictable.

2. The side-effects of some of the more effective drugs

are sufficiently aversive to preclude their general use.

3. Drug therapy for tinnitus has not developed yet to the stage where an effective and safe medication with wide usefulness was available.

Surgical treatments for tinnitus have been reviewed by House and Brackmann (1981) and McFadden (1982). After surgery for an acoustic neuroma, 40% of patients reported improvement in the tinnitus and 50% a worsening. After stapendectomy, 74% were improved, and after labyrinthine section of the eighth nerve, about 45% were improved. Surgical treatment, while successful in some cases, can be unreliable. In addition, studies do not indicate outcomes in the longer term. Apart from these cautions it should be borne in mind that the effects of surgery are frequently irreversible. Hazell (1981c) noted that section of the eighth nerve might preclude the use of future, as yet undiscovered, treatments.

House and Brackmann (1981) have noted that 80% of their patients with cochlear implants reported improvement in their tinnitus. Cochlear implants are devices which are surgically implanted in the hearing mechanism. They have an induction coil by means of which an incoming acoustic signal can be converted to an electrical signal which stimulates the cochlea and is heard as a sound. They suggested that electrical stimulation of the inner ear and the central pathways might hold some promise as a treatment method and they, too, drew a comparison between this and TENS. The work on electrical stimulation has been

reviewed by McFadden (1982) who concluded that it was a technique worthy of further investigation. Until the completion of more extensive research and the running of clinical trials, TENS could not be considered to be a primary therapeutic technique for tinnitus at present.

In more recent work, Vernon & Fenwick (1985) tested 50 tinniteurs by applying various electrical waveforms transdermally by electodes placed ipsilaterally to the ear with more severe tinnitus on the preauricular and postauricular regions. In a second study, electrodes were placed on the two mastoids. The design provided for each subject to receive a placebo treatment followed by the electrical stimulation. Only one subject reported a reduction in tinnitus intensity in the placebo phase, and post-treatment 28% reached the experimenters' criterion of a reduction of 40% or more. The diminution typically lasted for only about three hours. No negative effects were reported. These researchers concluded that the suppressive effects of non-invasive procedures such as they tried were exceeded by more invasive procedures such as used by Aran & Cazals (1981) and by Portman et al. (1979) who both used electrical stimulation to the round window membrane. They felt that deeper electrode placements held greater promise for future research. However, from the treatment perspective, the invasiveness of deeper placement is probably associated with increased risks to the patient.

Engelberg & Bauer (1985) reported a 81% success rate in

"improving the tinnitus" in 20 subjects (33 ears) by TENS. Improvement was somewhat arbitrarily defined as either a complete remission in tinnitus or a decrease in its frequency. They used a single blind procedure including a control group (who responded minimally to the control procedure). Unfortunately tinnitus intensity was neither objectively nor subjectively measured. Duration of improvement ranged from 20 minutes to more than six months.

In addition to the above treatments, there have been numerous claims for the success of other techniques e.g. hypnosis (Marlowe, 1973); and acupuncture (Mann, 1974). Hansen, Hansen, & Bentzen (1982) found some benefits to tinniteurs from acupuncture treatment. In a study of hypnotherapy treatment for tinnitus (Marks, Karl, & Onisiphorou, 1985), 36% of 14 subjects had improved tolerance for their tinnitus although the loudness and quality were unchanged. Neither of these treatments has been subjected to anything approaching full experimental testing. Therefore they should be regarded as speculative.

Since treatment of tinnitus by medication, surgery, and other means has not been found to bring relief reliably, it seemed important to investigate psychological techniques. However, formally deduced and clinically tested psychological interventions are almost totally absent from the literature.

One of the earliest suggestions in the literature for an active treatment approach was made by Fowler (1943) who wrote of tinnitus sounds: "They seem unnatural, and they are unnatural

because they are an illusion and, like all illusions, tend to be exaggerated" (p. 392). Tinnitus sounds which were not pure tones would be more likely to be exaggerated in terms of loudness, timbre, and distress, Fowler noted. This led him to suggest that a tinniteur who was distressed by these sounds might be treated by a rationally-based therapy in which the facts of this "psychic magnification was firmly planted in his consciousness until he understands that [these facts] do not correspond to his statements as to the severity of the symptom" (Fowler, 1943, p. 397).

Fowler (1942, 1943) noted in his early research the tenuous relationship between the loudness of the tinnitus sound and the degree of distress. This was also noted by Reed (1960) who reported that self-report measures of loudness of tinnitus were not closely related to more objective measures of loudness; nor do the latter correspond to self-reported severity of distress. In emphasizing a treatment approach which has elements of rational-emotive therapy (Ellis, 1962), he suggested playing a tone to the tinniteur at the same low intensity of the individual's own tinnitus sound to convince the tinniteur that this weak sound obviously did "not correspond to the severity of the problem....The patient must be educated to rationalize his symptoms and accept them at their face value and not allow them to "get on his nerves" (Fowler, 1943, p. 397).

After medical investigation the tinniteur is often given verbal reassurances that tinnitus is a common symptom; that it

is not a serious, life-threatening disease; that it does not lead inevitably to total deafness; nor does it imply the presence or prospect of mental disorder (these all being typical fears of new tinniteurs). He or she is then typically counselled to learn to live with the tinnitus because there is no successful treatment in most cases.

Heller and Bergman (1953) reported that 94% of their sample of normal-hearing subjects became aware of tinnitus-like sounds when they were placed in a sound-reduced environment. As an informational component of therapy, this knowledge might serve a normalizing function to tinniteurs. The effects of supplying this information and other reassuring facts, have not been formally evaluated. As Tyler and Baker (unpublished manuscript) have pointed out, "it is not enough to say 'You'll just have to learn to live with it.' Tinnitus sufferers need to be shown how to live with it," (p. 12). It is in this sphere that psychology has an important contribution to make to treatment.

In what has come to be known as the cognitive-behavioural treatments for coping with chronic physical distress, the patient plays an active role (as defined above). "A common feature of cognitive-behavioural treatments is that the patient is viewed as an important agent in guiding, directing, and controlling his or her own health, disease, and illness" (Turk, Meichenbaum, and, Genest, 1983, p. 33). These techniques have been used with some success in treatment of chronic headache (e.g. Bakal, Demjen, and Kaganov, 1981; Demjen and Bakal, 1979;

Holroyd, Andrasik, and Westbrook, 1977), migraine (e.g. Mitchell and White, 1977), and myofascial pain dysfunction (e.g. Stenn, Mothersill and Brooke, 1979). The report of three case-studies by MacLeod-Morgan, Court, and Roberts (1983) is one of few examples of this technique in the tinnitus literature. They used an intervention in which hypnotic induction together with relaxation training and cognitive restructuring were successful in reducing distress caused by tinnitus sounds. In the cognitive component tinniteurs were trained to reinterpret the tinnitus sounds to be something more acceptable. Examples of transformations used included splashing fountains and the hum of a car engine. The authors felt that the technique held promise but it was not clear which of the particular components of the treatment package were effective in reducing distress. No quantitative data were supplied in this report and, being a case-study, no controls were used. Conclusions regarding the effectiveness of the techniques used should therefore be guarded. Sweetow's (1985) paper described group cognitive-behavioural therapy for tinnitus distress in some detail and claims success in treatment but presented no data. Nevertheless it is likely to be an influential report because of the clear and confident translation of cognitive-behavioural techniques from pain to tinnitus, and the dissemination of this to professionals dealing with tinniteurs. One hearing-impaired child in Graham's (1981b) study said that he liked his tinnitus, found it soothing, and helped him to get to sleep. While this is anecdotal, it is an example of how a positive interpretation

can be made of a sound commonly held to be undeniably aversive.

House and Brackmann (1981) postulated that increasing muscle tension causes greater distress from tinnitus and also increases the loudness of the tinnitus. They proposed that training tinniteurs to relax (particularly through biofeedback), might offer them a way to control their tinnitus. As McFadden (1982) pointed out, the treatment of tinnitus by biofeedback depended on the assumption (not yet formally evaluated) that tinnitus magnitude is related to anxiety. However, in a carefully designed study incorporating a waiting-list control group, Ireland & Wilson (1985) found that seven sessions of relaxation training had no significant effects on the occurrence, awareness, or rated loudness of tinnitus, or interference from it.

A case study reported good results from a comprehensive behavioural programme including thermal biofeedback therapy, tinnitus management training, assertiveness training, cognitive treatment of depression, and marital therapy (Duckro, Pollard, Bray, & Scheiter, 1984). Tinnitus distress, depression, and other ratings improved substantially and the improvement was maintained at three month follow up.

Biofeedback training was given to 41 tinniteurs who had unsuccessfully attempted a variety of other treatments (House, Miller, and House, 1977). A combination of frontalis electomyographic (EMG) and digital temperature biofeedback was used. It was found that 80% of patients reported some

improvement in their tinnitus at post-treatment. Unfortunately this conclusion was based on self-report data only; there was no control group; and there was no statistical evaluation of the data. House (1978) reported on follow-up data at six- to twelve-month post-treatment and 56% claimed some improvement. If the "slightly improved" category were excluded, these results would be substantially lower: 36% were much improved or very much improved at post-treatment, and 17% at follow-up.

Grossan (1976) used both self-report and loudness balance estimates in a biofeedback study using frontalis EMG. While 100% of presbycusis subjects reported improvement post-treatment in the sense that they could "cope with it," no improvement was reflected in the objectively measured tinnitus loudness. Seventy-four percent of acoustic trauma subjects self-reported improvement, but only 11% improvement was reflected in objective data. For a cranial/cervical injury group, these figures were 81% to 10% respectively.

Both Grossan and House et al. noted marked decreases in the use of various medications by their subjects. In all these studies there was only gross measurement of improvement; it was often not clear whether the improvement referred to subjective loudness or distress; and, importantly, in the absence of control groups, there could be no certainty as to what the effective components of treatment were.

Walsh & Gerley (1985) used a combined thermal biofeedback and relaxation training treatment and found statistically

significant declines in tinnitus loudness and annoyance. Sixty-five percent of subjects reported a subjective reduction of tinnitus. There was no true control group and effects of biofeedback and relaxation training were not separated in this study.

Hallam, Rachman, and Hinchcliffe (1984) proposed a habituation model for explaining the process by which most tinniteurs adjusted to the symptom. However Rachman (personal communication, September, 1983) found that subjects in a pilot test of this model did not reliably habituate to the repeated presentation of a tone similar to the tinnitus sound in pitch. The findings of Penner, Brauth & Hood (1981) might offer some clues as to why a treatment protocol directed at habituating tinniteurs to an external sound might not work: they suggested that for some tinniteurs the neural process producing the tinnitus might be relatively independent of the process of perceiving external sounds. Another more drastic treatment by exposure to a "traumatizing tone" of 120 dB for three ten-minute periods one week apart, was reported by Reed and Christian (1961). The control group was led to believe that the tone was being presented even though they could not hear it, whereas in fact no tone was being presented. Experimental group subjects who were actually exposed to the tone experienced either alleviation or exacerbation of the tinnitus at a significantly different level compared to controls, but the effects in either direction were only temporary. It had been hypothesised that "partial cochlear fatigue" might be helpful in treating tinnitus

but this was not borne out by these findings.

Apart from a few clearly defined and treatable causes of tinnitus, e.g. cerumen on the eardrum, neuroma of the auditory nerve, and excessive use of aspirin, the majority of tinnitus cases cannot at present be treated by removal of the cause. It is to this large group of tinniteurs that psychological treatments could potentially provide relief. However, research into psychological techniques for treatment is not yet well developed. It is likely that these will increasingly be relied on in the absence of methods for the elimination of the physical symptoms of tinnitus.

G. Conclusions

Only a small percentage of tinniteurs feels severe distress, but many find it a disturbing and intrusive problem. A small proportion of cases with circumscribed etiologies can be cured by medical treatment but at present this is not possible for the majority of cases.

As with chronic pain, therefore, research into psychological interventions to promote relief from tinnitus is strongly indicated. In this early stage of knowledge about psychological factors associated with distress felt from tinnitus, anecdotal clinical information, the sparse literature on this subject, and heuristic possibilities from the presumably relevant pain literature should all serve as important leads for

further research. Possibilities for psychological factors associated with tinnitus which have emerged from these sources are:

firstly, arousal and affective factors such as fatigue and anxiety;

secondly, cognitive factors such as attention to and distraction from the symptom and perceived degree of control;

and thirdly, informational factors including education regarding the course of the underlying disease and reassurances about incorrect assumptions of its association with mental disorder. Knowledge about these factors could then serve as elements to be integrated into psychological treatments.

There is another way in which psychology can contribute. The objective measurements of the physical properties of tinnitus (mainly its pitch and intensity), have generally not been found to be associated with specific etiologies, distress level, or treatment outcome. It follows that measurement of subjective aspects of tinnitus and their effects on psychological functioning such as level of distress, intrusiveness, and affect, constitute a second area to which psychological expertise could be directed.

III Hypotheses

The preceding literature review has reported the relatively consistent result from the pain literature that when attention was focussed on pain, tolerance to pain decreased. Conversely it was found that when attention was focussed away from pain by distracting techniques, tolerance to pain increased. The effects of tinnitus of shifting attentional focus will be investigated in this research. The first and second hypothesis therefore are:

1. It is hypothesised that, while focussing on tinnitus as an experimental task, subjects will report an increase both in the intensity of tinnitus and in the distress felt from tinnitus compared with levels before this focussing was required.

2. It is hypothesised that, while focussing on a distracting task, subjects will report a decrease both in the intensity of tinnitus and in the distress felt from tinnitus compared with levels before this distracting focussing was required.

An informal survey of members of the Vancouver Tinnitus Self-Help Group and analysis of information from files of tinniteurs at the Vancouver General Hospital Tinnitus Clinic, both indicated that anxiety was rated as an important factor in exacerbating existing tinnitus. There is some evidence from the

pain literature that anxiety has a similar effect on pain.

3. It is hypothesized that, while participating in an anxiety-provoking task, subjects will report an increase both in the intensity of tinnitus and in the distress felt from tinnitus compared with levels before anxiety was induced.

4. It is hypothesized that when subjects rate the intensity of tinnitus and the distress felt from tinnitus in a naturalistic setting, these levels will be elevated when subjects rate themselves as relatively more anxious.

An informal survey of members of the Vancouver Tinnitus Self-Help Group and analysis of information from files of tinniteurs at the Vancouver General Hospital Tinnitus Clinic, both indicated that fatigue was rated as an important factor in exacerbating tinnitus.

5. It is hypothesised that, after participating in a fatiguing task, subjects will report an increase both in the intensity of tinnitus and in the distress felt from tinnitus compared with levels before fatigue was induced.

6. It is hypothesised that when subjects rate the

intensity of tinnitus and the distress felt from tinnitus in a naturalistic setting these levels will be elevated when subjects rate themselves as relatively more fatigued.

IV Method

A. Subjects

Subjects were recruited by publicity through the media, and from the membership of the Vancouver Tinnitus Self-Help Group. Inclusion criteria were:

1. The subject was experiencing tinnitus which complies with the following definition: internal sound or sounds localized in the head and occurring in the absence of external acoustic stimuli. The tinnitus was present continuously, was consciously experienced, and was not voluntarily producible. The sound might or might not be accompanied by otoacoustic emissions.
2. The tinnitus had been unresponsive to medical treatment.
3. The tinnitus had been present for at least three months.
4. The subject was between the ages of 18 and 75 years.
5. The subject had passed at least grade 8.
6. The subject had expressed a willingness to participate.

Subjects who had a hearing impairment severe enough to preclude understanding of normal conversation without the use of a hearing aid were excluded (see Screening Form, Appendix B).

B. Measurement

Since the emphasis in this study was on the distress felt by tinniteurs and their subjective experience of tinnitus intensity and pitch, subjective measures of tinnitus were used.

a. Self-Report Measures.

1. Tinnitus Diary (TD) (see Appendix C). This was used for home monitoring of tinnitus and affect levels. Each subject was asked to keep a tinnitus diary for one week in their natural environment. Subjects chose two times in a day when they thought they would be more fatigued and two times when they thought they would be less fatigued. This was done in order to promote a large difference between high and low fatigue ratings. At these four times subjects rated tinnitus pitch, intensity, and distress and also fatigue, boredom, and anxiety

2. Russell Affect Scale (RAS) (see Appendix D). This is a thoroughly researched instrument based on a circumplex model of affect (Russell, 1979). It has particular relevance to tinnitus research because it is based on two orthogonal dimensions for affect (arousal and pleasantness) which are likely to influence the level of tinnitus distress. Although the original version of the RAS included a third dimension, dominance, (Russell and Mehrabian, 1977), this was found to add little predictive power to the scale (Russell, 1980). Russell and Steiger (1982) demonstrated that the RAS (including the dominance scale), could predict scores on the seven subscales of the Profile of Mood States (POMS) (McNair, Lorr, and Droppleman, 1971) reasonably

well. Multiple correlations between predicted and actual POMS scores on the fatigue-inertia and the tension-anxiety subscales were .72 and .81 respectively when subjects rated the affect portrayed by actors on a videotape. Multiple correlations of .70 and .63 respectively were obtained when subjects rated their own affect (Russell and Steiger, 1982). Here again, the dominance dimension added little predictive power to the regression equations. In the interest of speed of completion of the instrument, therefore, dominance scale items were not included in the version of the RAS used in this study.

The RAS has been shown to have high internal consistency; Cronbach's coefficient alpha was above .88 for each of its three dimensions (Russell and Mehrabian, 1977).

In addition to its satisfactory psychometric properties, there is a practical attribute which make the RAS useful in this study: it usually can be completed in less than two minutes. Two of the manipulations in this study take five minutes each. Subjects would take at least as long as this to complete most other popular affect scales. The RAS is particularly suitable here for the speed with which it can be completed.

The regression equations developed by Russell and Steiger (1982, table 6) to predict the POMS fatigue-inertia score from the RAS scores will be used to estimate fatigue as a check on the visual analogue rating of fatigue. Similarly, regression estimates of anxiety will be used to verify the visual analogue ratings of anxiety.

The RAS was administered before and after each experimental manipulation.

