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THE PSYCHOPHYSIOLOGICAL RESPONSES OF PTSD PATIENTS: HABITUATION, RESPONSES TO STRESSFUL AND NEUTRAL VIGNETTES AND ASSOCIATION WITH TREATMENT OUTCOME

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Abstract. A number of studies have demonstrated that patients suffering from PTSD show differences from appropriate controls in psychophysiological responding. This study aimed to investigate whether there were differences in habituation and psychophysiological reactivity between PTSD patients and normals, and between patient subgroups depending on their symptoms and whether psychophysiological variables were associated with clinical outcome from a treatment trial. Participants were tested by measuring electrodermal activity to two sets of 15 auditory stimuli of different intensity, and to six vignettes, four neutral, one of general stress and one trauma related. Psychophysiological variables were entered into a

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multiple regression with clinical outcome as the dependent variable. There were no differences between patients and controls or within patients on the habituation paradigms. Patients differed from controls only on their response to the trauma related vignette. There were no differences on any within patient comparisons. There was no association with these measures and later clinical outcome. Psychophysiological differences between PTSD patients and normal controls are very specifically related to trauma related stimuli. Patients with startle or high arousal symptoms do not show differences from those without. These measures were not related to treatment response.

Keywords: PTSD, psychophysiology, electrodermal, habituation, trauma-vignettes.

Introduction

Post-traumatic Stress Disorder (PTSD) is an anxiety disorder that occurs after a traumatic life experience and is frequently characterized by a state of hyper-arousal and exaggerated startle (APA, 1987, 1994). The years since the appearance of PTSD as a diagnostic category have seen the publication of a number of psychophysiological studies that have successfully demonstrated this (Shalev & Rogel-Fuchs, 1993). Such studies have measured various autonomic measures such as heart rate and electrodermal activity, in response to: external stimuli resembling the trauma; internal stimuli, such as mental images; general stressors; and auditory startle. Populations studied include combat veterans (e.g. Pitman, Orr, Forgue, deJong & Claiborn, 1987; Pitman et al., 1990; Orr, Pitman, Lasko, & Herz, 1993; Orr, Lasko, Shalev, & Pitman, 1995; Keane et al., 1998), motor vehicle accident victims (Blanchard, Hickling, Taylor, Loos, & Gerardi, 1994; Blanchard et al., 1996), women survivors of childhood sexual abuse (Metzger et al., 1999; Orr et al., 1998) and mixed trauma victims (Shalev, Orr, Peri, Schreiber, & Pitman, 1992; Shalev, Peri, Orr, Bonne, & Pitman, 1997).

Cognitive and exposure-based behavioural treatments have been demonstrated to be efficacious in the treatment of PTSD, although clinical trials indicate that there is no superiority of one treatment over the other (Marks, Lovell, Noshirvani, Livanou, & Thrasher, 1998; Tarrier et al., 1999a; Tarrier, Sommerfield, Pilgrim, & Humphreys, 1999b). However, not all patients do respond to treatment (Tarrier et al., 1999a) and there is little indication which characteristics of the patient predict good or bad treatment response.

This study aimed to investigate arousal differences, as measured by electrodermal activity, between PTSD patients and normal controls and between patient sub-groups, and whether baseline electrodermal activity was associated with later treatment outcome. Specifically the following hypotheses will be tested. (1) Patients suffering from PTSD would have: slower habituation (i.e. response decrement to repeated stimulus presentation); greater amplitude of response and elevated tonic levels to both orienting and startle stimuli and elevated responses to trauma related vignettes than normal controls. (2) Patients with exaggerated startle symptom would have: slower habituation; greater response amplitude and tonic levels to both orienting and startle stimuli than patients without this symptom. (3) Patients with higher scores on arousal symptoms would have: higher tonic levels during the habituation paradigm and to all vignettes. (4) Because medication might also be predicted to effect psychophysiological responding, patients who were not taking medication would have: slower habituation; greater response amplitude and tonic levels to both orienting and startle stimuli and elevated reactivity to all vignettes compared to those who were taking medication. (5) Lastly, we wished to investigate whether psychophysiological responding at base-

line predicted subsequent response to treatment in a treatment trial. We predicted that those patients with lower levels of arousal and faster habituation would show a better response to cognitive-behavioural treatment.