3. Visual Analogue Tinnitus Scale (VATS). This instrument is designed to yield rapid ratings on dimensions of tinnitus relevant to this study. A visual analogue scale is a line, the length of which is taken to represent the continuum of some experience. It has many advantages as a method of measurement: sensitivity, simplicity, and reliability (Huskisson, 1983). The VATS consists of three horizontal lines representing three aspects of tinnitus: distress, intensity, and pitch. In the laboratory section of this study, the VATS was administered simultaneously with the RAS. In the home-monitoring section of this study, the VATS was included in the Tinnitus Diary.

4. Focus Verification (FV). In order to determine whether subjects in the tinnitus focus group had complied with instructions to focus on their tinnitus, they were asked to complete the FV-T (see Appendix E) after each phase (see Experimental Design, Figure 2). The FV-T requires subjects to estimate the percentage of time they spent focussing on their tinnitus during the tinnitus focus phase. The FV was similarly administered to anxiety and control group subjects in the appropriate version (FV-Numbers and FV-Reading respectively, see Appendices F and G). The FV-N and the FV-R differ from the FV-T only in instructions for form completion to be consistent with experimental task (focussing on printed numbers in a number vigilance task, and reading magazines, respectively.)

Figure 2

EXPERIMENTAL DESIGN

Group	Manipulation	n	Phases					
1	Attention Focus	15	Adaptation	Tinnitus Focus	Reversal			
2	Anxiety	15	Adaptation	Anxiety (Camera + NVT)	Reversal			
3	Fatigue	15	Adaptation	Fatigue (NVT)	Fatigue (NVT)	Fatigue (NVT)	Fatigue (NVT)	Fatigue (NVT)
4	Control	15	Adaptation	Control Task (Read)	Control Task (Read)	Control Task (Read)	Control Task (Read)	Control Task (Read)
	Duration (minutes)		10	5	5	15	15	15
	Phase		A	B	C	D	E	F

Note.
N=60
NVT number vigilance task

5. The Hearing Ability Scale (HAS). This brief questionnaire was developed for community surveys of hearing loss (see Appendix H). It consists of seven statements about hearing ability that complied with Guttman scaling in a large demographic study (Vital & Health Statistics, 1968). The scores range from 1 (normal hearing) to 8 (profound hearing loss). In this study hearing ability, as estimated by the HAS, correlated well with audiometrically determined estimates.

b. Physiological measure.

A Sanyo Pulsemeter Model HRM-97E (manufacturer: Sanyo Canada, Toronto) was used to take periodic heart-rate measurements. Accuracy of monitoring with this instrument is ±3%, (equivalent to ±1 beat). Finger blood volume varies with heart-beat which affects light transmission. This system uses a photo-electric cell clipped to the fourth finger of the subject's non-preferred hand, to estimate heart-rate from light transmitted through the finger. It was recommended as a simple, non-invasive technique for measurement of heart-rate (Jennings, Tahmoush, and Redmond, 1980). Readings were taken every 10 seconds during the last minute of each experimental phase (see Experimental Design, Figure 2). The arithmetic mean of each such set of these readings was used in analyses as a measure of heart-rate.

C. Experimental Procedure and Design

a. Laboratory procedure.

Subjects were randomly assigned to one of four groups, each consisting of 15 members. The experimental design is represented in Figure 2 and the experimental procedure is summarized below.

Subjects were shown into a quiet 12 foot x 12 foot room lit by incandescent lights to avoid fluorescent lighting hum, and furnished with a table and chair for the subject and a table and chair for the experimenter. Subjects signed a consent form (see Appendix D). During the 10 minutes adaptation phase (phase A in Figure 2) the heart-rate sensor clip was attached to the fourth finger of the non-preferred hand. Subjects were asked to sit quietly while completing a Tinnitus Questionnaire (TQ), (see Appendix I) and the Hearing Ability Scale. Each subject was then individually administered one of the following experimental manipulations.

1. Attentional focus. Subjects were instructed from a script (see manipulation phase of protocol in Appendix J) read by the experimenter to focus their attention as exclusively as possible on their tinnitus sound and to listen to all its characteristics for five minutes during which HR readings were taken and at the end of which the FV-T and the RAS were administered.

During reversal phase (phase C in Figure 2) subjects were

asked to think for five minutes about a neutral subject such as the route to be taken when driving home later that day or what they might be having for dinner. The FV-T and RAS were administered at the end of this phase.

2. Anxiety induction. The Number Vigilance Task (NVT) was developed by Moran and Mefferd (1959) to provide researchers with multiple parallel forms of experimental tasks with high test-retest reliabilities. Subjects were required to mark off a target number, identified at the beginning of each row of numbers, wherever it occurred in that row. To induce anxiety, subjects were asked to do the NVT, while having a video camera aimed at them. They were informed as follows: "When I turn the video camera on, a video picture of you will be transmitted to a lab next door, where two psychologists will observe you as you mark the numbers for five minutes. We are starting now." In fact the video camera was not turned on, nor were any observers present. HR was taken during this period. After five minutes the FV-N and RAS were administered. This protocol is summarized in Appendix K.

3. Fatigue induction. A pilot study on college undergraduates was run to assess the practicability of inducing fatigue by means of a prolonged number vigilance task. Results showed that this was feasible (see Appendix A). Subjects were asked to do the NVT for 60 minutes (see Appendix L for description of protocol).

4. Control. Subjects were asked to read National

Geographic Magazines after being told that there would be no enquiry or testing of their reading, in order to relieve any anxiety they might have about this (see protocol in Appendix M). They were asked to record the number written on the cover of each magazine on a Reading List (see Appendix N) to assist in verifying that they were in fact reading magazines.

b. Home-monitoring procedure.

Each subject was required to identify two times during a typical day when he or she felt most fatigued, and two times when least fatigued. These times were entered by the experimenter in the subject's Tinnitus Diary (TD), (see Appendix C), and the subject was asked to record information about the tinnitus in the tinnitus diary at these four times daily for one week.

V RESULTS

1. Subjects.

One hundred and twenty-seven tinniteurs were contacted as potential subjects; 60 (47.3%) complied with criteria and were used as subjects. Reasons for non-participation of the remaining 67 (52.7%) are summarized in Appendix O. Of these, 44.8% failed to meet criteria for participation and 55.2% did not participate for administrative reasons.

Participating subjects had a mean age of 53.9 years (range 30 to 70 years) and mean duration of tinnitus was 11.1 years (range .6 to 50 years). They had received a mean of 14.5 years of education (range 8 to 23 years) and the male:female ratio was .82. In general subjects had good hearing ability as indicated by a mean score of 1.5 (range 1 to 3) on the HAS. This suggested that, on average, subjects could hear and understand normal speech from across a quiet room. Table 2 summarizes demographic characteristics of participants.

2. Group Equivalence.

In testing for group equivalence, no significant differences were found among groups. Inspection of Table 2 revealed only one noteworthy trend regarding group equivalence: the variation in the ratio of males/females in each group. However, there are no reports in the literature which find

Table 2

Demographic Characteristics of Subjects

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	Group				
	Attention Focus (n=15)	Anxiety (n=15)	Fatigue (n=15)	Control (n=15)	Total (n=60)
AGE (years)					
Mean	53.6	54.4	54.1	53.7	53.9
SD	12.8	11.0	9.1	11.3	10.8
Range	30-70	30-69	41-66	32-65	30-70
Duration (years)					
Mean	11.7	11.8	7.1	13.8	11.1
SD	10.3	11.1	5.1	15.1	11.0
Range	.6-35	.8-40	1.2-20	1.1-50	.6-50
Education (years)					
Mean	14.8	15.2	14.0	14.1	14.5
SD	3.3	3.2	3.3	3.4	3.2
Range	12-23	11-22	9-21	8-21	8-23
Sex:number (%)					
Male	3(20)	8(53.3)	6(40)	10(66.7)	27(45)
Female	12(80)	7(46.7)	9(60)	5(33.3)	33(55)
Ratio: male/female	.25	1.14	.66	2.00	.82
Hearing Ability [a]					
Mean (n)[b]	1.4(13)	1.8(14)	1.4(14)	1.5(13)	1.5(54)
SD	.5	.7	.5	.8	.6
Range	1-2	1-3	1-3	1-3	1-3

Note:

a From Hearing Ability Scale (range:1 normal to 8 severe disability)

b Group sizes depleted by some non-scaling responses

differential responses to tinnitus between male and females. The multiple regression analysis, described later in this section, similarly yielded the lowest regression weight for sex in predicting tinnitus distress from a number of variables. A MANOVA[1] [2] among the four groups on demographic variables (sex, age, education, and hearing ability) yielded no significant group difference, $F(12,124)=1.74$, n.s.[3] A MANOVA among the groups on affect-related variables (initial scores on self-rated anxiety, self-rated fatigue, pleasure and arousal scores on the Russell Affect Scale, and heart rate) yielded no significant group difference, $F(15,143)=.39$, n.s. A similar MANOVA on initial self-ratings of tinnitus variables (distress, intensity, pitch, complexity, and duration from onset) disclosed no significant group difference, $F(15,143)=83$, $p>.64$.

Thus statistical evaluation indicated that the groups were well matched.

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[1] All MANOVAs were performed through BMDP4V, (Dixon, 1981).

[2] Statistical assumptions underlying MANOVA were not critical in the present analysis. It is well known that ANOVA procedures (including MANOVA) are, in general, robust with respect to violations of the normality assumption (extended to multivariate normality in the case of MANOVA). With regard to the variance-covariance assumption, it has been established that, as in the case of univariate ANOVA (see Glass, Peckham & Sanders, 1972), heterogeneity of covariance matrices can be tolerated as long as the n's are equal (see e.g. Hakstian, Roed, & Lind, 1979). This was the case in this study.

[3] Wilk's Lambda criterion for testing significance of MANOVAs was used throughout this section.

3. Manipulation checks.

A series of group x period repeated measures MANOVAs was performed. Each MANOVA compared the target manipulation group with a group or groups which could best serve as comparison.

a. Attention Focus.

After an adaptation period, members of the attention focus group were instructed to focus on their tinnitus and then, during a reversal period, away from their tinnitus. The fatigue group members were requested to perform a number vigilance task, the control group members were instructed to read, and these groups were thus appropriate for comparison. A repeated measures group x period MANOVA (3x3) was performed at times A,B, & C (adaptation, manipulation, and reversal phases respectively) on scores for the target group (attention focus) and two comparison groups (see Table 3). Cell means are summarized in Table 4. Variables used were FV (focus verification; the percentage of time subjects estimated focussing on their tinnitus); R anxiety (anxiety score from the Russell Affect Scale); and R fatigue (fatigue score from the Russell Affect Scale).

For the attention focus group, the overall period effect and the group x period interaction were significant, but not the overall group effect. The only variable contributing significantly to the effects, as expected, was percentage of time focussing on tinnitus.

Table 3

Manipulation Check for Attention Focus. (Comparison Groups: Fatigue and Anxiety)
Repeated Measures MANOVA with Subsequent ANOVAs.

Analysis	(effect)	MSw[a]	df	F[c]	p[b]
MANOVA	at A,B,C (group)		6,80	2.02	>.07
ANOVA	at A,B,C (FV)	7,243.76	2,42	4.75	<.01
ANOVA	at A,B,C (R anxiety)[d]	.07	2,42	.12	>.88
ANOVA	at A,B,C (R fatigue)[d]	.53	2,42	.96	>.39
MANOVA	at A,B,C (period)		6,37	8.20	<.01
ANOVA	at A,B,C (FV)	11,552.6	2,41	19.87	<.01
ANOVA	at A,B,C (R anxiety)[d]	.19	2,41	3.21	>.05
ANOVA	at A,B,C (R fatigue)[d]	.10	2,41	1.10	>.34
MANOVA	at A,B,C (period x group)		12,74	10.77	<.01
ANOVA	at A,B,C (FV)	8,479.61	4,82	24.81	<.01
ANOVA	at A,B,C (R anxiety)[d]	.12	4,82	1.95	>.11
ANOVA	at A,B,C (R fatigue)[d]	.18	4,82	2.30	>.07

Note:

a MSb for treatments is reproducible from F x MSw
b Two-tailed probability
c Using Wilk's Lambda criterion
d Scores from Russell Affect Scale

Table 4

Cell Means of Dependent Variables

Phase	Measure	Group			
		Attention Focus	Anxiety	Fatigue	Control
A	Focus Verification[b]	56.60 (37.89)[a]	54.33 (35.04)	64.00 (32.47)	63.73 (33.91)
	Anxiety[c]	3.20 (2.27)	3.13 (2.42)	3.27 (2.77)	3.60 (1.92)
	R anxiety[d]	.01 (.47)	.10 (.49)	-.13 (.54)	.01 (.43)
	Fatigue[e]	2.80 (2.21)	3.31 (1.88)	2.47 (1.92)	2.47 (1.60)
	R fatigue[f]	-.19 (.40)	.29 (.46)	-.03 (.44)	-.06 (.46)
	Heart Rate[g]	78.50 (10.66)	75.09 (9.19)	74.96 (9.95)	74.60 (9.29)
B	Focus Verification	91.07 (9.29)	11.07 (23.05)	16.60 (27.62)	29.20 (31.90)
	Anxiety	3.67 (2.16)	3.07 (1.71)	3.80 (2.24)	3.67 (1.68)
	R anxiety	.21 (.62)	.17 (.59)	.04 (.49)	.02 (.39)
	Fatigue	2.80 (1.94)	3.40 (2.06)	2.60 (1.68)	2.60 (1.45)
	R fatigue	-.09 (.35)	-.15 (.55)	-.27 (.41)	.10 (.59)
	Heart Rate	73.46 (9.80)	80.06 (11.06)	77.62 (10.32)	71.00 (9.48)
C	Focus Verification	32.33 (28.90)	20.53 (22.46)	28.87 (34.01)	27.00 (27.31)
	Anxiety	2.87 (1.85)	2.67 (1.68)	3.40 (2.29)	2.93 (1.62)
	R anxiety	-.03 (.58)	.03 (.44)	.06 (.59)	-.04 (.39)
	Fatigue	2.80 (1.93)	3.20 (1.82)	3.13 (1.81)	2.53 (1.25)
	R fatigue	-.08 (.46)	.25 (.39)	-.09 (.65)	.14 (.59)
	Heart Rate	73.12 (9.51)	72.67 (10.94)	76.96 (11.49)	69.98 (10.57)

(continued)

Table 4 (cont'd)

Cell Means of Dependent Variables

Phase	Measure	Group			
		Attention Focus	Anxiety	Fatigue	Control
D	Focus Verification			23.20 (31.75)	23.80 (23.88)
	Anxiety			3.27 (1.94)	3.13 (1.41)
	R anxiety			.32 (.61)	-.07 (.45)
	Fatigue			3.93 (2.43)	2.87 (1.51)
	R fatigue			.15 (.72)	.22 (.48)
	Heart Rate			74.02 (9.31)	68.97 (9.51)
E	Focus Verification			20.40 (31.61)	20.20 (23.20)
	Anxiety			3.87 (1.92)	3.13 (1.64)
	R anxiety			.42 (.56)	-.08 (.54)
	Fatigue			4.87 (2.03)	3.80 (1.90)
	R fatigue			.52 (.71)	.47 (.50)
	Heart Rate			71.25 (7.97)	66.75 (10.68)
F	Focus Verification			22.33 (30.46)	19.13 (22.21)
	Anxiety			4.07 (1.94)	3.40 (1.59)
	R anxiety			.72 (.64)	.13 (.59)
	Fatigue			5.67 (2.25)	3.93 (2.19)
	R fatigue			.73 (.66)	.70 (.55)
	Heart Rate			71.35 (8.41)	66.25 (9.82)

Note:

a (Standard deviations)
b Self-rating of % time focussed on tinnitus
c Self-rating of anxiety; range 1-9
d Anxiety estimate from Russell Affect Scale; range 6-54
e Self-rating of fatigue; range 1-9
f Fatigue estimate from Russell Affect Scale; range 6-54
g Beats per minute

The MANOVA group effect missed significance $F(6,80)=2.02$, $p>.07$. However, the period effect was highly significant, $F(6,37)=8.20$, $p<.0001$. Subsequent ANOVAs on the dependent variables revealed a highly significant period effect for FV, $F(2,42)=19.87$, $p<.0001$, but not for R anxiety, $F(2,42)=3.21$, n.s., nor R fatigue, $F(2,42)=1.14$,n.s.[4]

There was a highly significant period x group interaction effect on the MANOVA, $F(12,74)=10.77$, $p<.0001$. Once again subsequent ANOVAs on the dependent variables showed high significance for FV, $F(4,82)=24.81$, $p<.0001$; but not for R anxiety $F(4,82)=1.95$, n.s.; nor the R fatigue, $F(4,82)=2.30$, n.s.

To determine at which phases significant effects occurred, separate one way MANOVAs were done for each phase, A,B, and C using the variables FV, R anxiety, and R fatigue. The critical α level was set at .05/3=0.017 after Bonferroni adjustment.[5] The group effect was significant at phase B, $F(6,80)=11.27$, $p<.0001$; but not at A, $F(6,80)=.58$,n.s.; nor at C, $F(6,80)=.46$,n.s. Subsequent ANOVAs were performed at B on each variable

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[4] Throughout the following repeated measures ANOVAs, the Greenhouse-Geisser adjustment was used when the correlation matrix was significantly different from spherical form by Bartlett's test of sphericity. The Greehnouse-Geisser adjustment compensates for the fact that such tests tend to be too liberal in some cases by reducing the degrees of freedom by a so-called epsilon factor (Winer, 1962).

[5] In order to control for the possibility of inflating type I error rates due to the number of tests being performed in these and in further sub-analyses, Bonferroni adjustments were made to the critical levels for judging significance (Harris, 1975).

separately to determine which contributed significantly to the group effect. Critical α level was set at .05/9=.0056. The ANOVA for FV was significant, $F(2,42)=38.29, p<.0001$; but R anxiety was not, $F(2,42)=.65$, n.s.; nor was R fatigue, $F(2,42)=2.50$, n.s. In order to discern which intergroup differences contributed to the significant group effect for FV at B, Tukey tests (honestly significant difference with studentized range, q) were performed with critical α level set at .0056. While there were significant differences between the attention focus and fatigue group scores, $q(3,42)=11.56$, $p<.005$; and also between attention focus and control groups, $q(3,42)=9.61$, $p<.005$; no significant difference was found between the fatigue and control groups, $q(3,42)=1.96$, n.s.

These analyses indicated that the experimental manipulation of tinnitus focus was successfully achieved. The FV scores for the attention focus group were significantly higher than for the comparison groups at the expected phase of the manipulation (see Figure 3). Anxiety and fatigue scores did not vary significantly either between groups or across time in these analyses. Thus, the attentional focus manipulation did not affect measures of anxiety or fatigue in these subjects.

b. Anxiety

A repeated measures group x period MANOVA (2x3) was performed at times A, B, and C on scores of the anxiety group and a comparison group (fatigue group) (see Table 5). The

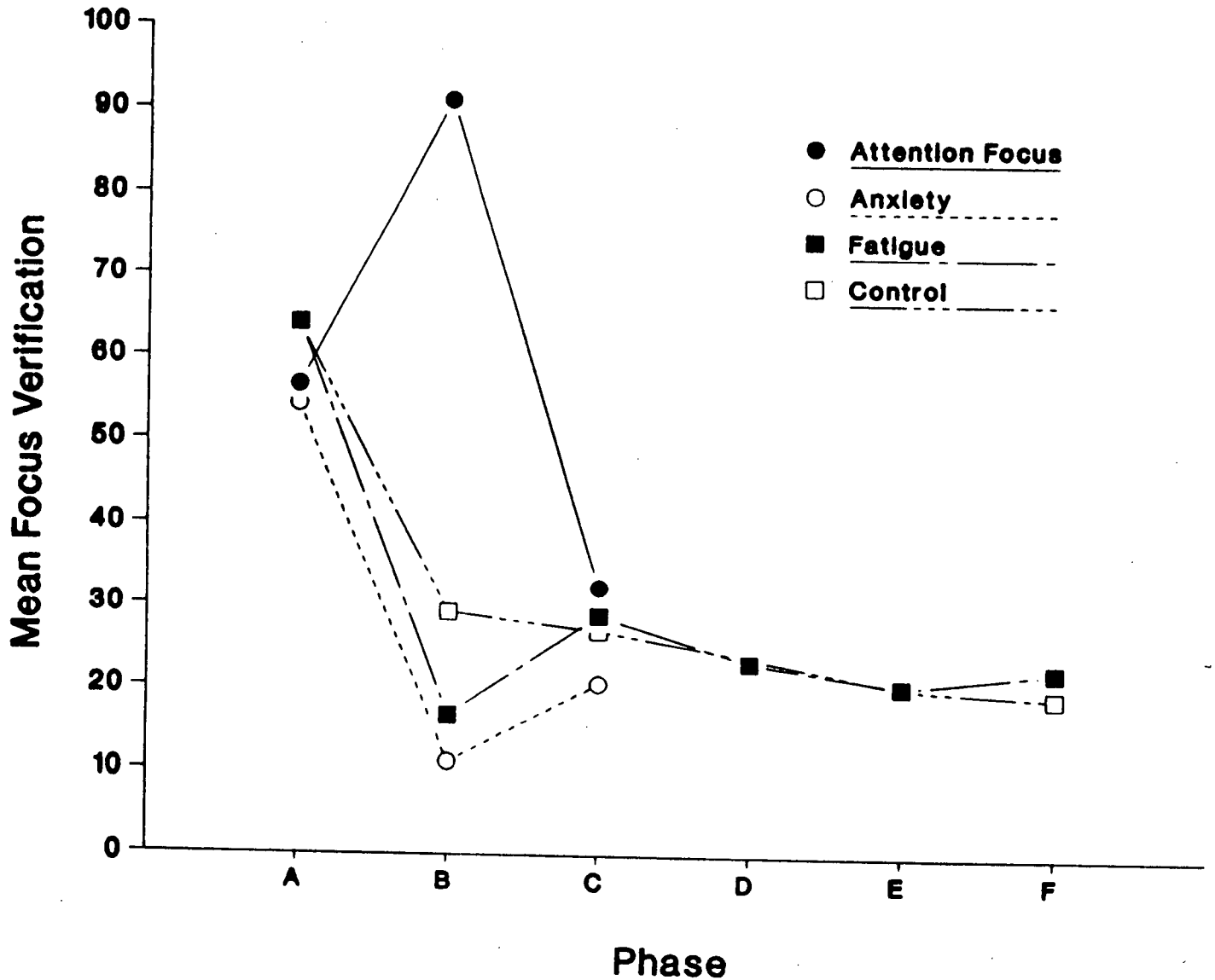

Fig. 3. Mean focus verification over experimental phases.

Table 5

Manipulation Check for Anxiety. (Comparison Group: Fatigue)
Repeated Measures MANOVA with Subsequent ANOVAs.

Analysis (effect)		MSw[a]	df	F[c]	p[b]
MANOVA	at A,B,C (group)		2,27	.74	>.48
ANOVA	at A,B,C (anxiety)	6.40	1,28	.69	>.41
ANOVA	at A,B,C (R anxiety)[d]	2.70	1,28	.39	>.53
MANOVA	at A,B,C (period)		4,25	.88	>.49
ANOVA	at A,B,C (anxiety)	1.21	2,27	.58	>.56
ANOVA	at A,B,C (R anxiety)	.09	2,27	1.24	>.30
MANOVA	at A,B,C (period x group)		4,25	1.02	>.41
ANOVA	at A,B,C (anxiety)	.90	2,27	.29	>.74
ANOVA	at A,B,C (R anxiety)	.14	2,27	2.03	>.15

Note:

a MSb for treatments is reproducible from F x MSw
b Two-tailed probability
c Using Wilk's Lambda criterion
d Scores from Russell Affect Scale

fatigue group was an appropriate comparison group because subjects in this group received the same experimental treatment as subjects in the anxiety group (i.e. the number vigilance task) except for the anxiety induction supplement for anxiety group members only. Cell means are summarized in Table 4. Variables used were two measures of anxiety level: anxiety (self-rated anxiety on a 1-9 scale) and R anxiety. The MANOVA group effect, period effect, and group x period interaction were all non-significant (respectively $F(2,27)=.74$, n.s.; $F(1.81,50.70)=.44$, n.s.; and $F(4,25)=1.02$, n.s.). Thus the anxiety manipulation did not affect the measures of anxiety significantly.

c. Fatigue

Analysis of data for the fatigue manipulation showed that there was a significant time effect (fatigue ratings increased significantly) but group and interaction effects were not significant. A repeated measures group x period MANOVA (2x6) was run at times A,B,C,D,E, and F on scores for the fatigue group and a comparison group (control group). Two measures of fatigue level were used: fatigue (self-rated fatigue on a 1-9 scale) and R fatigue. Results are given in Table 6 and cell means in Table 4.

The MANOVA for group effect was not significant, $F(2,27)=2.02$, n.s.; but the finding was highly significant for the period effect, $F(10,19)=7.52$, $p<.0001$. Subsequent ANOVAs on

Table 6

Manipulation Check for Fatigue. (Comparison Group: Control)
Repeated Measures MANOVA with Subsequent ANOVAs and MANOVAs at Each Phase.

Analysis (effect)	MSw[a]	df	F[c]	p[b]
MANOVA at A-F (group)		2,27	2.02	>.15
ANOVA at A-F (fatigue)[d]	24.94	1,28	1.67	>.20
ANOVA at A-F (R fatigue)	.41	1,28	.30	>.58
MANOVA at A-F (period)		10,19	7.52	<.0001
ANOVA at A-F (fatigue)	27.98	5,24	9.37	<.0001
ANOVA at A-F (R fatigue)	3.17	5,24	11.84	<.0001
MANOVA at period A		2,27	.01	>.98
MANOVA at period B		2,27	2.36	>.11
MANOVA at period C		2,27	2.75	>.08
MANOVA at period D		2,27	2.12	>.13
MANOVA at period E		2,27	1.22	>.30
MANOVA at period F		2,27	2.47	>.10
MANOVA at A-F (period x group)		10,19	2.01	>.09
ANOVA at A-F (fatigue)	3.47	5,24	1.53	<.04
ANOVA at A-F (R fatigue)	.22	5,24	1.91	<.13

Note:

a MSb for treatments is reproducible from F x MSw
b Two-tailed probability
c Using Wilk's Lambda criterion
d Scores from Russell Affect Scale

the dependent variables showed a highly significant period effect for both fatigue and R fatigue; respectively $F(5,24)=9.37$, $p<.0001$; and $F(5,24)=11.84, p<.0001$. The period x group interaction missed significance for the MANOVA, $F(10,19)=2.01, p>.09$.

Separate one way MANOVAs were done for each phase A through F, with dependent measures fatigue and R fatigue. None of these reached significance (see Table 6).

d. Heart rate

An ANOVA was performed on heart rate (HR) for each group during the adaptation phase (phase A). The mean HR was computed from samples collected during the first, middle, and last minute of the adaptation phase. These initial HRs across groups were not significantly different, $F(3,56)=.70$, n.s.

(i) HR - attentional focus

Mean HR[6] was compared between the attention focus group and comparison groups (the fatigue group in which attention was focused on a number vigilance task, and the control group where focus was on reading magazines). A repeated measures ANOVA was performed on mean HR for phases A,B, and C. There was a highly significant overall time effect, $F(2,84)=7.11$, $p\leq.001$; and a highly significant overall period x group interaction,

[6] Cell HR means are tabulated in Table 4 and plotted on Figure 4.

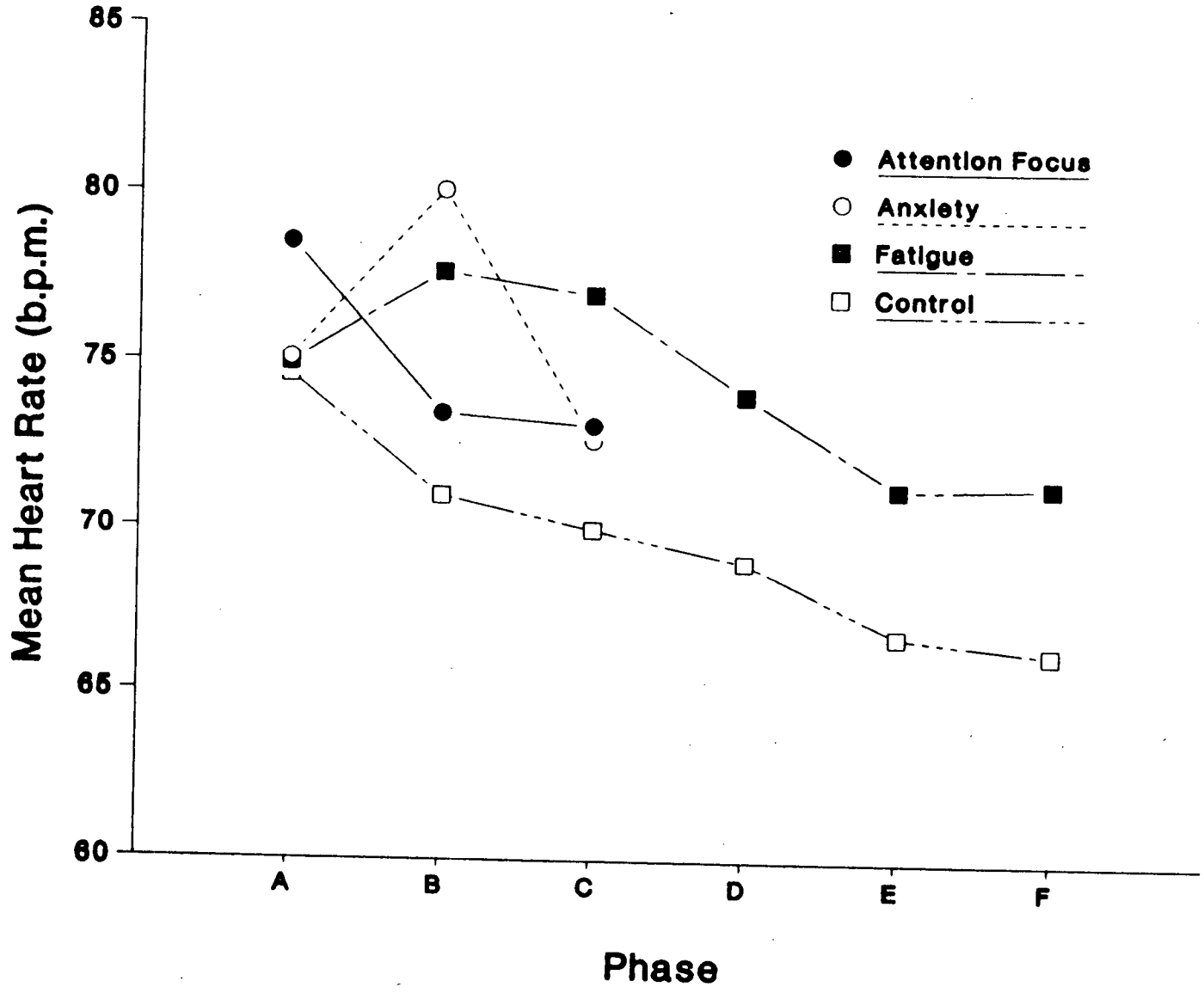

Fig. 4. Mean heart rate (b.p.m.) over experimental phases.

$F(4,84)=6.86$, $p \leq .0001$. This analysis was followed by ANOVAs at each of the three phases with significance levels set at $\alpha=.05/3=.017$ by Bonferroni adjustment. None of these ANOVAs was significant (see Table 7). The group effect did not reach significance, $F(2,42)=.89$, n.s. These analyses indicated that although there was a strong group x period interaction for HR when all time points were included in one analysis, there was no one phase at which groups differed significantly.

(ii) HR - anxiety

A repeated measures ANOVA (see Table 7) for phases A,B, and C was performed on HR for the anxiety group and its comparison group (fatigue group). There was a strong period effect, $F(2,56)=4.93$, $p \leq .01$. The linear component of the curve describing HR over time was non-significant, $F(1,28)=.02$, n.s. This was not unexpected given the ABA design of the manipulation for anxiety i.e. adaptation, anxiety induction, followed by anxiety reversal (debriefing). Thus the quadratic component of this curve was salient and statistically significant, $F(1,28)=14.19$, $p<.001$. The interaction effect between this quadratic component of HR over time and group was also significant, $F(1,28)=4.72$, $p<.05$, although the overall interaction effect missed significance, $F(2,56)=2.81$, $p<.07$. In order to investigate during which phases significant differences in HR between groups were present, t-tests were done at each of the three phases with α significance levels set more stringently by Bonferroni adjustment to $.05/3=0.017$. The group difference

Table 7

Repeated Measures ANOVAs on Heart Rate and Subsequent ANOVAs or *t*-tests at Each Phase

Manipulation (Comparison Groups)	Analysis (effect)	MSw[a]	df	*F*[c]	*p*[b]
Attention Focus (Fatigue, Control)	ANOVA at A,B,C (period)	86.47	2,84	7.11	<.001
	ANOVA at A	69.61	2,42	.70	>.50
	ANOVA at B	167.98	2,42	1.72	>.19
	ANOVA at C	183.31	2,42	1.64	>.20
	ANOVA at A,B,C (group)	254.03	2,42	.89	>.41
	ANOVA at A,B,C (period × group)	83.44	4,84	6.86	<.0001
Anxiety (Fatigue)	ANOVA at A,B,C (period)	87.65	2,56	4.93	<.01
	t-test at A	.13	28	.01	>.50
	t-test at B	44.66	28	4.20	<.05
	t-test at C	138.06	28	12.39	<.001
	ANOVA at A,B,C (group)	7.40	1,28	.03	>.86
	ANOVA at A,B,C (period × group)	87.65	2,56	2.81	>.08
Fatigue (Control)	ANOVA at A-F (period)	208.33	5,140	14.27	<.001
	t-test at A	.97	28	.10	>.05
	t-test at B	328.77	28	33.18	<.001
	t-test at C	365.49	28	33.18	<.001
	t-test at D	191.32	28	20.34	<.001
	t-test at E	151.91	28	16.32	<.001
	t-test at F	195.69	28	21.53	<.001
	ANOVA at A-F (group)	1024.12	1,28	2.05	>.16
	ANOVA at A-F (period × group)	42.07	5,140	2.88	<.05

Note:
a MSb for treatments is reproducible from F x MSw
b Two-tailed probability
c Using Wilk's Lambda criterion

was non-significant during the adaptation phase, $t(28)=.12$, n.s.; missed significance by this criterion during the manipulation phase, $t(28)=2.05$, $p\leq.05$; and was significant during the reversal phase, $t(28)==3.52$, $p\leq.001$.

The group effect on HR missed significance, $F(1,28)=.03$, $p<.86$.

These results are graphed in Figure 4. Group HR means were very similar at adaptation phase. HR for the anxiety group exceeded the HR for the comparison group during the anxiety phase; and then dropped significantly below HR for the comparison (fatigue) group during the reversal phase.

In general these analyses indicated that when anxiety level was manipulated, both period and period x group interactions displayed significant HR effects. HR scores were significantly higher for the fatigue group at reversal phase and missed significance at the manipulation phase.

(iii) HR - fatigue

Mean HRs were compared for fatigue and control groups across phases A through F by means of a repeated measures ANOVA, (see Table 7). A highly significant period effect was found, $F(5,140)=14.27$ $p<.001$, and also a significant period x group interaction $F(5,140)=2.88$, $p<.05$. There was a strong linear component in HR change, $F(1,28)=35.93$, $p<.0001$, but not in the interaction effect, $F(1,28)=.94$, n.s. However, there was a

significant quadratic period x group interaction, $F(1,28)=8.25$, $p<.01$. When these data were re-analysed over phases B through F (the manipulation phases), the overall and quadratic interaction effects disappeared, whereas the strong overall and linear components of the period effect persisted. To determine at which phases there were significant differences between groups, t-tests were performed at each phase with significance levels set at $a=.05/6=.008$ (Bonferroni adjustment). Group differences were significant for each phase except phase A, $p<.001$. Heart-rate was consistently and significantly higher for the fatigue group than for the control group. In summary it was found that during the post-adaptation (i.e. the manipulation) phases B through F, HR changed (decreased) significantly and linearly. At each such phase HR was significantly higher for the fatigue group than for the control group (see Figure 4).