Method

Design

The design was a cross section comparison between patient and normal controls and between patient sub-groups on psychophysiological responses, and a longitudinal study of the association between baseline psychophysiological responses and clinical outcome at 12 months post-treatment in a clinical trial.

Sample and recruitment

Suitable patients were referred from primary and secondary health services and voluntary series in the north west region of Britain. These patients took part in a randomized-controlled trial (see Tarrier et al., 1999a,b for details) if they fulfilled the following entry criteria: a DSM IV diagnosis of PTSD using the Clinician Administered PTSD Scale (CAPS, Blake et al., 1990); duration of PTSD symptoms for more than 6 months and less than 10 years; if receiving psychotropic medication then this had to have been constant for 3 months prior to entry onto the project; not receiving any concurrent psychological intervention and not have received any type of cognitive behavioural treatment in the 6 months preceding their entry into the project; childhood sexual abuse was not the index trauma; not suffering from any organic brain illness or psychotic illness; the primary disorder was not alcohol or substance abuse: and they remained a PTSD case after a 4-week symptom self-monitoring period (Tarrier et al., 1999c).

Patients were randomly allocated to either 16 hourly sessions of imaginal exposure or cognitive therapy. Patients were re-assessed blind to treatment allocation and psychophysiological recordings at post-treatment and 6 and 12 month follow-up.

Twenty-three participants[1] who had no history of a psychiatric disorder and were not taking any medication were recruited to act as a normal control group. The recruitment of the control group involved the patients asking, where possible, a friend of approximately the same age and gender to accompany them to one of their weekly monitoring sessions. This method of recruitment attempted to increase comparability on demographic characteristics of the control group. It was explained that the friend would then complete the psychophysiological assessment as one of the control group. The patient was informed of the purpose of this, and both the patient and the control had to agree to the assessment taking place. The patient's recruitment of the control was not always possible.

Psychophysiological testing

At recruitment, which took place during the baseline monitoring period, patients were asked to participate in the psychophysiology assessment. Those who gave permission were asked

[1] Severe water damage to the equipment from a leaking roof curtailed the use of the equipment and further recruitment of control systems.

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to complete the psychophysiology assessment following one of their weekly monitoring sessions; thus all psychophysiology assessments were carried out prior to treatment allocation. However, not all patients completed every aspect of the psychophysiological test, although every attempt was made to obtain as many data as were possible (see Tables for exact numbers). Controls were recruited and participated in the psychophysiology assessment throughout the duration of the project.

Measure. Electrodermal activity was chosen as the psychophysiological dependent variable because it is associated with activity in the sympathetic nervous system, which is a component of the autonomic nervous system. The sympathetic nervous system has the function of energizing the body in time of crisis or emergency. Changes in electrodermal activity are also involved in responses to changes in the environment that may be trivial or threatening (Hassett, 1978). Thus electrodermal activity is thought to be representative of levels of physiological arousal and is a convenient, reliable and objective measure of an individual's response to novel or significant stimuli (Lader, 1975). Changes in cardiac activity are also frequently used in psychophysiological studies. Heart rate measures were not used in this study because of the complex relationship between cardiac responses and other measures of arousal and because of bi-directional changes in response to some stimuli (Siddle & Turpin, 1980). Previous research in the laboratory found that electrodermal measures were more responsive to stimulus events than heart rate (Connell, 1996). For a detailed account of the measurement of electrodermal activity see Venables and Christie (1980). Changes in tonic levels of electrodermal activity such as the skin conductance level and the frequency of non-specific responses represent relatively long-term changes (Hassett, 1978; Lader, 1975), although these two measures are only modestly correlated (Venables & Christie, 1980), whereas, phasic measures, such as the skin conductance response, represent transient responses to specific stimuli.

Procedure. The psychophysiology assessment took place individually in a temperature controlled soundproof room and generally followed the procedure used previously in this laboratory (e.g. Ashcroft, Guimaraes, Wang, & Deakin, 1991; Connell, 1996; Guimaraes, Hellewel, Hensman, Wang, & Deakin, 1991). The assessment procedure was explained and it was made clear to the participants that they could withdraw from the assessment at any time without prejudice. Once the participants had familiarized themselves with the testing situation the procedure was commenced. Participants were presented with audio-taped instructions and stimulus material through headphones. Two experimental paradigms were used: a habituation paradigm and a vignette paradigm.