4. Hypothesis Testing.

Hypotheses were tested by comparing the values of the tinnitus variables (distress, intensity, and pitch) for the appropriate experimental groups after the various experimental manipulations in repeated measures MANOVAs. When a MANOVA was significant, the result was analysed further with ANOVAs on each of the tinnitus variables (pitch, intensity, and distress) to identify the source of the multivariate effect. The significance level was made more stringent by Bonferroni adjustment to $a=.05/3=.017$ to control for inflated type I error rates. Cell means for tinnitus variables are summarized in

Table 8.

a. Attention focus

The outcome on these variables for the attention focus group was compared with two comparison groups over the first three phases A,B, and C (see Table 9 and Figures 5,6, and 7). In one comparison group subjects were required to focus on a number vigilance task (fatigue group) and in the second on reading (control group). The MANOVA did not yield significant overall group differences, $F(6,80)=.59$, n.s. There was a significant period effect $F(6,37)=3.26$, $p\leq.01$. ANOVAs on individual variables were performed. Tinnitus distress did not contribute significantly in the attention focus manipulation to the overall time effect, $F(1.48,62.35)=.00$, n.s., and neither did tinnitus pitch, $F(1.58,66.49)=1.60$, n.s. The effect of tinnitus intensity was highly significant, $F(1.93,80.86)=7.59$, $p\leq.001$. When attention was focussed on tinnitus by the subjects in the attention focus group during phase B, this caused a significant increase in mean tinnitus intensity compared to a baseline level (phase A). When attention was directed away from the tinnitus during phase C, tinnitus intensity dropped significantly (see Figure 6). Tinnitus intensity for the comparison groups (fatigue and control), did not change in this way. Instead, there was a decreasing trend from phase A, to B, to C for these subjects.

The period x group interaction was also significant,

Table 8

Cell Means of Tinnitus Measures

Phase	Measure	Group			
		Attention Focus	Anxiety	Fatigue	Control
A	Tinnitus distress[b]	3.87 (2.50)[a]	5.00 (2.67)	3.87 (1.64)	4.20 (2.21)
	" intensity[c]	4.53 (2.23)	5.80 (2.15)	4.93 (2.15)	5.40 (2.10)
	" pitch[d]	4.80 (2.48)	6.27 (2.34)	5.73 (2.12)	6.00 (2.04)
B	Tinnitus distress	4.27 (2.43)	4.47 (2.56)	3.87 (2.13)	3.73 (2.28)
	" intensity	5.80 (2.81)	5.13 (2.26)	4.13 (2.23)	4.53 (1.96)
	" pitch	5.60 (2.56)	5.87 (2.64)	4.67 (2.13)	5.33 (2.16)
C	Tinnitus distress	3.80 (2.11)	4.40 (2.56)	4.47 (2.33)	3.67 (2.06)
	" intensity	4.07 (2.09)	5.20 (2.65)	4.13 (1.89)	3.73 (1.91)
	" pitch	4.87 (2.42)	6.33 (2.23)	4.87 (2.39)	5.67 (1.95)
D	Tinnitus distress			3.93 (2.22)	3.67 (2.16)
	" intensity			4.13 (2.07)	4.00 (1.93)
	" pitch			5.13 (2.36)	5.40 (2.50)
E	Tinnitus distress			4.47 (2.17)	3.40 (2.03)
	" intensity			4.80 (2.21)	3.80 (1.86)
	" pitch			5.20 (2.11)	5.20 (2.31)
F	Tinnitus distress			4.60 (2.13)	3.53 (2.13)
	" intensity			4.93 (2.19)	3.87 (2.00)
	" pitch			5.47 (2.00)	5.47 (2.17)

Note:
a (Standard deviations)
b Self-rating of tinnitus distress; range 1-9
c Self-rating of tinnitus intensity; range 1-9
d Self-rating of tinnitus pitch; range 1-9

Table 9

Repeated Measures MANOVA on Tinnitus Variables for Attention Focus Manipulation with Subsequent ANOVAs.
(Comparison Groups: Fatigue and Control)

Analysis (effect)	Tinnitus Measure	MSw[a]	df	F[c]	p[b]
MANOVA at A,B,C (group)	d,i,p[d]		6,80	.59	>.73
ANOVA at A,B,C	d	.45	2,42	.04	>.96
ANOVA at A,B,C	i	1.83	2,42	.17	>.84
ANOVA at A,B,C	p	5.01	2,42	.38	>.68
MANOVA at A (group)	d,i,p		6,80	.49	>.81
ANOVA at A	d	.56	2,42	.12	>.88
ANOVA at A	i	2.82	2,42	.60	>.55
ANOVA at A	p	5.96	2,42	1.21	>.31
MANOVA at B (group)	d,i,p		6,80	1.04	>.40
ANOVA at B	d	1.16	2,42	.22	>.80
ANOVA at B	i	11.36	2,42	2.04	>.14
ANOVA at B	p	3.47	2,42	.66	>.52
MANOVA at C (group)	d,i,p		6,80	.87	>.52
ANOVA at C	d	2.76	2,42	.59	>.56
ANOVA at C	i	.69	2,42	.18	>.83
ANOVA at C	p	3.20	2,42	.63	>.53
MANOVA at A,B,C (period)	d,i,p		6,37	3.26	≤.01
ANOVA at A,B,C	d	.01	1.48,62.35[e]	.00	>.98
ANOVA at A,B,C	i	12.65	1.93,80.86[e]	7.59	≤.001
ANOVA at A,B,C	p	1.83	1.58,66.49[e]	1.60	>.20
MANOVA at A,B,C (period x group)	d,i,p		12,74	2.19	≤.02
ANOVA at A,B,C	d	2.01	2.97,62.35[e]	1.82	>.31
ANOVA at A,B,C	i	6.52	3.85,80.86[e]	3.91	<.01
ANOVA at A,B,C	p	3.81	3.17,66.49[e]	3.34	<.05

Note:
a MSb for treatments is reproducible from F x MSw
b Two-tailed probability
c Using Wilk's Lambda criterion
d Distress, intensity, pitch
e After Greenhouse-Geisser adjustment

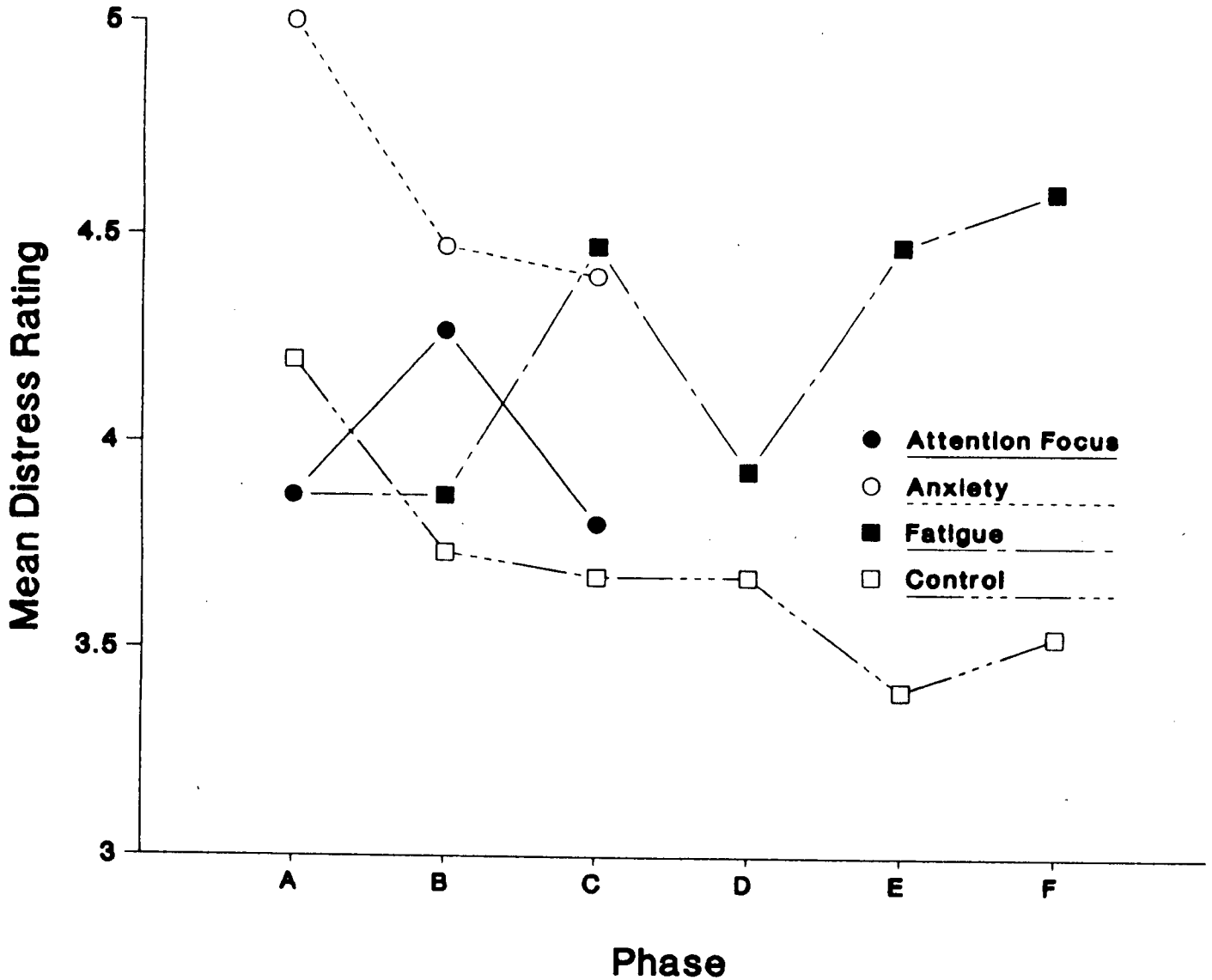

Fig. 5. Mean distress ratings over experimental phases.

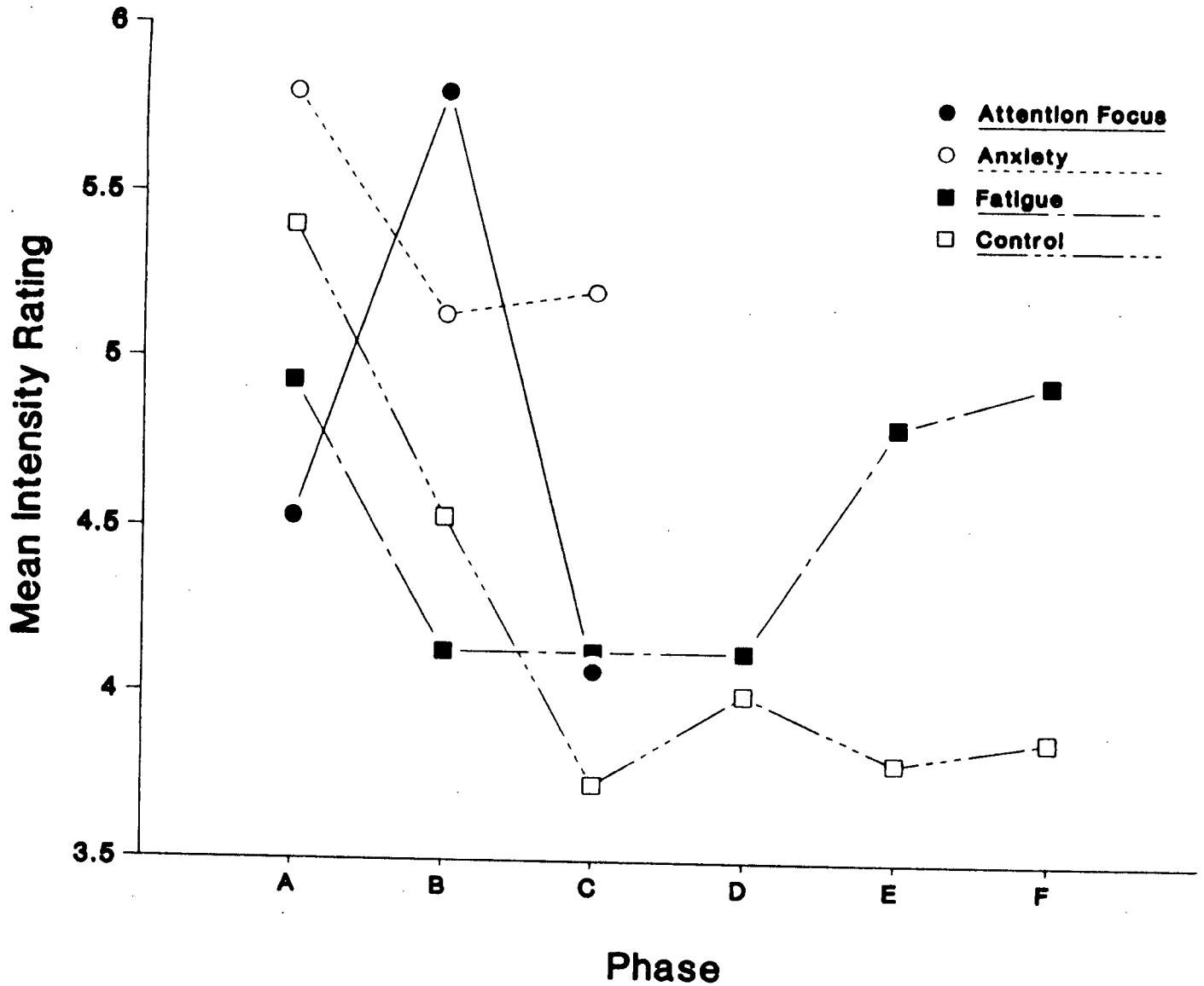

Fig. 6. Mean tinnitus intensity ratings over experimental phases.

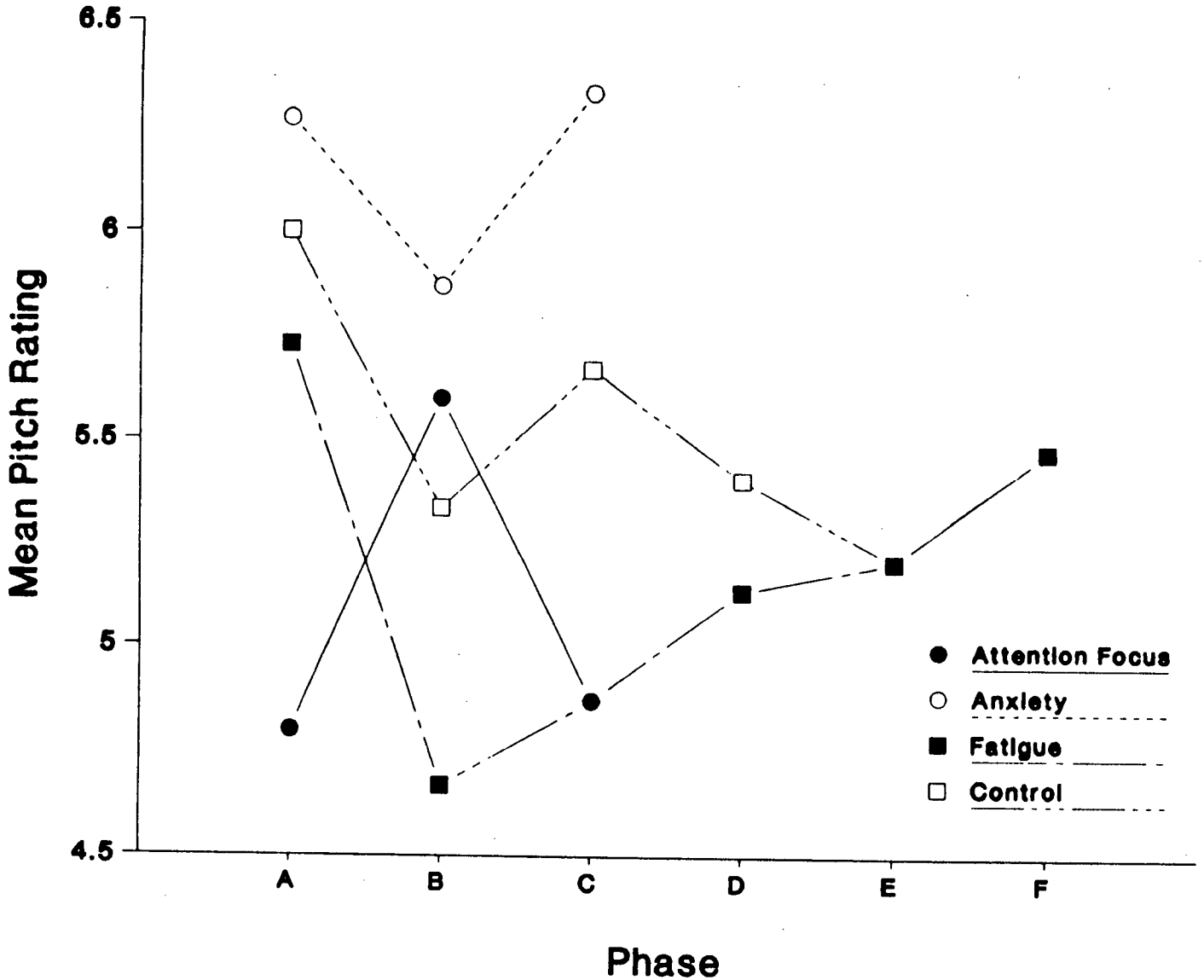

Fig. 7. Mean tinnitus pitch ratings over experimental phases.

$F(12,74)=2.19$, $p<.05$. This was probed further with repeated measure ANOVAs on each variable (see Table 9). The period x group interaction for tinnitus intensity had a significant bearing on the overall period x group interaction $F(3.85,80.86)=3.91$, $p\leq.007$. Tinnitus distress was non-significant, $F(2.97,62.35)=1.19$, n.s.; and tinnitus pitch missed significance, $F(3.17,66.49)=3.34$, $p\leq.02$ (after setting α to .05/3=.0167 by Bonferroni adjustment).

To follow up on the repeated measures MANOVAs discussed above, a one-factor (group) MANOVA was done at each phase (see Table 9). None was significant (at phase A, $F(6,80)=.49$, n.s.; at phase B, $F(6,80)=1.04$, n.s.; and at phase C, $F(6,80)=.87$, n.s). Thus, there were no intergroup differences on tinnitus variables when data were analysed at individual phases.