The habituation paradigm consisted of two trials of presentations of 15 sets of tones. One set was of a low intensity tone and designed to elicit an orienting response from the subject. This is a response that is elicited to a change in the environment and is characterized by a range of physiological and behavioural changes, including electrodermal activity. The higher intensity stimuli were designed to elicit a startle reaction, which is a more dramatic reaction to a potentially threatening stimulus. This reaction also consists of physiological and behavioural changes including elevation in electrodermal activity. Repeated presentations of both these sets of stimuli would be expected to result in habituation or decrement in measurable responses.

The order of presentation was of one habituation set followed by the six vignette trials, followed by the second habituation trial. The order of the habituation sets was counterbal-

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anced. Each trial consisted of a one-minute rest period followed by the stimulus presentation and then a three-minute recovery period. Electrodermal activity was measured using equipment supplied by Contact Precision Instruments, which measured skin conductance using a computer-controlled constant voltage (0.6 V) with automatic back off. Beckman silver/silver chloride electrodes were applied to the middle phalanges of the first two fingers of the left hand with adhesive rings that exposed 1 cm diameter of skin to the conducting medium (KY jelly). See Guimaraes et al. (1991) for more details of the laboratory procedure.

Habituation paradigm. Each person was presented with two sets of 15 computer generated tones of 1000 Hz and 500 ms duration, one of 70 dB to elicit orienting responses and one at 95 dB to elicit startle responses. The order of the set of tones was counterbalanced. The inter-stimulus interval was between 45 and 75 seconds pseudo-randomized with a mean duration of 60 seconds. The rise and decay time of the tone was 50 msec. For each habituation set the following were recorded: the skin conductance response to each tone (SCRs) and its amplitude, the number of non-specific responses (NS-SCRs) and skin conductance level (SCL) during the time period. A response being defined as an increase of 0.02 micromhos occurring within 10 seconds of the tone offset. A 10-second window had previously been shown to be appropriate for measuring SCRs (Guimaraes et al., 1991; Connell, 1996). For both orienting and startle sets of tones habituation was calculated in a number of different ways: regression coefficients and intercepts for the amplitudes of the SCR to each of the 15 tones; the number of responses until habituation (defined as 3 consecutive non-responses); and the percentage of participants not showing habituation. The amplitude of SCRs, the level of SCL and frequency of NS-SCR were also compared between groups.

Vignette paradigm. Six short pre-recorded vignettes were presented. As well as including a vignette of specific traumas other vignettes included neutral, positive and other potentially stressful situations to act as controls. The latter included a situation that would be potentially life threatening and one that would involve social embarrassment or censure. Different situations were used so as to ascertain whether the patient group was generally more reactive or whether the subjects were reactive solely to the trauma related vignette. The scripts were prepared in the second person and each vignette included a script presentation of two minutes recorded by a female research assistant, preceded by a one minute rest period and followed by a three minute recovery period. The vignette session commenced with a short introduction of taped instructions explaining the procedure. The instructions were as follows:

> During this session you are going to hear a series of short stories. During each story, I would like you to imagine that you are in the situation being described. You can do this by trying to picture each situation in your mind while listening. There will be a short break between each story, please do not get up or move any of the equipment during this time, just relax and wait for the next story. This session will take about 30 minutes in all. Please try to finish the session, if possible. If you wish to stop, please ask the experimenter.

The vignettes[2] were as follows:

Vignette 1 – Neutral: described a scene looking out of a window at a quiet street.

[2] Detailed descriptions of each vignette have been submitted with this paper and are also available from the first author.

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Vignette 2 – Standard Trauma: described a passenger travelling on a aeroplane that appeared to be about to crash.
Vignette 3 – Neutral/Positive: described a pleasant walk in a beautiful garden.
Vignette 4 – Specific Trauma: For the patients completing the psychophysiology the specific trauma vignette was similar to their particular trauma, that is the same type of trauma but not actually what they experienced. A rape vignette was given to the female controls and a violent assault vignette was given to the male controls as their specific vignette.
Vignette 5 – Positive: described wining £5000 in a competition.
Vignette 6 – Socially Embarrassing: described suddenly vomiting during a bus journey in front of other passengers.