To summarize: when the data were analysed using multivariate statistics over phases A,B, and C, there was a significant period effect significantly attributable to the large increase in tinnitus intensity during phase B for the attention focus group which contrasted with the decreases at this time for the two comparison groups. Similarly, when the significant interaction effect was probed by performing repeated measures ANOVAs for each variable separately, tinnitus intensity was the only variable contributing significantly to the effect (see Table 9).

b. Anxiety

The effect of manipulating anxiety on the tinnitus variables distress, intensity, and pitch was assessed by comparing these variables for the anxiety group with its comparison group (the fatigue group) over phases A,B, and C by measures of a repeated measures MANOVA. The MANOVA did not reach overall significance for the group effect, $F(3,26)=.59$, n.s. There was a significant period effect, $F(6,23)=2.63$, $p<.05$. This was further investigated by univariate analyses of individual tinnitus variables. Tinnitus intensity and tinnitus pitch contributed significantly to the period effect (respectively $F(1.81,50.64)=3.78$, $p<.03$; and $F(1.68,47.01)=3.55$, $p<.04$. The ANOVA for tinnitus distress was non-significant, $F(1.57,44.03)=.53$, n.s. Period x group interaction was also non-significant, $F(6,23)=.95$, n.s. These analyses are summarized in Table 10.

Subsequent one-way (group) ANOVAs were done at each phase (A,B, and C) to probe for group differences with the critical significance level set at .05/3=.017. None was significant.

c. Fatigue

A 2 x 6 (group x period) repeated measures MANOVA was performed to compare the effects of fatigue on the tinnitus scores of the fatigue group with those of the control group. None of the group, period, or period x group interaction effects was significant (respectively $F(3,26)=.40$, n.s.; $F(15,14)=1.10$, n.s.; $F(15,14)=1.21$, n.s.; see Table 11). Although the

Table 10

Repeated Measures MANOVA with Subsequent ANOVAs on
Tinnitus Variables for Anxiety Manipulation (Comparison Group: Fatigue)

Analysis (effect)	Tinnitus Measure	MSw[a]	df	F[c]	p[b]
MANOVA at A,B,C (group)	d,i,p[d]		3,26	.59	>.62
ANOVA at A,B,C	d	6.94	1,28	.51	>.48
ANOVA at A,B,C	i	21.51	1,28	1.64	>.21
ANOVA at A,B,C	p	25.60	1,28	1.86	>.18
MANOVA at A,B,C (period)	d,i,p		6,23	2.63	<.04
ANOVA at A,B,C	d	.71	1.57,44.03[e]	.53	>.55
ANOVA at A,B,C	i	5.14	1.81,50.64[e]	3.78	<.04
ANOVA at A,B,C	p	4.04	1.68,47.01[e]	3.55	<.05
MANOVA at A (group)	d,i,p		3,26	.75	>.53
ANOVA at A	d	9.63	1,28	1.96	>.17
ANOVA at A	i	5.63	1,28	1.03	>.31
ANOVA at A	p	2.13	1,28	.43	>.52
MANOVA at B (group)	d,i,p		3,26	.60	>.62
ANOVA at B	d	2.70	1,28	.49	>.49
ANOVA at B	i	7.50	1,28	1.48	>.23
ANOVA at B	p	10.80	1,28	1.80	>.18
MANOVA at C (group)	d,i,p		3,26	1.83	>.16
ANOVA at C	d	.03	1,28	.01	>.94
ANOVA at C	i	8.53	1,28	1.61	>.21
ANOVA at C	p	16.13	1,28	3.03	>.09
MANOVA at A,B,C (period x group)	d,i,p		6,23	.95	>.47
ANOVA at A,B,C	d	2.71	1.57,44.03[e]	2.00	>.15
ANOVA at A,B,C	i	.07	1.81,50.64[e]	.06	>.93
ANOVA at A,B,C	p	1.73	1.68,47.01[e]	1.52	>.22

Note:
a MSb for treatments is reproducible from F x MSw
b Two-tailed probability
c Using Wilk's Lambda criterion
d Distress, intensity, pitch
e After Greenhouse-Geisser adjustment

Table 11

Repeated Measures MANOVA with Subsequent ANOVAs on
Tinnitus Variables for Fatigue Manipulation (Comparison Group: Control)

Analysis (effect)		Tinnitus Measure	MSw[a]	df	F[c]	p[b]
MANOVA	at A,B,C (group)	d,i,p[d]		3,26	.40	>.75
ANOVA	at A,B,C	d	11.25	1,28	.54	>.47
ANOVA	at A,B,C	i	3.76	1,28	.20	>.66
ANOVA	at A,B,C	p	5.00	1,28	.24	>.63
MANOVA	at A,B,C (period))	d,i,p		15,14	1.10	>.43
ANOVA	at A,B,C	d	.48	3.21,89.80[e]	.38	>.77
ANOVA	at A,B,C	i	5.55	2.81,78.69[e]	4.44	<.01
ANOVA	at A,B,C	p	2.64	2.83,79.22[e]	1.70	>.17
MANOVA	at A,B,C (period x group)	d,i,p		15,14	1.21	>.36
ANOVA	at A,B,C	d	2.42	3.21,89.80[e]	1.95	>.12
ANOVA	at A,B,C	i	3.29	2.81,78.69[e]	2.63	>.05
ANOVA	at A,B,C	p	.84	2.83,79.22[e]	.54	>.64

Note:
a MSb for treatments is reproducible from F x MSw
b Two-tailed probability
c Using Wilk's Lambda criterion
d Distress, intensity, pitch
e After Greenhouse-Geisser adjustment

multivariate analyses did not yield significant results it was decided to investigate the tinnitus variables individually to determine whether there were any trends. Findings were interpreted tentatively. The period effect was significant for tinnitus intensity, $F(2.81,78.68)=4.44$, $p<.001$ but not the group effect nor the period x group interaction. For tinnitus distress, none of the effects was significant, with the interaction effect closest to reaching significance, $F(3.21,89.80)=1.95$, $p>.12$. None of the effects was significant for tinnitus pitch.

d. Tinnitus diary.

As a naturalistic parallel to the laboratory manipulations of tinnitus focus, anxiety, and fatigue, tinnitus diaries were analysed for variation in tinnitus pitch, intensity, and distress by considering the values of these variables for the highest and lowest quartiles of the affect, bored, anxious, and fatigued variables. An extreme groups design was selected to provide for maximal contrasts for each affect variable. The 28 scores from each subject for an affect variable were rank-ordered. The mean of the seven scores for each tinnitus variable associated with the top quartile, and the mean associated with the bottom quartile of an affect variable, were calculated. The differences of these means for all subjects, and over the three tinnitus variables were tested in a one sample t test for each affect variable in turn. Sorting in turn by each affect variable bored, anxious, and fatigued

respectively, highly significant differences were obtained from T^2 analyses of tinnitus pitch, intensity, and distress in each case: $F(3,52)=12.06$, $p<.0001$; $F(3,52)=15.04$, $p<.0001$; $F(3,52)=15.89$, $p<.0001$. Univariate t-tests were subsequently performed on each tinnitus variable and it was found that for every affect variable, the variation in each tinnitus variable was highly significant, $p<.0001$. High values of a tinnitus variable were associated with high values of an affect variable in all cases.

Correlations between tinnitus variables and affect variables were analysed in two ways. Statistical significance could not be estimated because of dependencies in the data arising from repeated measurement procedures. Firstly, Pearson correlation coefficients were calculated for the three tinnitus variables and the three affect variables over all subjects and all days (see Table 12). All the r's were positive and values varied from .22 (tinnitus pitch x boredom) to .70 (tinnitus distress x tinnitus loudness).[7]

However, if there was substantial variability in individual correlational patterns (between affect and tinnitus variables) with some positive and others negative or close to zero, it is possible that these global correlations might obscure certain results. To explore further the individual intercorrelations between tinnitus variables and affect variables on tinnitus

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[7] All significances for correlations were calculated for two-tailed distributions.

Table 12

Global Correlations Between Tinnitus Variables and Mood Variables from Tinnitus Diary.[a,b]

	Fatigue	Boredom	Anxiety	Tinnitus Pitch	Tinnitus Intensity	Tinnitus Distress
Fatigue		.401	.511	.380	.437	.473
Boredom			.583	.224	.398	.502
Anxiety				.354	.469	.628
Tinnitus Pitch					.677	.577
Tinnitus Intensity						.696

Note. a *n*s for each correlation ranged from 1480 to 1492

b Probabilities (two-tailed) were all significant at the .0001 level

diaries, Pearson correlation coefficients were calculated for self-ratings of individual subjects. No significances were calculated because of the dependencies in the data due to the repeated measures design. Their modal ranges were summarized in Table 13. Modal correlation ranges were positive and low (+.10 to +.19) between boredom on the one hand and tinnitus intensity and pitch on the other. A similar modal range was found between pitch and anxiety. Slightly higher modal ranges (+.20 to +.29) were found for correlations between fatigue on the one hand and tinnitus intensity and pitch on the other, as well as between anxiety and tinnitus distress. The highest modal correlations (+.40 to +.49) were between tinnitus distress and fatigue.

The correlations between tinnitus distress and affect variables were in the approximate range +.50 to +.60. Since the intercorrelations between affect measures were high (about +.40 to +.60), a clearer indication of correlations between tinnitus distress and each affect variable would be given by partialling out effect from the affect variable under consideration (Glass & Stanley, 1970). So, for example, the part correlation between tinnitus distress and anxiety could be computed with the relationship between anxiety and fatigue removed. Inspection of Table 14 of part correlation coefficients indicates that partialling out anxiety had the largest effect on the coefficient. The strongest associations were $r_{D(A.F)}$ and $r_{D(A.B)}$ (+.45 and +.41 respectively). Then followed $r_{D(B.F)}$ and $r_{D(F.B)}$ (+.34 and +.30). The part correlations $r_{D(F.A)}$ and $r_{D(B.A)}$ were lowest (+.18 and +.17).

Table 13

Modal Ranges of Intraindividual Correlations between Tinnitus Variables and Mood Variables on Tinnitus Diaries.[a,b]

	Mood Variables		
	Fatigue	Boredom	Anxiety
Tinnitus distress	+.40 to +.49	+.20 to +.29	+.20 to +.29
Tinnitus intensity	+.20 to +.29	+.10 to +.19	+.20 to +.29
Tinnitus pitch	+.20 to +.29	+.10 to +.19	+.10 to +.19

Note:
a N=52
b Tie in modal range decided by median split

Table 14

Part Correlation Coefficients Between Tinnitus Distress and Anxiety, Fatigue, and Boredom

Variable (v) Partialled Out	Part Correlation Coefficients[a]		
	$r_{D(A.V)}$	$r_{D(F.V)}$	$r_{D(B.V)}$
none[b]	.628	.473	.502
A	----	.177	.167
F	.449	----	.341
B	.413	.297	----

Note. a range of n: 1480-1492
b Pearson *r*

Double-smoothed time-series plots (Tukey, 1977) were made of tinnitus distress for each subject to inspect individual patterns of this variable. Smoothing was performed by calculating means successively of groups of three data points, and then repeating the process on the derived means. Forty-two diaries with no missing data were used. Two aspects of these plots were examined: the range of the tinnitus distress rating (maximum range 1-9), and its cyclical pattern. Range widths for tinnitus distress varied from .3 to 5.3. The modal range was 2 to 3.

There was a high degree of variability of tinnitus distress ratings within subjects. Of the 294 diary days reported by 42 subjects, only 24 diary days (8%) with constant distress ratings (after double smoothing) were recorded by as few as nine subjects. The most common pattern of distress ratings over one week (after double smoothing) was sinusoidal with two cycles (50% of subjects); followed by 21% with one cycle; and 7% with more than three.

Distress ratings varied from one to nine covering the full range of the diary distress scale and reflecting a wide range of suffering. The modal range was 2 to 3 indicating a positively skewed distribution with sufferers most frequently experiencing a mild degree of distress. The time patterning of distress ratings for one week indicates a high degree of variability.

Fatigue self-ratings on the tinnitus diary were grouped according to whether subjects had predicted, prior to starting

the diary, whether a particular time chosen to complete the diary would be a low-fatigue or a high-fatigue time. A paired sample t-test on fatigue ratings showed a significant difference between the high- and low-fatigue groups of scores, $t(1480)=115.5$, $p<.0001$.

e. Other analyses.

A forced entry multiple regression was performed between tinnitus distress as the dependent variable and the independent variables: complexity[8] of tinnitus sound, duration (years since onset of tinnitus), subjective pitch, subjective loudness, sex, age, and hearing ability (from the Hearing Ability Scale). Four of the regression coefficients differed significantly from zero resulting in a regression equation with standardized regression weights:

Tinnitus Distress=

.56 subjective intensity - .29 duration + .25 age

+ .22 complexity

Altogether 61% of variability in distress could be predicted from scores on these four variables. Hearing ability, tinnitus pitch and sex all missed significance.

The ratio of bilateral : left-sided : right-sided tinnitus in this sample (N=60) was 3.9:1.8:1 (if the 6 subjects who

[8] Complexity score was calculated by scoring one for each of these tinnitus characteristics if present in an average day: more than one sound, fluctuates a lot between loud/soft, fluctuates a lot between high/low pitch, has additional sounds starting/stopping.

described the sound as located in the head rather than the ears are included in the bilateral total, as per the MRC, 1981 study). The present study thus confirms the relatively consistent finding (see Table 1) that left-sided tinnitus is substantially more prevalent than right-sided tinnitus. The ratio of bilateral to right-sided tinnitus in this study is higher than any reported in the literature to date. There are inconsistencies in the reporting of sidedness data in the literature. Some authors (e.g. MRC, 1981) specify inclusion of tinnitus located in the head in the bilateral count, while others are silent on this point (e.g. Hallam et al, 1984; Hazell, 1981b; Reed, 1960).

In this study, if bilateral tinnitus more prominent on one side is included in the count for that side (and not in the bilateral count), the prevalence of right to left evens out to yield ratios for equally-sided:left:right of 0.7:1.1:1.

VI DISCUSSION

a. Effects of attention focus.

The various analyses of the attention focus manipulation indicate that this manipulation was successful. The tinnitus focus measure, focus verification, was the potent variable accounting for both period effects and period x group effects. Measures of anxiety and fatigue did not change significantly during this manipulation. Focus verification for the attention focus group rose from the adaptation to the manipulation phases and then dropped in the reversal phase (see Figures 5,6, & 7). It was significantly higher during the manipulation phase for the attention focus group than for the two comparison groups in which subjects focused on number checking or reading (the fatigue and control groups, respectively).

Focussing attention on tinnitus seemed to affect the perceived tinnitus intensity. When attentional focus was directed to the tinnitus sound, tinnitus intensity increased and when attention was directed away, tinnitus intensity decreased. Changes in tinnitus intensity significantly accounted for both the period effect and the period x time interaction effect in this study. There is a suggestion that tinnitus pitch might be affected by attention focus, but this effect was not statistically supported.

These findings parallel data from the literature where it has been found that focussing on symptoms increases perceived

non-pain symptom intensity (Pennebaker & Lightner, 1980; where amplified sounds of their own breathing were played to joggers). Directing attention of subjects to their pain in a cold-pressor task decreased tolerance to pain and increased the self-rated discomfort in the pain-focussing group compared with the distraction groups (Kanfer & Goldfoot, 1966). This suggests an important distinction between tinnitus and pain. While sound is not intrinsically distressing, pain is. Craig (1984) has suggested that disagreeable emotional components may be a necessary attribute for experiences to be reasonably described as pain. Thus it could be that without these components, focussing on tinnitus did not result in increased distress.

During the manipulation phase (when attention focus subjects were focussing on their tinnitus), the comparison group members were engaging in tasks (checking numbers or reading) that can be regarded as relatively distracting from their tinnitus when compared to the adaptation phase (in which some of the activity involved answering questionnaires about tinnitus). Both comparison groups show decreases in tinnitus intensity and pitch, probably due to the distracting effects of their duties (see Figures 5,6, & 7). Tinnitus distress declined from the adaptation phase to the manipulation (reading) phase for control subjects but did not change for number vigilance task (fatigue) subjects between these phases. This may be due to the more distracting effects of reading possibly because it may have been more engrossing. Distraction has been found to reduce the number of symptoms noticed and the perceived level of fatigue

for joggers (Pennebaker & Lightner, 1980). McCaul & Malott (1984) reviewed the literature on the effects of distraction on pain and concluded that most experimental studies found that distraction was associated with higher pain thresholds and increased tolerance (e.g. McCaul & Haugtvedt, 1982). Rybstein-Blinchik (1979) found that the use of neutral imagery caused reductions in self-ratings of pain intensity in chronic pain patients.

The commencement of the distracting task in phase C was associated with a sharp decline in tinnitus intensity for the attention focus subjects (see Fig 6). A possible framework for explaining this is the controlled and automatic information processing model proposed by Schneider & Shiffrin (1977). What is termed controlled processing involves the conscious allocation of short-term memory store to a task. It is capacity-bound in that, when a task is more difficult or absorbing, it becomes more difficult to attend to an unrelated task. Processing of tasks which require minimal attention or awareness is termed automatic processing. McCaul & Malott (1984) propose that attention both to symptoms (e.g. tinnitus or pain) and attention to distractors (in this case, the number vigilance and the reading tasks) require controlled processing. Since capacity for this type of processing is supposedly limited, expending it on distractors would, according to this model, decrease the available capacity for attention to symptoms (in this case, tinnitus). In support of this model, focus verification ratings dropped sharply for both distraction groups

(fatigue and control) and rose substantially for the tinnitus focus group from the adaptation phase to the manipulation phase (see Fig. 3), with tinnitus intensity ratings reflecting this. When the tinnitus focus manipulation was reversed, tinnitus intensity dropped correspondingly. In the reversal phase C of this manipulation, attention focus subjects were requested to stop focussing on tinnitus and instead to think about a proximate, neutral, everyday activity such as planning the dinner menu, or the details of the route to be followed when going home. Comparison subjects continued during this phase C with tasks started in phase B. While there was a sharp decrease in tinnitus intensity for attention focus subjects, between phases B and C, intensity continued to fall for control (reading) subjects, and remained the same for the fatigue (number vigilance) subjects. Tinnitus pitch was less affected by the tinnitus focus/distraction manipulation although there is a trend suggestive of concordance with intensity.