The non-trauma stories were vignettes one, three, five and six, presented in this order to each person. Stories two and four were either the air crash (standard trauma) or the specific trauma vignette; the order of these two stories was counterbalanced. For the vignettes only NS-SCRs and SCL were measured, as there was no specific event linked response.

Clinical assessment

The complete assessment battery is described in Tarrier et al. (1999a). For the purposes of this report the primary outcome measure was PTSD symptomatology as measured on the Clinician Administered PTSD Scale (CAPS, Blake et al., 1990). From this measure a total severity score was computed by adding the severity and frequency score for each symptom; similar scores were computed for each symptom category (intrusions, avoidance and arousal). This measure also allowed the patient group to be divided into sub-groups: i) those who had the symptom of an exaggerated startle response and those who did not; ii) those who had high and low scores (a median split) on arousal symptoms (category D as defined in DSM IIIR in which *physiologic reactivity upon exposure to events that symbolize or resemble the trauma* is included as an arousal symptom). Patients were also divided into subgroups on the basis of whether or not they were taking psychotropic medication.

Results

Sample

One hundred and ninety-three patients were referred to the PTSD project. Following initial screening and assessment, 72 met the study criteria and were randomized into treatment, 62 were available for post-treatment and 54 for 12 month follow-up assessments. Fifty-four patients who were recruited and 42 who completed treatment underwent psychophysiology testing. This represented 60% and 68% of the available sample respectively. The characteristics of the total sample ($n = 54$) were as follows: 30 (56%) were male; their mean age was 36.65 (13.12) years; their mean age for completion of full-time education was 16.75 (3.39) years; 32 (59%) were married; 18 (33%) were taking medication; and 40 (74%) were involved in an ongoing compensation claim. They were involved in differing traumatic events: 24 (44%) were the victims of crime, 24 (44%) had been involved in accidents and 6 (11%) in some other traumatic incident. In 43 (80%) cases the trauma had lasted for less than 1 hour, 37 (68%) had been experiencing their symptoms for 12 months or more, and 3 (6%) had experienced a delay to the onset of their PTSD symptoms. Of the 42 therapy

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patients completing treatment and undergoing the psychophysiology: 23 (55%) were male, their mean age was 37.05 (*SD* 12.64) years, their mean age for completion of full-time education was 16.88 (*SD* 3.66) years, 24 (57%) were married, 15 (36%) were taking psychotropic medication, 31 (74%) were involved in a compensation claim. The 42 therapy patients were involved in differing traumatic events: 20 (48%) were the victims of crime, 17 (41%) had been involved in accidents and 5 (12%) in some other traumatic incident, for 33 (79%) the trauma had lasted for less than 1 hour, 28 (67%) had been experiencing their symptoms for 12 months or more, 2 (5%) had experienced a delay to the onset of their PTSD symptoms. Of the 22 control participants: 17 (74%) were female with a mean age of 34.13 (13.03) years.

Statistical analysis

Electrodermal data were log transformed as recommended by Venables and Christie (1980), and analysed with parametric statistics using SPSS version 7.0. Data from 54 patients are included in the cross-sectional analysis and from the 42 treatment completers in the prediction of treatment outcome multiple regression. Independent *t*-tests were used for pairwise comparisons. Comparisons were decided upon on an a priori basis and were: patients (n = 54) versus controls (n = 23), and the following within patients comparisons: patients with startle (n = 33) versus those without (n = 19); patients with high arousal (n = 29) versus those with low arousal (n = 25); and patients taking psychotropic medication (n = 18) versus those medication free (n = 36). Multiple regression analysis was carried out entering the data for the 42 patients who completed treatment.

Habituation paradigms

There were no significant differences in any comparisons between patients and controls or within patient sub-group comparisons (those with exaggerated startle and those without, those with higher arousal scores and those with low scores, and those taking medication and those medication free) on either the orienting or startle set of tones. These data are presented in Table 1, 2a and 2b.