Interestingly, when subjects were asked (in open-ended questions), prior to participation in the research, to describe which situations improved or decreased tolerance to tinnitus, of those who included distracting situations in their replies, 45% of responses described that being involved in some other activity in general was associated with tinnitus being less troublesome. No subjects responded that distraction made tinnitus worse. Conversely 4.4% of responses indicated that focussing on tinnitus seemed to make it worse and none found that this improved tolerance to it. Thus it appears that

subjects were more likely to attribute benefits in experiencing tinnitus to distraction, than to attribute exacerbating effects to focussing on the tinnitus.

b. Effects of anxiety.

The statistical evaluation of the anxiety manipulation indicated that, as measured by the self-report variables chosen, the manipulation was unsuccessful although heart rate responded to the manipulation with a significant increase during the manipulation phase (see fig. 4). It is interesting to note that when debriefing subjects after anxiety induction, many spontaneously offered strong denials that the manipulation was anxiety-provoking. One could speculate that they felt constrained in admitting to feeling anxious and that this is reflected in their self-ratings but not in their heart rate.

In a laboratory study investigating whether the presence of observers affected responses of subjects to painful electric shock, Kleck et al. (1976) found that being observed had an attenuating effect on non-verbal expression of pain, subjective pain ratings, and skin conductance. Izard (1971) has suggested that socialization plays an important part in inhibiting or attenuating expressive behaviour to pain in the presence of others. He argued that this might be because parents might increasingly punish displays of emotion by children as they age from infancy through childhood.

Induction of anxiety by using an observing audience with

videotaping has been achieved in at least one other study (Craske & Craig, 1984). Subjects were pianists, half of whom were classified as relatively anxious and half as relatively nonanxious performers. The presence of an audience elicited elevations in self-reported distress levels only for the relatively anxious group, but caused increased heart rate for both classifications.

These studies indicated that the presence of observers can evoke a more complex response than the elevation of anxiety expected from the manipulation in this research. The tinniteurs were not preselected to form a "performance anxiety" group and this might explain why they did not respond with increased anxiety to being observed. It may also be that the reason offered by the experimenter for the observation was not as credible as when provided to subjects who were pianists for whom performing for an audience is more congruent with the experimental context (as in Craske & Craig, 1984).

The failure to generate a high level of anxiety is reflected in the absence of significant group, and period x group interaction effects for the tinnitus variables. The significant period effect is accounted for by changes in tinnitus intensity and pitch (but not distress). It reflects the responsiveness of tinnitus intensity and pitch to an experimental task which was essentially distracting (see Figures 5, 6, and 7).

The differing response between heart rate and reported

anxiety may be explained in terms of the "three systems model" of anxiety (Lang, 1981) which describes three loosely-coupled components: behavioural, physiological, and verbal. These components are capable of responding differentially at a given time i.e. they are discordant. Thus Rachman (1978) reports that self-reports of fear tend to correlate quite well with avoidance behaviour, but less closely with autonomic indicators of fear. Hodgson and Rachman (1974) extended this model by introducing predictions about the degree of covariation over time among the three systems. Rachman (1978) suggested that the temporal order of change was usually first autonomic, then behavioural, and finally verbal. Thus it is possible that, whereas HR increased in the manipulation phase B for the anxiety group (see Figure 4), changes in anxiety as reflected in self-report measures had not yet developed because of the brevity of the anxiety induction. Hodgson & Rachman (1974) hypothesized that concordance would be more likely under conditions evoking strong emotional responses. Since the anxiety manipulation was designed to evoke a mild result, this could explain the difference in responses between the two systems. In contrast to the self-report measures of anxiety, HR shows both a significant period effect and period x group interaction. The quadratic components of these effects are even more pronounced. It appears, therefore, that whereas self-report measures of anxiety were not affected by the manipulation, HR changed significantly. As discussed above, there are difficulties in deciding whether tinniteurs subjected to this manipulation became more anxious

during manipulation phase B. Their ratings of tinnitus variables showed decreases from adaptation phase to manipulation phase, whereas it was hypothesized that anxiety would causes increases. One explanation is that, rather than being an anxiety-provoking task, number vigilance with observation served as a distracting task. This might have mitigated against the expectedly aggravating effects of anxiety on tinnitus.

Although this confound was considered when designing the research by having a control group perform the same task without anxiety induction, it might be argued that the particular anxiety induction used might have had the effect of causing closer attention to the number vigilance task with resulting increased distraction from tinnitus. However, this possibility is not supported by the focus verification measurements. Both the anxiety and the comparison groups reacted very similarly on this measure (see Figure 3).

It is interesting to note that on the tinnitus survey questionnaire 51.7% of the subjects listed anxiety as a affect which increased the degree to which tinnitus bothered them. Only 1.7% (one subject) felt that being anxious improved tinnitus. It appears that many tinniteurs are aware that increased anxiety is associated with exacerbation of tinnitus symptoms.

Ratings of anxiety from the Tinnitus Diary were found to correlate significantly and positively with ratings of all three tinnitus variables: pitch, intensity, distress (r=.35, .47 and

.63 respectively) from the Tinnitus Diary over all subjects. When intraindividual correlations for these variables were computed, a wide range of correlation became apparent with about 30% of subjects having r's of zero or less. It is clear that the tinnitus variables of some sufferers is associated highly and positively with anxiety (r=.4 to .8 for the upper quartile). For others they are associated negatively or not at all with anxiety (r=.0 to -.5).

Part correlations between tinnitus distress and self-ratings of anxiety, fatigue, or boredom indicated that the association between tinnitus distress and anxiety was strongest in comparison with its associations with fatigue or boredom.

c. Effects of fatigue.

Results show that self-report measures of fatigue increased significantly over time during the experimental task. There were no significant group differences nor period x group interaction effects on this variable. This suggests that both the fatiguing and the control tasks led to increases in this measure and that subjects in both groups rated fatigue similarly.

None of the tinnitus variables was significantly affected by the fatiguing manipulation when effects were considered in a multivariate context. There is a suggestion of tinnitus intensity increasing with increasing fatigue which was not supported statistically, but fatigue seemed to have had no

effect on tinnitus distress and tinnitus pitch (see Figures 5, 6, &7).

It may be important to note in designing treatment programs for tinnitus distress that there were no differential effects on tinnitus variables whether tinniteurs engaged in a more leisurely distraction (reading) or in a more demanding task (number vigilance). It is also noteworthy that, from phase B of doing the required task, both the reading and the number vigilance subjects (in the control and fatigue groups) had almost equivalent values for focus verification during the remainder of the manipulation. A task designed to have a high degree of attentional demand does not detract from focus on tinnitus any more than a task with purportedly less attentional demand.

HR data reflect a significant overall decrease in HR over time with HR significantly higher for the fatigue group than for the control group throughout the manipulation. The reason for this differential effect may be due to the differences in physical activity between the two groups with the number vigilance subjects being more active and the reading subjects more sedentary. If this were so, the significant HR differences for period and period x group interaction may reflect more of an activity level confound than other cognitively-based effects. Berlyne (1960) has suggested that boredom increases autonomic arousal. This has been supported experimentally (e.g. London, Schubert, and Washburn, 1972 who monitored HR). They offer the

explanation that if a task is boring because it is too easy, "continued attention requires... autonomic arousal". An alternative explanation is that HR was higher for the fatigue group because they were more bored by their task compared with the reading group.

Ratings of fatigue from the Tinnitus Diary were found to correlate significantly and positively with ratings of all three tinnitus variables: pitch, intensity, and distress (r=.38, .44, and .47 respectively) from the Tinnitus Diary over all subjects. When intraindividual correlations for these variables were computed, a wide range of correlation became apparent as was the case when anxiety was considered. About 30% of subjects had r's of zero or less. It is clear that ratings of fatigue are correlated highly and positively with the tinnitus variables for some tinniteurs (r=.4 to .8 for the upper quartile). For others, they are associated negatively or not at all (r=.0 to −.7).

The question arises why two such different affect states might affect tinnitus variables similarly. A possible explanation emerges from Russell's circumplex model of affect (Russell, 1980). Because these two affect states have the attribute of unpleasantness in common, it may be this aspect of negative affect that is associated with exacerbation of symptoms (cf. Romano and Turner, 1985). The other dimension of arousal/unarousal which Russell's two-dimensional model of affect proposes, does not account for the similar effect that

anxiety and fatigue have on tinnitus variables because these |MUDLs have quite different arousal levels in the model. Emotions which are rated as more pleasant seem to correspond to less distress and lower ratings of pitch and intensity. Unpleasant emotions are associated with higher levels of these variables. A substantial number of subjects (37%) reported that, in their natural environment, fatigue was associated with exacerbation of tinnitus.

When subjects were asked in open-ended questions on the Tinnitus Questionnaire, prior to participating in the research, to describe which factors were associated with tinnitus bothering them more, two classes of responses were supplied by subjects. One class (distraction/attention) has been described above. Summarized briefly, 40% responded that distracting activity ameliorated tinnitus, and none responded that it was exacerbated by such activity. The second class of responses referred to environmental sound levels and these responses were more idiosyncratic than the first class. Quietness was associated with exacerbation of tinnitus for some subjects (32.3% of responses), but other subjects associated it with assisting in tolerance of tinnitus (14.1%). Similarly, noise was associated with exacerbation of tinnitus (30.9%) but, for other subjects, with an improved tolerance (8.5%). In contrast, "background sounds" was not listed as an exacerbating factor by any subject, where 19.7% of responses indicated that background sounds helped tolerance of tinnitus. Thus the most frequently suggested ameliorating factor was distraction and second most

frequent was background sounds. Subjects were idiosyncratic in expressing their responses to quietness and to noise: for some these were ameliorating factors and for others, exacerbating.

d. Summary of findings.

The attentional focus manipulation was successful and primarily affected tinnitus intensity. When focus was directed towards the tinnitus, its intensity increased, and when focus was directed away from the tinnitus, its intensity decreased. Experimental results thus confirm hypothesis 1 insofar as tinnitus intensity is concerned, not for tinnitus distress. Similarly distraction was found to be associated with a decrease in tinnitus intensity but not in tinnitus distress.

The anxiety manipulation did not lead to a significant increase in self-reported anxiety (although heart-rate was significantly increased during the anxiety manipulation). This experimental manipulation did not cause changes in the tinnitus variables, distress, intensity, and pitch. The third hypothesis could not be adequately tested because of the failure to induce high enough anxiety levels in subjects. Naturalistic reporting supported the fourth hypothesis and yielded a strong positive association between anxiety and tinnitus distress.

The experimental manipulation of fatigue led to significant increases in self-reported fatigue in both the fatigue and control group members but did not bring about significant changes in the tinnitus variables. Hypothesis 5 was therefore

not supported by the laboratory manipulation of fatigue. However, the naturalistic parallel of this found significant positive correlations between fatigue and tinnitus distress, intensity and pitch and supported hypothesis 6.

e. A proposed model of tinnitus distress.

The results of this research together with information from the tinnitus literature indicate the following model to describe factors which are likely to influence the level of distress felt from tinnitus and its etiology.

1. Predisposing factors. Predisposing factors (Evans, 1981) are general factors whose presence is associated with an increased probability of tinnitus occurring but whose absence does not preclude the possibility of tinnitus. Examples are presence of multiple sclerosis, hyperthyroidism, and diabetes (Schleuning, 1981).

2. Causatory factors. These are factors which are unequivocally associated with onset of tinnitus (McFadden, 1982). They include disease processes, physical damage to the ear or head, and ototoxic substances. For the majority of cases, however, the causatory factors are not specifiable.

3. Revealing factors. It is possible for an ear-sound to be present but not defined by the hearer as a symptom. In this case a revealing factor (Evans, 1981) may bring a sound that the patient was unaware of to awareness.

4. Modulating factors. Whereas predisposing, causatory, and revealing factors are all concerned with the presence or absence

of tinnitus or the awareness of its presence, modulating factors influence the level of distress felt from tinnitus: (i) This research indicates that the demographic factor, higher age, is significantly associated with increased distress. (ii) Tinnitus characteristics such as higher perceived tinnitus intensity, increased tinnitus complexity, and short duration since tinnitus onset, have likewise been found in this research to be linked with higher distress levels. (iii) Negative affect states such as fatigue or anxiety which have unpleasantness of affect as an attribute (rather than high or low arousal) have been found to be exacerbating tinnitus distress in this research. Conversely, positive affect states with pleasantness of affect as an attribute, tended to ameliorate distress. (iv) Environmental sound levels seem to be a factor. Subjects indicated that loud environmental sounds tended to be exacerbating, and the presence of background sounds ameliorating of distress. A quiet environment seems to affect tinnitus distress more idiosyncratically. Some tinniteurs associate it with increased distress and other with decreased distress. (v) Cognitive factors seem to play a role in modulating distress. One such factor is attentional focus. This research has found that when attention was focused on the tinnitus sound, its perceived intensity increased; and it was also determined that higher intensity levels were associated with increased distress. Conversely, distraction was related to decreased intensity levels and distress. A second cognitive factor (observed in clinical work but not experimentally investigated) may well be

the nature of the belief system regarding tinnitus held by a tinniteur. Negative beliefs such as "my tinnitus will get louder until I will not be able to hear anything" or " my tinnitus indicates that I have something seriously wrong with my brain" are very likely to be associated with higher distress levels.

An important difference between this proposed model and the habituation model of tolerance for tinnitus (Hallam, Rachman, & Hinchcliffe, 1984) is the varying emphasis on arousal as a component. The habituation model proposes that arousal level is an important variable with respect to the habituation process: low arousal facilitating habituation and high arousal retarding habituation. The present study found some evidence that the pleasantness dimension of affect (rather than the arousal dimension) was important in affecting tinnitus. The effects of arousal on tinnitus need to be investigated more closely before more confident statements can be made about this relationship.

The model proposed in this study stresses the importance of cognitive factors on the course of tinnitus distress. It proposes that revealing factors are a necessary element for the development of tinnitus distress. For some people with ear sounds it is conceivable that they would not be regarded as symptoms i.e. they do not acquire a negative significance. The habituation model does not make this distinction.

The model proposed in this study suggests that the belief system held by tinniteurs about tinnitus, may significantly

affect the course of their distress. Information supplied to tinniteurs to correct inaccurate negative beliefs may facilitate habituation. Although the habituation model alludes to the effects of beliefs and revealing factors, it regards them as secondary factors. The present model regards them as primary.

The two models have a number of components in common: the decrease in tinnitus distress as duration of tinnitus increases; the variability of tinnitus sounds as a factor (the present model proposing more specifically what the elements of tinnitus complexity are); and the role that environmental sound plays.

f. Implications for measurement.

Findings from this research have implications for what measurement is relevant for research in tinnitus distress. Subjective rating of hearing ability does not seem to be a significant factor. Stephens & Hallam (1985) have similarly found that degree of hearing difficulty bore no relationship to measures of psychopathology on the Crown Crisp Experiential Index. Previous research has repeatedly demonstrated that objectively measured tinnitus loudness was uncorrelated with tinnitus distress. Here it has been found that the subjective intensity of the tinnitus sound is a significant factor in determining tinnitus distress. It would be convenient for tinnitus researchers to measure this intensity on a uniform scale and it is suggested that a visual analogue scale of the type used here would be appropriate. Recently Jakes et al.

(1986) found that scores on Guttman-type scales and adjectival scales produced good correlations with loudness match values.

Complexity of the tinnitus sound has not previously been reported as a tinnitus measure in the literature. The zero/one weighting system for absence/presence of each of the four components of tinnitus complexity was utilized in this research. The components were: multiplicity of sounds, substantial intensity fluctuation, substantial pitch fluctuation, and appearance/disappearance of additional sounds (all within an "average" day). This complexity measure proved to be significantly correlated with tinnitus distress. It is therefore recommended that a measure of complexity be considered for appropriateness of inclusion in future research.

Where affect is a relevant variable in tinnitus research, there is some evidence that measurement of affect should be made of both the arousal and pleasantness dimensions as conceived in Russell's two-dimensional model of affect (1980). This research found that the pleasantness of affect (rather than arousal) was the dimension more closely associated with tinnitus distress. The implication is that something might be missed if, for example, in considering the effects of relaxation training on tinnitus distress, only arousal were measured (as is usually the case).

g. Implications for treatment.

Sweetow (1984) has described a cognitive behavioural treatment approach for tinnitus distress modeled after Turk, Meichenbaum, and Genest (1983). Data from this present research indicate the importance of attentional focus as a factor in increasing or decreasing tinnitus distress. It would seem that for more acutely distressing situations, specific techniques of distraction would be helpful. Long duration sleep latency has been improved clinically by imaginative transformation of the tinnitus sound (cf. Turk et al., 1983); for example from the hissing it was heard as, to the sound of air issuing from the air nozzle in an airplane to Hawaii. For some tinniteurs completing crossword puzzles has been described by them as being so absorbing as to result in the absence of awareness of the tinnitus sound. The dramatic effect of the attention/distraction switch can be readily recalled by most tinniteurs. The long-term beneficial effects of the longer duration distractors such as work, hobbies, and social involvement are also to be carefully considered and encouraged in treatment.

The present research has demonstrated the exacerbating effect that anxiety has on tinnitus distress. Hallam & Stephens (1985) found that tinniteurs have a higher anxiety score on the Crown Crisp Experiential Index than the general population. This implies that alleviation of anxiety levels would have beneficial results on tinnitus distress. The benefits of

relaxation training for distress from tinnitus have been documented in an experimental-design study by Scott, Lindberg, Lyttkens, and Melin (1985). Their study, however, combined relaxation training and distraction training and did not attempt a dismantling analysis of these two components. Hallam & Jakes (1985) have reported a case study in which relaxation training decreased tinnitus annoyance but not subjective loudness. Interestingly the anti-anxiety drug, Valium, has not been generally found to help tinniteurs (Goodey, 1981). If this implies that it is not the change in the arousal dimension that is relevant but rather the change in the pleasantness dimension, then this would be in line with present findings. It follows that heuristically, it might be informative to test the effects of anti-depressant medications on tinnitus distress if in fact these work by changing the pleasantness dimension of affect. Analysis of the effects of anti-depressants on the components of affect have not been reported in the literature to date.