Vignette paradigms

Comparisons were made between patients and controls on each vignette, and these data are presented in Table 3. There were no significant differences on the non-trauma (V1, V3, V5 & V6) and general trauma vignettes (V2). However, there was a significant difference between patients and controls on the specific trauma vignette (V4) with patients showing a greater frequency of NS-SCRs (t = –2.01, df = 72, p = .05). Comparisons between patient and controls were further made by creating a new variable by subtracting the mean score of the non-trauma vignettes from that for the specific trauma. Patients had significantly higher scores for the difference between specific trauma and non-trauma vignettes on the frequency of NS-SCRs (equal variances not assumed) (t = –3.45, df = 65.39, p = .001). There were no significant differences or trends within the patient sub-group comparisons (those with exaggerated startle and those without, those with higher arousal scores and those with low scores, and those taking medication and those medication free).

Table 1. Means and standard deviations and regression coefficients for patients and controls for tone measurements: Habituation and startle paradigms

		Tone measurement				
Group	*n*	SCL (mmhos)	Coeff.	SCR (mmhos)	Coeff.	NS-SCR
			Habituation paradigm – 70 dB			
Total patient group	54	6.33[c]	–.00064	0.41[c]	–.0023	2.92[d]
		(6.27)		(0.50)		(2.34)
Treated patients	42	6.66[g]	–.00089	0.45[g]	–.0032	2.97[h]
		(6.84)		(0.54)		(2.31)
Control group	23	6.10	–.0036	0.32	–.0060	2.12
		(5.91)		(0.42)		(2.25)
			Startle paradigm – 95 dB			
Total patient group	54	5.92[a]	0	0.44[a]	–.0067	2.59
		(5.27)		(0.56)		(1.99)
Treated patients	42	5.69[e]	0	0.40[e]	–.0070	2.49[f]
		(4.86)		(0.46)		(1.67)
Control group	23	6.48	–.0013	0.39	–.011	2.67
		(5.98)		(0.55)		(2.04)

Notes:
[a]$n = 53$ [b]$n = 52$ [c]$n = 49$ [d]$n = 48$ [e]$n = 41$ [f]$n = 40$ [g]$n = 37$ [h]$n = 36$

Table 2a. Means and standard deviations for patient sub-groups for tone measurements: Habituation and startle paradigms

		Tone measurement				
Group	*n*	SCL (mmhos)	Coeff.	SCR (mmhos)	Coeff.	NS-SCR
			Habituation paradigm – 70 dB			
Startle	35	5.68[a]	0	0.36[a]	–.0015	3.03[b]
		(4.47)		(0.39)		(2.38)
Non-startle	19	7.80[k]	–.0031	0.50[k]	–.0039	2.68[k]
		(9.20)		(0.70)		(2.32)
High arousal	29	6.37[d]	–.0011	0.42[d]	–.0023	2.35[d]
		(6.77)		(0.57)		(2.38)
Low arousal	25	6.28[g]	–.00013	0.39[g]	–.0023	3.00[h]
		(5.76)		(0.42)		(2.41)
Medication	18	5.43[j]	0	0.31[j]	–.0015	2.87[j]
		(4.91)		(0.40)		(2.72)
No medication	35	6.76[b]	.0017	0.45[b]	–.0026	2.94[c]
		(6.37)		(0.55)		(2.18)

Notes:
[a]$n = 34$ [b]$n = 33$ [c]$n = 32$ [d]$n = 27$ [e]$n = 24$ [f]$n = 23$ [g]$n = 32$ [h]$n = 21$ [i]$n = 18$ [j]$n = 16$
[k]$n = 15$

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Table 2b. Means and standard deviations for patient sub-groups for tone measurements: Habituation and startle paradigms

		Tone measurement				
Group	*n*	SCL (mmhos)	Coeff.	SCR (mmhos)	Coeff.	NS-SCR
				Startle paradigm – 95 dB		
Startle	35	5.84	–.00035	0.52	–.0063	2.78[a]
		(5.18)		(0.61)		(2.00)
Non-startle	19	6.04[i]	0	0.28[i]	–.0074	2.25[i]
		(5.58)		(0.41)		(1.89)
High arousal	29	6.16	0	0.53	–.0083	2.75
		(5.46)		(0.63)		(2.13)
Low arousal	25	5.64[e]	0	0.33[e]	–.0047	2.39[f]
		(5.12)		(0.43)		(1.82)
Medication	18	5.68	–.0011	0.53	–.0070	2.30
		(6.14)		(0.74)		(2.13)
No medication	35	6.05	0	0.40	–.0066	2.75[a]
		(4.85)		(0.44)		(1.92)