The individuality of responses to tinnitus has been evident from analysis of tinnitus diaries. The tinnitus cycles of some tinniteurs showed wide intersubject variability in the range of tinnitus distress ratings. Some showed very little fluctuation and others broad fluctuation of tinnitus distress. The cyclicity of distress also varied: half of the subjects had two cycles of tinnitus distress within a week but others had one cycle or more than two. From a treatment perspective, it would be helpful to be able to specify the factor(s) for an individual tinniteur that is associated with this fluctuation. If this

could be regulated, the tinnitus distress would be able to be better controlled. The individuality of tinnitus patterns over time suggests the clinical importance of tinniteurs keeping tinnitus diaries pre-treatment for at least a week for another reason. This could provide necessary information post-treatment for assessing treatment efficacy.

Avoidance of fatigue should be an important element in a treatment program. Subjects in this study self-monitored fatigue for a week. A significant correlation was found between fatigue and tinnitus distress. This indicates that an improvement in physical fitness, and more sleep in cases of sleep disturbance (which is a common concomitant of tinnitus) would generally improve distress from tinnitus.

The proposed model of tinnitus distress suggests that an important component of a treatment program would be informational. There would be an emphasis on changing inaccurate beliefs about the effects of tinnitus and its course. Hallam & Jakes (1985) have noted the importance of informational aspects of treatment in a case study report.

h. Future research.

This study was conceived as a precursor to a psychological treatment program for tinnitus distress. Although a tentative framework for such a program exists, more basic research is necessary to decide which program elements are efficacious and to refine methods of using these elements clinically.

The absence of reported research regarding the relationship between belief systems of tinniteurs about their symptoms and distress is a significant gap in knowledge of psychological aspects of tinnitus.

There is ongoing research in surgical, drug, and physical treatment modalities for tinnitus. Pain treatment has the advantage of having effective analgesics available for many patients whereas no such medication exists for tinnitus. Both symptoms, however, share the problem of large numbers of distressed sufferers who have no immediate prospect of satisfactory aleviation. It seems that for tinnitus, psychological treatment which aims at decreasing distress rather than erasing the symptom should be an important emphasis in research until safe and effective methods of silencing tinnitus are discovered.

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Appendix A

A pilot study was run to examine how fatigue might be induced experimentally so as to result in increases in self-reported fatigue in subjects. If successful, the method could be used to induce fatigue in tinniteurs in order to assess its effects experimentally.

College undergraduates (who did not suffer from tinnitus) were randomly assigned to an experimental (22 subjects) or a control group (21 subjects). Experimental subjects scanned rows of numbers continuously for 60 minutes. They were required to mark off the target number specified for each row. Measurements were taken before, midway, and at the end of the session by administering the Russell Affect Scale. Control subjects read National Geographic Magazines for 60 minutes and were similarly measured.

The pilot study found that:

1. the increase in self-reported fatigue in the fatigue group was significantly higher than that observed in the control group of subjects. A repeated measures ANCOVA (with initial scores as the covariate) on fatigue as reported on a visual analogue scale found a significant group effect, $F(1,40)=4.84$, $p<.04$.

2. level of concentration (as self-reported on a visual analogue scale) on the experimental task was significantly negatively correlated with level of fatigue, $r=-.53$, $p<.01$.

Appendix B

Screening Form

Subject number..... Name.....

Phone (home).....(work).....

For completion by experimenter. PLEASE CHECK WHERE APPROPRIATE.

A. Tinnitus/hearing:

1. Internal sound or sounds present in ears or head occurring in the absence of external acoustic stimuli

2. The sound(s) are not voluntarily reproducible

3. The sound(s) are heard continuously

4. The sound(s) are not responsive to medical treatment

5. Duration of tinnitus /___/years OR /___/months
The sound(s) have been heard for at least three months

6. Does the subject wear a hearing aid?
no /___/
some of the time /___/
most of the time /___/
all of the time /___/

7. Can the subject understand normal levels of speech in a quiet room without a hearing aid?
no/___/ yes/___/

B. Personal data:

8. Age ....(make a checkmark if 18 to 75 years)

9. Highest grade passed at school?

10. Is the subject currently receiving treatment for a serious psychological disorder? yes/___/ no/___/

If "yes", please supply details (nature of problem, duration of current therapy, etc.) SEE OVER

11. Is the subject willing to participate in this research by spending about 1 1/2 hours with us?

Appendix C

Tinnitus Diary

Subject no.... Sequence no....

DATE.....1985 DAY..... TIME.....am/pm

WAS YOUR TINNITUS PRESENT AT THE ABOVE TIME? (yes or no) .....

AT THE TIME WRITTEN ABOVE please make an "X" somewhere along the line to indicate how you are feeling now and how your tinnitus is.
Please do not write your mark ON the dots. Write it in one of the spaces.

EXAMPLE ___:_X_:___

Tinnitus pitch not at all high ___:___:___:___:___:___:___:___:___ Tinnitus pitch extremely high

Tinnitus extremely loud ___:___:___:___:___:___:___:___:___ Tinnitus not at all loud

Tinnitus not at all distressing ___:___:___:___:___:___:___:___:___ Tinnitus extremely distressing

PLEASE CONTINUE OVERLEAF

Not at all fatigued ___:___:___:___:___:___:___:___:___ Extremely fatigued

Extremely bored ___:___:___:___:___:___:___:___:___ Not at all bored

Not at all anxious ___:___:___:___:___:___:___:___:___ Extremely anxious

NOW PLEASE DETACH THIS FORM AND PLACE IT IN THE ENVELOPE PROVIDED.

THANK YOU.

Appendix D

Russell Affect Scale

Subject number.....Sequence.....

Some of the word pairs below may seem unusual, but you'll probably feel more one way than another. So, for each word pair below, put a checkmark somewhere along the line to indicate how you are feeling now.

Please do NOT write your mark on the DOTS. Write it in one of the SPACES.

EXAMPLE ___:_X_:___

When you have finished, please be sure that there is one check on each line.

Unhappy	___:___:___:___:___:___:___:___:___	Happy
Relaxed	___:___:___:___:___:___:___:___:___	Stimulated
Pleased	___:___:___:___:___:___:___:___:___	Annoyed
Not at all fatigued	___:___:___:___:___:___:___:___:___	Extremely fatigued
Excited	___:___:___:___:___:___:___:___:___	Calm
Dissatisfied	___:___:___:___:___:___:___:___:___	Satisfied
Tinnitus extremely distressing	___:___:___:___:___:___:___:___:___	Tinnitus not at all distressing
Sluggish	___:___:___:___:___:___:___:___:___	Frenzied
Unable to concentrate	___:___:___:___:___:___:___:___:___	Able to concentrate
Contented	___:___:___:___:___:___:___:___:___	Melancholic
Tinnitus pitch not at all high	___:___:___:___:___:___:___:___:___	Tinnitus pitch extremely high
Jittery	___:___:___:___:___:___:___:___:___	Dull
Despairing	___:___:___:___:___:___:___:___:___	Hopeful
Extremely angry	___:___:___:___:___:___:___:___:___	Not at all angry
Sleepy	___:___:___:___:___:___:___:___:___	Wide awake
Tinnitus extremely loud	___:___:___:___:___:___:___:___:___	Tinnitus not at all loud
Relaxed	___:___:___:___:___:___:___:___:___	Bored
Aroused	___:___:___:___:___:___:___:___:___	Unaroused
Not at all anxious	___:___:___:___:___:___:___:___:___	Extremely anxious

Appendix E

Focus Verification (Tinnitus Version)

Subject number.....

Sequence.....

What percentage of time, from when I asked you to begin focussing on your tinnitus, would you estimate that you spent THINKING ABOUT YOUR TINNITUS?

Please make an X somewhere along the line below to indicate this.

Example: ___:_X_:___

PERCENTAGE OF TIME	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Appendix F

Focus Verification (Number Version)

Subject number.....

Sequence.....

What percentage of time, from when I asked you to begin marking off numbers, would you estimate that you spent THINKING ABOUT YOUR TINNITUS?

Please make an X somewhere along the line below to indicate this.

Example: ___:_X_:___

PERCENTAGE OF TIME	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Appendix G

Focus Verification (Reading Version)

Subject number.....

Sequence.....

What percentage of time, from when I asked you to begin reading the magazines, would you estimate that you spent THINKING ABOUT YOUR TINNITUS?

Please make an X somewhere along the line below to indicate this.

Example: ___:_X_:___

PERCENTAGE OF TIME	_____:	_____:	_____:	_____:	_____:	_____:	_____:	_____:	_____:	_____:	_____
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Appendix H

HEARING ABILITY SCALE

Subject number.....

Please answer the following questions the way you usually hear with both ears. If you are using a hearing aid, please answer the way you hear without a hearing aid.

FOR EACH QUESTION CHECK EITHER YES OR NO.

	YES	NO
1. Can you usually hear and understand what a person says without seeing his or her face if he or she whispers to you from across a quiet room?	...	...
2. Can you usually hear and understand what a person says without seeing his or her face if he or she talks in a normal voice to you from across a quiet room?	...	...
3. Can you usually hear and understand what a person says without seeing his or her face if he or she shouts to you from across a quiet room?	...	...
4. Can you usually hear and understand a person if he or she speaks loudly into your better ear?	...	...
5. Can you usually tell the sound of speech from other sounds and noises?	...	...
6. Can you usually tell one kind of noise from another?	...	...
7. Can you hear loud noises?	...	...

Appendix I

Tinnitus Questionnaire

Subject number...

Tinnitus is the sound or sounds that you hear in your ear(s) or head even when there is no sound being made near you.

PLEASE ANSWER THE FOLLOWING QUESTIONS ABOUT YOUR TINNITUS.

1. I have had tinnitus for .....years

.....months

2. My tinnitus bothers me MORE when I am feeling

.. ..

3. My tinnitus bothers me LESS when I am feeling

.. ..

4. My tinnitus bothers me MORE when I am in the following places or situations

.. ..

5. My tinnitus bothers me LESS when I am in the following places or situations

.. ..

Do you USUALLY hear more than one tinnitus sound? (YES or NO) ....

If you do hear more than one sound, please answer the following questions about the MAIN sound you hear. If you

Tinnitus Questionnaire (cont)

hear only ONE sound, please answer the following questions about it.

6. Please make a mark on the following vertical line at a point which you feel describes how HIGH-PITCHED or how LOW-PITCHED your tinnitus sound usually is:

extremely
high-pitched

extremely
low-pitched

7. The closest description that I can give of the main tinnitus sound is that it sounds like

.. ..

Tinnitus Questionnaire (cont)

8. Please make a mark on the following vertical line at a point which you feel describes how LOUD or how SOFT your tinnitus sound usually is:

extremely
loud

extremely
soft

Tinnitus Questionnaire (cont)

9. Please make a mark on the following vertical line at a point which you feel describes how DISTRESSING your tinnitus sound generally is:

extremely
ditressing

not at all
distressing

Tinnitus Questionnaire (cont)

10. My MAIN tinnitus sound seems to be located:
(CHECK ONE)

in my left ear /__/

in my right ear /__/

in both ears but mainly in my left ear /__/

in both ears but mainly in my right ear /__/

in both ears equally /__/

in my head /__/

11. IN AN AVERAGE DAY my tinnitus sound (or sounds)
CHECK WHICHEVER DESCRIPTIONS APPLY TO YOU:

stays fairly constant /__/

fluctuates a lot between loud and soft /__/

fluctuates a lot between high-pitched and low-pitched /__/

has additional sounds starting and stopping /__/

12. From what you know about yourself, give TWO times IN AN AVERAGE DAY when you usually feel LESS FATIGUED than at other times:

1....am/pm

2....am/pm

Now please give two times when you usually feel MORE FATIGUED than at other times:

1....am/pm

2....am/pm

Tinnitus Questionnaire (cont)

13. Which of the following generally seem to cause an INCREASE or a DECREASE in your tinnitus level?
PLEASE WRITE + IN THE FIRST COLUMN OPPOSITE THE WORDS WHICH CAUSE AN INCREASE IN YOUR TINNITUS LEVEL.

WRITE - IN THE SECOND COLUMN OPPOSITE THE WORDS WHICH CAUSE A DECREASE IN YOUR TINNITUS LEVEL.

(+) causes an increase		(-) causes a decrease
/__/	alcohol	/__/
/__/	coffee	/__/
/__/	tea	/__/
/__/	eating	/__/
/__/	feeling relaxed	/__/
/__/	weather changes	/__/
/__/	massage	/__/
/__/	feeling depressed	/__/
/__/	while resting	/__/
/__/	watching TV	/__/
/__/	listening to radio	/__/
/__/	stress/tension	/__/
/__/	bright lights	/__/
/__/	fatigue	/__/
/__/	noisy environment	/__/
/__/	quiet environment	/__/
/__/	while doing a task	/__/
/__/	exercise	/__/

THANK YOU FOR THIS INFORMAT-

Appendix J

PROTOCOL FOR ATTENTION FOCUS GROUP

PREPARATION

1. Assemble forms and write subject number on each.

2. Make sure that the camera and magazines are behind the screen.

3. Seat subject and ask subject to sign consent form ("e" version).
GIVE SUBJECT A COPY.

4. Record starting time from your watch on the Heart-Rate form.

ADAPTATION

5. Attach heart-rate meter to little finger of the subject's non-dominant hand. Explain what it is but DO NOT show reading to subject.
ASK SUBJECT WHETHER HE/SHE CAN UNDERSTAND YOUR SPEECH.

6. Ask subject to sit quietly and relax.
DO NOT TALK TO SUBJECT APART FROM ANSWERING QUESTIONS ABOUT FORMS.

7. Start stop-watch.

8. In the first minute <u>starting at 10 seconds</u> take 6 heart-rate readings at 10 second intervals.

9. Ask subject to complete these forms IN THIS ORDER:
hearing ability scale
tinnitus questionnaire

****** After subject completes each form in this research, PLEASE SCAN EACH FORM AND CHECK THAT IT HAS BEEN FULLY AND CORRECTLY COMPLETED before continuing.******

10. In the 5th minute take 6 heart-rate readings at 10 second intervals, <u>starting at 4 mins and 10 secs.</u>

11. Check time on stop-watch. If < 9 minutes have elapsed, ask subject to sit quietly and after 9 minutes go to step 11.
If > or = 9 minutes, go to step 11.

ATTENTION FOCUS PROTOCOL

12. Take 6 heart-rate readings at 10 second intervals.

13. Then ask subject to complete RAS.

14. Then record time from stop-watch. on the Heart-rate sheet.

15. Reset stop-watch to zero.

MANIPULATION

16. Read the tinnitus focus script SLOWLY AND CLEARLY:

> "I would like you to focus on your tinnitus sound. Try to direct your attention as much as you can to all aspects of the tinnitus sound: what the sound is. whether it seems louder or softer than usual. whether you are hearing it in both ears or in one ear. what the sound reminds you of.
> Please close your eyes now and try to keep your attention focussed on your tinnitus sound for the next few minutes until I ask you to stop.
> PLEASE BEGIN TO FOCUS ON YOUR TINNITUS SOUND NOW."

17. Start stop-watch and, <u>starting at 10 seconds</u>, take 6 heart-rate readings at 10 second intervals.

18. In the 3rd minute take 6 heart-rate readings at 10 second intervals, <u>starting at 2 mins and 10 secs.</u>

19. In the 5th minute take 6 heart-rate readings at 10 second intervals, <u>starting at 4 mins and 10 secs.</u>

20. Stop stop-watch and reset to zero.

REVERSAL

21. Say to subject: "Please open your eyes and stop focussing on your tinnitus. Please complete these forms."

22. Administer Focus Verification ("t" version) and afterwards the RAS.

23. Say to subject: "Please stop focussing on your tinnitus now. Just sit quietly and relax for a few minutes STARTING NOW."

24. Start stop-watch and, <u>starting at 10 seconds</u>, take 6 heart-rate readings at 10 second intervals.

ATTENTION FOCUS PROTOCOL

25. In the 3rd minute take 6 heart-rate readings at 10 second intervals, starting at 2 mins and 10 secs.

26. In the 5th minute take 6 heart-rate readings at 10 second intervals, starting at 4 mins and 10 secs.

27. Then administer first the FV-post and afterwards the RAS.

CONCLUSION

28. Disconnect heart-rate meter.

29. DEBRIEFING. Explain to subject:
"The purpose of what we did during this time was to examine the effect of focussing your attention on your tinnitus. We were trying to find out whether focussing on tinnitus is linked to the way you perceive it."

30. Explain to subject how to keep the Tinnitus Diary:

-Briefly flip through pages to show that each page has a time on it and that there are four times per day.

-Ask subject to enter their ratings of mood and tinnitus at the times stated at the top of each page four times daily. Ask subject to take diary pages with them if they are away from home.

-Stress the importance of doing it at the time stated and not trying to remember at some later time what the tinnitus was like at the time written on diary page.

-Get subject to practice completing BOTH BACK AND FRONT of one sample diary page (supplied by you and not from their home-record set) by actually marking X's on scales.

-Explain that they are to detach each page after completion and insert it in the envelope provided. Ask them to mail the envelope when they have completed the set of forms which will take seven days.

31. Thank subject and ask if there are any questions.

32. RECORD FINISHING TIME FROM YOUR WATCH ON THE HEART-RATE FORM.

Appendix K

PROTOCOL FOR ANXIETY GROUP

PREPARATION

1. Assemble forms and write subject number on each.

2. Make sure that the camera and magazines are behind the screen.

3. Seat subject and ask subject to sign consent form ("e" version).
GIVE SUBJECT A COPY.

4. Record starting time from your watch on the Heart-rate form.

ADAPTATION

5. Attach heart-rate meter to little finger of the subject's non-dominant hand. Explain what it is but DO NOT show reading to subject.
ASK THE SUBJECT WHETHER HE/SHE CAN UNDERSTAND YOUR SPEECH.