Notes:
[a]$n = 34$ [b]$n = 33$ [c]$n = 32$ [d]$n = 27$ [e]$n = 24$ [f]$n = 23$ [g]$n = 22$ [h]$n = 21$ [i]$n = 18$ [j]$n = 16$ [k]$n = 15$

Association of baseline physiological measures with clinical outcome

Stepwise multiple regression analyses with the post-treatment and follow-up total CAPs scores as dependent variables and the psychophysiological measures as independent variables were carried out. Other demographic and clinical variables were also used as independent variables. A number of models were investigated but no psychophysiological variables were significant or entered the model. Thus there is no evidence that psychophysiological measures make an independent and significant contribution to outcome variance after treatment.

Discussion

This study investigated the electrodermal reactivity of a diverse group of PTSD patients who had experienced a range of traumas. There was no evidence of any differences between patients and normal controls on the habituation paradigms with either high or low intensity of stimuli. PTSD patients did have significantly higher electrodermal reactivity to the specific trauma vignette than control subjects. This was partial support for hypothesis 1 in that PTSD patients demonstrated psychophysiological reactivity, in terms of a greater frequency of NS-SCRs, to stimuli that directly resembled their traumatic experience, independent of the type of trauma. This is consistent with previous literature on patients showing significant greater reactivity to the presentation of trauma-related vignettes. This result held when the results were adjusted to account for the level of responding to non-trauma vignettes. But PTSD patients did not show greater psychophysiological reactivity to other stimuli, even ones that might be considered stressful, or in general tonic levels of electrodermal activity.

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Table 3. Means and standard deviations for patients (total group and treated group) controls for vignettes

Group	*n*	Measurement	
		SCL (mmhos)	NS-SCR
		Vignette 1 – Control	
Patient	54	6.25 (5.46)[a]	5.35 (3.55)[a]
Treatment	42	6.26 (5.51)[d]	3.49 (3.02)[d]
Control	23	6.66 (6.08)[g]	3.36 (2.63)[g]
		Vignette 2 – General trauma	
Patient	54	5.96 (5.71)[a]	3.75 (3.44)[a]
Treatment	42	6.25 (6.07)[d]	4.07 (3.66)[d]
Control	23	6.60 (6.13)[g]	2.77 (2.62)[g]
		Vignette 3 – Control	
Patient	54	5.97 (5.53)[a]	2.15 (2.54)[a]
Treatment	42	6.27 (5.84)[d]	2.24 (2.46)[d]
Control	23	6.05 (5.90)[g]	2.05 (2.01)[g]
		Vignette 4 – Specific trauma	
Patient	54	6.27 (5.52)[b]	4.65 (4.15)[b]
Treatment	42	6.31 (5.61)[e]	4.43 (3.53)[e]
Control	23	6.10 (5.80)[g]	2.73 (2.62)[g]
		Vignette 5 – Control	
Patient	54	6.03 (5.91)[c]	3.00 (2.63)[c]
Treatment	42	6.37 (6.28)[f]	2.95 (2.38)[f]
Control	23	6.41 (5.83)[g]	3.00 (2.53)[g]
		Vignette 6 – Control	
Patient	54	6.01 (6.45)[c]	2.69 (2.78)[c]
Treatment	42	6.37 (6.97)[f]	2.74 (2.79)[f]
Control	23	6.74 (6.55)[h]	3.16 (3.25)[h]

Notes:
[a]$n = 53$ [b]$n = 52$ [c]$n = 51$ [d]$n = 41$ [e]$n = 40$ [f]$n = 39$ [g]$n = 22$ [h]$n = 19$

There was no support for hypotheses 2, 3 and 4 in that the patient sub-groups of those with exaggerated startle, higher levels of arousal symptoms and those medication free did not differ from their counterparts. Lastly, there was no support for hypothesis 5 that predicted that treatment outcome would be associated with psychophysiological responding.