6. Ask subject to sit quietly and relax.
DO NOT TALK TO THE SUBJECT APART FROM ANSWERING QUESTIONS ABOUT FORMS.

7. Start stop-watch.

8. In the first minute <u>starting at 10 seconds</u> take 6 heart-rate readings at 10 second intervals.

9. Ask subject to complete these forms IN THIS ORDER:
hearing ability scale
tinnitus questionnaire

****** After subject completes each form in this research, PLEASE SCAN EACH FORM AND CHECK THAT IT HAS BEEN FULLY AND CORRECTLY COMPLETED before continuing.******

10. In the 5th minute take 6 heart-rate readings at 10 second intervals, <u>starting at 4 mins and 10 secs.</u>

11. Check time on stop-watch. If < 9 minutes have elapsed, ask subject to sit quietly and after 9 minutes go to step 11.
If > or = 9 minutes, go to step 11.

ANXIETY GROUP PROTOCOL

12. Take 6 heart-rate readings at 10 second intervals.

13. Then ask subject to complete RAS.

14. Then record time from stop-watch on the Heart-rate sheet.

15. Reset stop-watch to zero.

MANIPULATION

16. Hand out one set of Number Vigilance Sheets to each subject.

17. Ask subject to read top page and to do the practice task ONLY.

18. Check the practice responses to see if they are done correctly, ask for queries, and answer any (but only by repeating instructions on form or given verbally).

19. Say: "Now turn the page and, when I tell you to, start with the numbers on this page. When you have completed that one, please continue with the following pages one after the other."

20. Move the screen to expose the video camera.

21. Say: "When I turn the video camera on, a picture of you will be transmitted to a lab next door where two psychologists will observe you as you mark the numbers off. A video recording will be made and observed later to study your reactions."

22. Say "Begin" and start the stop-watch.

23. <u>Starting at 10 seconds</u>, take 6 heart-rate readings at 10 second intervals.

24. In the 3rd minute take 6 heart-rate readings at 10 second intervals, <u>starting at 2 mins and 10 secs.</u>

25. In the 5th minute take 6 heart-rate readings at 10 second intervals, <u>starting at 4 mins and 10 secs.</u>

26. At the end of the 5th minute say "Stop," stop the stop-watch, and reset to zero.

27. Administer Focus Verification ("n" version) and afterwards the RAS.

REVERSAL

ANXIETY GROUP PROTOCOL

28. DEBRIEFING:
"I would like to explain why I told you that there would be someone watching you over the video. In fact there was no-one there and the camera was not connected to anything. (DRAW BACK CURTAIN TO SHOW THIS). The purpose of telling you that someone would be watching you was to make you a little anxious. We are trying to find out whether anxiety levels are linked to tinnitus in some way and that is why we needed to induce a little anxiety in you.
Any questions?"

29. Say to subject: "Now I'd like you just to sit quietly and relax for a few minutes."

30. Start stop-watch.

31. Beginning at 10 seconds, take 6 heart-rate readings at 10 second intervals.

32. In the 3rd minute take 6 heart-rate readings at 10 second intervals, starting at 2 mins and 10 secs.

33. In the 5th minute take 6 heart-rate readings at 10 second intervals, starting at 4 mins and 10 secs.

34. Then administer first the FV-post and afterwards the RAS.

CONCLUSION

35. Disconnect heart-rate meter.

36. Explain to subject how to keep the Tinnitus Diary:

-Briefly flip through pages to show that each page has a time on it and that there are four times per day.

-Ask subject to enter their ratings of mood and tinnitus at the times stated at the top of each page four times daily. Ask subject to take diary pages with them if they are away from home.

-Stress the importance of doing it at the time stated and not trying to remember at some later time what the tinnitus was like at the time written on diary page.

-Get subject to practice completing BOTH BACK AND FRONT of one sample diary page (supplied by you and not from their home-record set) by actually marking X's on scales.

ANXIETY GROUP PROTOCOL

-Explain that they are to detach each page after completion and insert it in the envelope provided. Ask them to mail the envelope when they have completed the set of forms which will take seven days.

37. Thank subject and ask if there are any questions.

38. RECORD FINISHING TIME FROM YOUR WATCH ON THE HEART-RATE FORM.

Appendix L

PROTOCOL FOR FATIGUE GROUP

PREPARATION

1. Assemble forms and write subject number on each.

2. Make sure that the camera and magazines are behind the screen.

3. Seat subject and ask subject to sign Consent Form ("e" version).
GIVE SUBJECT A COPY.

4. Record starting time from your watch on the Heart-rate form.

ADAPTATION

5. Attach heart-rate meter to little finger of the subject's non-dominant hand. Explain what it is but DO NOT show reading to subject.
ASK THE SUBJECT WHETHER HE/SHE CAN UNDERSTAND YOUR SPEECH.

6. Ask subject to sit quietly and relax.
DO NOT TALK TO SUBJECT APART FROM ANSWERING QUESTIONS ABOUT FORMS.

7. Start stop-watch.

8. In the first minute, <u>starting at 10 seconds</u>, take 6 heart-rate readings at 10 second intervals.

9. Then ask subject to complete these forms IN THIS ORDER:
hearing ability scale
tinnitus questionnaire

****** After subject completes each form in this research, PLEASE SCAN EACH FORM AND CHECK THAT IT HAS BEEN FULLY AND CORRECTLY COMPLETED before continuing.******

10. In the 5th minute take 6 heart-rate readings at 10 second intervals, <u>starting at 4 mins and 10 secs</u>.

11. Check time on stop-watch. If < 9 minutes have elapsed, ask subject to sit quietly and after 9 minutes, go to step 12.
If > or = 9 minutes, go to step 12.

FATIGUE GROUP PROTOCOL

12. Take 6 heart-rate readings at 10 second intervals.

13. Then ask subject to complete RAS.

14. Then record time from stop-watch on Heart-rate form.

15. Reset stop-watch to zero.
MANIPULATION

16. Hand out one set of Number Vigilance Sheets to the subject.

17. Ask subject to read the top page and to do the practice task ONLY.

18. Check the practice responses to see if they are done correctly, ask for queries, and answer any (but only by repeating instructions on form or given verbally).

19. Say: "Now turn the page and, when I tell you to, start with the numbers on this page. When you have completed that one, please continue with the following pages one after the other.

20. Say: "Begin" and start the stop-watch.

21. In the first minute, <u>starting at 10 secs</u>, take 6 heart-rate readings at 10 second intervals.

22. In the 3rd minute take 6 heart-rate readings at 10 second intervals, <u>starting at 2 mins and 10 secs</u>.

23. In the 5th minute take 6 heart-rate readings at 10 second intervals, <u>starting at 4 mins and 10 secs</u>.

24. <u>At the end of the 5th minute</u> say "Stop", stop the stop-watch, and reset to zero.

25. Administer FV-n and afterwards the RAS.

26. Say to subject: "Find the place on the number sheets that you stopped at and, when I tell you to, please start crossing out numbers again."

27. Say "Begin" and start stop-watch.

28. In the 3rd minute take 6 heart-rate readings at 10 second intervals, <u>starting at 2 mins and 10 secs.</u>

29. In the 5th minute take 6 heart-rate readings at 10 second intervals, <u>starting at 4 mins and 10 secs.</u>

FATIGUE GROUP PROTOCOL

30. At the end of the 5th minute say "Stop", stop the stop-watch, and reset to zero.

31. Administer FV-n and afterwards the RAS.

***** INSPECT THE FATIGUE SCALE ON THE RAS. IF FATIGUE RATING HAS INCREASED BY 2 OR MORE UNITS. GO TO STEP 50 ********

32. Say to subject: "Find the place on the number sheets that you stopped at and, when I tell you to, please start crossing out numbers again."

33. Say "Begin" and start stop-watch.

34. In the 7th minute take 6 heart-rate readings at 10 second intervals, starting at 6 mins and 10 secs.

35. In the 15th minute take 6 heart-rate readings at 10 second intervals, starting at 14 mins and 10 secs.

36. At the end of the 15th minute say "Stop", stop the stop-watch, and reset to zero.

37. Administer FV-n and afterwards the RAS.

***** INSPECT THE FATIGUE SCALE ON THE RAS. IF FATIGUE RATING HAS INCREASED BY 2 OR MORE UNITS. GO TO STEP 50 ********

38. Say to subject: "Find the place on the number sheets that you stopped at and, when I tell you to, please start crossing out numbers again."

39. Say "Begin" and start stop-watch.

40. In the 7th minute take 6 heart-rate readings at 10 second intervals, starting at 6 mins and 10 secs.

41. In the 15th minute take 6 heart-rate readings at 10 second intervals, starting at 14 mins and 10 secs.

42. At the end of the 15th minute say "Stop", stop the stop-watch, and reset to zero.

43. Administer FV-n and afterwards the RAS.

***** INSPECT THE FATIGUE SCALE ON THE RAS. IF FATIGUE RATING HAS INCREASED BY 2 OR MORE UNITS. GO TO STEP 50 ********

44. Say to subject: "Find the place on the number sheets that you stopped at and, when I tell you to, please start crossing out numbers again."

FATIGUE GROUP PROTOCOL

45. Say "Begin" and start stop-watch.

46. In the 7th minute take 6 heart-rate readings at 10 second intervals, starting at 6 mins and 10 secs.

47. In the 15rd minute take 6 heart-rate readings at 10 second intervals, starting at 14 mins and 10 secs.

48. At the end of the 15th minute say "Stop", stop the stop-watch, and reset to zero.

49. Administer FV-n and afterwards the RAS.
CONCLUSION

50. Disconnect the heart-rate meter.

51. DEBRIEFING:
Explain to subject "The purpose of what we did during this time with you was to make you mildly fatigued. We were trying to find out whether fatigue levels are linked to tinnitus in some way."

52. Explain to subject how to keep the Tinnitus Diary:

-Briefly flip through pages to show that each page has a time on it and that there are four times per day.

-Ask subject to enter their ratings of mood and tinnitus at the times stated at the top of each page four times daily. Ask subject to take diary pages with them if they are away from home.

-Stress the importance of doing it at the time stated and not trying to remember at some later time what the tinnitus was like at the time written on diary page.

-Get subject to practice completing BOTH BACK AND FRONT of one sample diary page (supplied by you and not from their home-record set) by actually marking X's on scales.

-Explain that they are to detach each page after completion and insert it in the envelope provided. Ask them to mail the envelope when they have completed the set of forms which will take seven days.

53. Thank subject and ask if there are any questions.

54. RECORD FINISHING TIME FROM YOUR WATCH ON THE HEART-RATE FORM.

Appendix M

PROTOCOL FOR CONTROL GROUP

PREPARATION

1. Assemble forms and write subject number on each.

2. Make sure that the camera and magazines are behind the screen.

3. Seat subject and ask subject to sign Consent Form ("c" version). Give subject a copy.

4. Record starting time from your watch on the Heart-rate form.

ADAPTATION

5. Attach heart-rate meter to little finger of the subject's non-dominant hand. Explain what it is but DO NOT show reading to subject.
ASK THE SUBJECT WHETHER HE/SHE CAN UNDERSTAND YOUR SPEECH.

6. Ask subject to sit quietly and relax.
DO NOT TALK TO SUBJECT APART FROM ANSWERING QUESTIONS ABOUT FORMS.

7. Start stop-watch.

8. In the first minute, starting at 10 seconds, take 6 heart-rate readings at 10 second intervals.

9. Then ask subject to complete these forms IN THIS ORDER:
hearing ability scale
tinnitus questionnaire

****** After subject completes each form in this research, PLEASE SCAN EACH FORM AND CHECK THAT IT HAS BEEN FULLY AND CORRECTLY COMPLETED before continuing.******

10. In the 5th minute take 6 heart-rate readings at 10 second intervals, starting at 4 mins and 10 secs.

11. Check time on stop-watch. If < 9 minutes have elapsed, ask subject to sit quietly and after 9 minutes, go to step 12.
If > or = 9 minutes, go to step 12.

12. Take 6 heart-rate readings at 10 second intervals.

CONTROL GOUP PROTOCOL

13. Then ask subject to comolete RAS.

14. Then record time from stop-watch on Heart-rate form.

15. Reset stop-watch to zero.

MANIPULATION

16. Place 15 copies of the National Geographic Magazine in the centre of the table in front of the subject.

17. Hand subject a Reading List.

18. Sav: "In this research we need to see whether just being in this room without doing any of the more complex tasks, has an effect on subjects' tinnitus. This is why we asked you to come today. We need you here just to relax and to complete some simple forms. When I ask you to, please start reading or browsing through these magazines. When you have finished one, write the red number which is on the magazine cover (INDICATE) on your reading list. Then take another magazine of your choice. There will be no questions about what you read, so please just enjoy the magazines. Any questions?"

19. Say: "Begin" and start the stop-watch.

20. In the 1st minute take 6 heart-rate readings at 10 second intervals <u>starting at 10 seconds.</u>

21. In the 3rd minute take 6 heart-rate readings at 10 second intervals <u>starting at 2 minutes and 10 seconds.</u>

22. In the 5th minute take 6 heart-rate readings at 10 second intervals <u>starting at 4 minutes and 10 seconds.</u>

23. At the end of the 5th minute sav "Stop" and stop the stop-watch.

24. Administer Focus Verification ("r" version) and afterwards the RAS.

25. Sav "Now please continue reading" and start the stop-watch.

26. In the 3rd minute take 6 heart-rate readings at 10 second intervals <u>starting at 2 minutes and 10 seconds.</u>

27. In the 5th minute take 6 heart-rate readings at 10 second intervals <u>starting at 4 minutes and 10 seconds.</u>

28. At the end of the 5th minute sav "Stop" and stop the

CONTROL GOUP PROTOCOL

stop-watch.

29. Administer Focus Verification ("r" version) and afterwards the RAS.

30. Sav: "Now please continue reading" and start the stop-watch.

31. In the 7th minute take 6 heart-rate readings at 10 second intervals starting at 6 minutes and 10 seconds.

32. In the 15th minute take 6 heart-rate readings at 10 second intervals starting at 14 minutes and 10 seconds.

33. At the end of the 15th minute sav "Stop" and stop the stop-watch.

34. Administer FV-r and then the RAS.

35. Say: "Now please continue reading" and start the stop-watch.

36. In the 7th minute take 6 heart-rate readings at 10 second intervals starting at 6 minutes and 10 seconds.

37. In the 15th minute take 6 heart-rate readings at 10 second intervals starting at 14 minutes and 10 seconds.

38. At the end of the 15th minute sav "Stop" and stop the stop-watch.

39. Administer FV-r and then the RAS.

40. Say: "Now please continue reading" and start the stop-watch.

41. In the 7th minute take 6 heart-rate readings at 10 second intervals starting at 6 minutes and 10 seconds.

42. In the 15th minute take 6 heart-rate readings at 10 second intervals starting at 14 minutes and 10 seconds.

43. At the end of the 15th minute sav "Stop" and stop the stop-watch.

44. Administer FV-r and then the RAS.

CONCLUSION

45. Disconnect the heart-rate meter.

46. Explain to subject how to keep the Tinnitus Diary:

CONTROL GOUP PROTOCOL

-Briefly flip through pages to show that each page has a time on it and that there are four times per day.

-Ask subject to enter their ratings of mood and tinnitus at the times stated at the top of each page four times daily. Ask subject to take diary pages with them if they are away from home.

-Stress the importance of doing it at the time stated and not trying to remember at some later time what the tinnitus was like at the time written on diary page.

-Get subject to practice completing BOTH BACK AND FRONT of one sample diary page (supplied by you and not from their home-record set) by actually marking X's on scales.

-Explain that they are to detach each page after completion and insert it in the envelope provided. Ask them to mail the envelope when they have completed the set of forms which will take seven days.

47. Thank subject and ask if there are any questions.

48. RECORD FINISHING TIME FROM YOUR WATCH ON THE HEART-RATE FORM.

Appendix N

Reading List

Subject number.....

As you select a magazine to look at, please write on this list the RED LETTERS which are on the cover of the magazine.

1 ___

2 ___

3 ___

4 ___

5 ___

6 ___

7 ___

8 ___

9 ___

10___

11___

12___

13___

14___

15___

16___

17___

18___

19___

20___

Appendix O

Reasons for Respondents Not Participating

a. Failure to meet criteria		30
unwillingness to participate	11	
discontinuous tinnitus	10	
older than 75 years	6	
tinnitus duration <3 months	1	
voluntary control over tinnitus	1	
suffering from severe depression	1	
b. Administrative reasons for non-participation		37
no convenient appointment times	23	
lived out of town	7	
failed to keep appointment	6	
died	1	
Total		67

Appendix F

CONSENT FORM (experimentals)

Subject number .....

I have agreed to participate in the study titled "Psychological Aspects of Tinnitus" being conducted by Les Leader of the U.B.C. Psychology Department. I have been informed of the requirements of my participation in this study, which involves one session lasting between one hour and one and a half hours. The purpose of the study is to find out whether one's mood at a particular time influences one's tinnitus.

I am aware that I will complete several questionnaires about my tinnitus and my mood during the session and that I may be required to do a simple pencil and paper task involving scanning rows of numbers.

I know that all information gathered from me in the course of the study is confidential, and that this confidentality will be protected by numerical coding.

I understand that, if I so wish, I am entitled to make enquiries concerning the procedures to ensure that they are fully understood. If I wish to terminate my participation in the study, I know that I am free to do so at any time and this will in no way affect access to further treatment or services.

I HAVE RECEIVED A COPY OF THIS CONSENT FORM.

I HAVE READ THIS CONSENT FORM AND AGREE TO PARTICIPATE IN THIS STUDY.

Signed:.....Date.....1985

Appendix Q

CONSENT FORM (controls)

Subject number .....

I have agreed to participate in the study titled "Psychological Aspects of Tinnitus" being conducted by Les Leader of the U.B.C. Psychology Department. I have been informed of the requirements of my participation in this study, which involves one session lasting about one and a half hours. The purpose of the study is to find out whether one's mood at a particular time influences one's tinnitus.

I am aware that I will complete several questionnaires about my tinnitus and my mood during the session and that I will be required to read National Geographic magazines.

I know that all information gathered from me in the course of the study is confidential, and that this confidentality will be protected by numerical coding.

I understand that, if I so wish, I am entitled to make enquiries concerning the procedures to ensure that they are fully understood. If I wish to terminate my participation in the study, I know that I am free to do so at any time and this will in no way affect access to further treatment or services.

I HAVE RECEIVED A COPY OF THIS CONSENT FORM.

I HAVE READ THIS CONSENT FORM AND AGREE TO PARTICIPATE IN THIS STUDY.

Signed:.....Date.....1985