It is perhaps surprising that there appears to be no consistency between patients' self-report of symptoms and psychophysiological results. Patients reporting the presence of a startle response and/or high levels of arousal symptoms would be expected to demonstrate this in their level of electrodermal activity. Electrodermal arousal is often associated with

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increase in sympathetic nervous activity (Lader & Montagu, 1962) the basic function of which ''is the mobilization of the body to meet an emergency'' (Hassett, 1978, p. 12). There are consistent findings in the literature that anxious patients show greater SCR amplitude, more frequent NS-SCRs and higher SCL and there is often, although not always, slower habituation of SCRs (Lader, 1975; Ashcroft et al., 1991). It would seem reasonable to assume that PTSD patients, consistent with anxious patients in general, would be more likely to have over-activity in the sympathetic nervous system than normal controls, and that those who report greater levels of arousal symptoms would have greater sympathetic activity than those who do not. These hypotheses were not supported. However, this lack of consistency between subjective report and psychophysiological recordings, or response discordance, has been often reported in the literature on anxiety patients (e.g. Haynes, Falkin, & Sexton-Radek, 1989, p. 196). Examination of group means and standard deviations in Tables 1 and 2 would suggest that an absence of group differences was not due to a lack of power and Type II error.

In this study there were no differences between patients and normals in the habituation of either orienting (70 dB) or startle (95 dB) paradigms. It was predicted that habituation in both these paradigms would be impaired in the patient group compared to the normal controls, as there would be a putative sensitivity in PTSD patients to external stimuli and in high intensity stimuli in particular. We also predicted this impaired habituation to be more likely in patients who reported elevated startle compared to those who did not. This was not evidenced by the results. It is possible that the 10 second window we used to identify stimulus-linked responses was too long and that group differences in SCRs was masked by coincidentally occurring NS-SCRs within this time frame. Another possibility is that the number of subjects was just too low to demonstrate clear group differences.

The startle reflex can be measured through a number of parameters, the magnitude of muscular eye blink, increased cardiac acceleration and increased electrodermal conductivity (Turpin, 1968). We utilized electrodermal activity as the dependent measure as changes in this measure are described as similar in both orienting and startle reactions, whereas cardiac measures may show some differences depending on intensity of the stimulus (Hassett, 1978, p. 45). The sole reliance on electrodermal measures, however, may be a limitation of our study as this measure could be less sensitive to group differences. This may explain our negative findings in terms of habituation and patient sub-groups.

However, the literature is not consistent on findings of startle response within PTSD patients. A failure of some reports to demonstrate startle in chronic patients (e.g. Grillon, Morgan, Southwick, Davis, & Charney, 1996) led Morgan, Grillon, Lubin and Southwick (1997) to conclude that exaggerated startle may represent a trauma induced sensitization response that dissipates with time even when PTSD symptoms persist. Shalev et al. (2000) provided evidence from subjects, who had experienced a range of traumas and participated in a prospective study, that all subjects demonstrated startle one week after the trauma but only those who went on to be diagnosed as suffering from PTSD showed this at one and four months. They interpreted their results as indicating that PTSD was associated with progressive neuronal sensitization. Other studies have reported heightened startle in Vietnam veterans suffering chronic PTSD (Butler et al., 1990; Morgan, Grillon, Southwick, Davis, & Charney, 1995; Orr et al., 1995). The current study recruited patients with at least 6 months since the time of the trauma and 67% had at least 12 months, thus this group consisted of chronic PTSD patients and it is possible that the physiological aspects of the startle response

had dissipated in these patients. Further support for this may be the fact that patients with startle did not differ from those without this symptom.

Keane et al. (1998) reported that psychophysiological responding to trauma-related vignettes was able to correctly classify approximately two-thirds of current PTSD cases in Vietnam veterans. However, this classification rate suggests some overlap in responding across cases and non-cases. They also reported that participants who did not react psychophysiologically reported less re-experiencing symptoms, depression and guilt at follow-up. Blanchard et al. (1996) reported that in victims of road traffic accidents, although there was a general diminution to responding to vignettes at one year follow-up, the initial level of responding was associated with clinical status at follow-up. To our knowledge our study is the first to investigate whether baseline psychophysiological responding was associated with later response to treatment. However, we were unable to reveal any such association.

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