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ATTENTIONAL CONTROL OF PAIN PERCEPTION: THE ROLE OF HYPOCHONDRIASIS

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Abstract—The role of hypochondriasis in the attentional control of pain perception was investigated in 28 in-patients (12 women and 16 men) at a hospital for psychosomatic disorders, who had been classified into high- and low-hypochondriacal categories by means of the Illness Attitude Scales (IAS). The two groups did not differ in their basic pain sensitivity based on their heat pain thresholds. Attentional control was manipulated by a mental arithmetic task, resulting in one experimental condition with distraction and one without distraction. In both of the conditions, subjects rated the intensity and the unpleasantness of nonpainful and painful heat stimuli on visual analog scales (VAS). Distraction significantly reduced the perceived intensity and unpleasantness of the stimuli at painful levels but not at nonpainful levels. Contrary to our expectation, the individual level of hypochondriasis did not influence this result. Although distraction seemed to have a strong influence on pain perception, hypochondriasis as a symptom or a trait did not contribute to this effect. © 1998 Elsevier Science Inc.

Keywords: Pain perception, Attention, Hypochondriasis, Psychosomatic disorders, Illness Attitude Scales

INTRODUCTION

The influence of attention on pain experience has been established in the pain literature, and training in attentional pain control has become a component of many psychological pain therapies [1, 2].

There have been numerous attempts to elucidate the mechanisms by which attention alters pain perception and to find the best technique for pain reduction [3]. The findings suggest that there are multiple cognitive techniques (e.g., focusing on body parts not in pain, expecting other [nonpainful] stimuli, remembering pleasant events, engaging in numerical tasks, thinking about a lecture), which seem to be of similar effectiveness, on average, but can produce different effects in certain situations and populations [4–9].

There are probably many reasons why these cognitive techniques have appeared efficient in some cases and inefficient in others [10]. Little attention has been paid

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to individual differences, although they have been demonstrated to be important factors in other forms of psychological pain control (e.g., in hypnosis [11]). Therefore, McCaul and Malott [3] encouraged research on individual differences in attentional pain control.

A psychological condition that appears relevant in this context is hypochondriasis, because one of its main characteristics is a heightened awareness and preoccupation with bodily symptoms [12, 13]. If this characteristic is considered a stable perceptual habit, it seems likely that attempts by hypochondriacs to displace pain from consciousness by attentional strategies fail. Consequently, hypochondriacal individuals should rarely be successful in attentional control of pain perception.

Experimental attempts to verify this assumption have been infrequent and only partially successful. Individuals low and high in "private body consciousness," a perceptual orientation toward somatic events and processes, did not differ in their ability to reduce pain responsiveness or to alter pain experience by various attentional strategies [14, 15]. Furthermore, high-hypochondriacal individuals did not appear to be more attentionally absorbed by the anticipation of pain than low-hypochondriacal subjects. Instead, the former performed worse on a distraction task than the latter, no matter whether pain was anticipated or not [16].

One reason for these equivocal findings may be related to the use of subjects with nonclinical levels of hypochondriasis in these studies. Significant levels of bodily preoccupation in hypochondriasis are more often seen in clinical cases involving psychiatric and psychosomatic patients. Because strong attentional absorption by pain and an inability to control it by distraction may be more likely to arise among these patients, a group of psychosomatic patients was scheduled for investigation. Hypochondriacal symptoms are very common among these patients although the full syndrome is infrequent even in these cases.

Other reasons for the disappointing results in earlier studies might be an actual lack of association between hypochondriasis and attentional pain control or a very complex relationship between the two variables. It seems reasonable to assume that an individual suffering from heightened awareness and preoccupation with bodily symptoms cannot be distracted from pain. However, hypochondriacal and nonhypochondriacal individuals might differ in another way in the mode of processing of potentially aversive signals, such as pain stimuli. It is generally accepted that there are tasks that require controlled attention (serial processing), which take much attentional capacity, and others that require only automatic attention (parallel processing), which take little attentional capacity [17]. With respect to bodily discomfort like pain, it is appealing to assume that hypochondriacs use the controlled (serial) mode and spend much of their attentional capacity in processing pain whereas nonhypochondriacs rely upon the automatic (parallel) mode. If this is the case, distraction, which diverts attentional capacity to the processing of "irrelevant" stimuli, might be highly effective in influencing (possibly even reducing) pain perception in hypochondriacs but not in nonhypochondriacs.

To test these two theoretical alternatives, the perception of nonpainful and painful contact heat stimuli was investigated in low- and high-hypochondriacal subjects under conditions of distraction and of no distraction. To control for *a priori* differences in pain sensitivity, heat pain thresholds were assessed in the groups of subjects before the experimental manipulations.

METHOD

Subjects

Twenty-eight in-patients at a hospital for psychosomatic diseases (Windach), 12 women and 16 men, took part in the study. The age range was 25–63 years with a mean age of 44.1 years (SD=9.1). Six patients suffered from anxiety disorder, two from mood disorder, nine from somatoform disorders, one from eating disorder, five from migraine, two from tension-type headache, and three from combination headache. The patients belong to all social classes and were financially supported by public or private health insurance programs. The hospital specializes in the treatment of neurotic and psychosomatic patients by behavior therapy with an emphasis on self-management and, in some cases, by psychopharmacological medication. Physicians and psychologists of two wards were asked to inform their patients about the study. Patients who were interested in participating were provided further information about the study by the investigator.

The Illness Attitude Scales (IAS [18]) were used to assess abnormal illness behavior and hypochondriasis. The IAS are widely used measures [19–21], which have been shown to reliably differentiate between patients with DSM-III-diagnosed hypochondriasis and various other groups including normal controls, other psychiatric patients, and general medical out-patients [22]. The IAS consist of nine subscales. According to Kellner and coworkers [18, 22], most of the hypochondriacal patients can be identified by means of two scales, the Disease Phobia Scale and the Hypochondriacal Belief Scale. Therefore, a sum score of these two scales was calculated according to a procedure adopted from Pauli et al. [16], and the patients with a score of 3 or less were considered low-hypochondriacal subjects whereas the patients with a score of 4 and higher were considered high-hypochondriacal subjects. Because the mean sum score of students is below 2 [21] and the mean sum scores of various groups of patients with the exception of hypochondriacal ones are below 4 [22], our cutoff criteria appeared appropriate to identify low- and high-hypochondriacal subjects.

The low-hypochondriacal subjects (six women and six men) had a mean sum score for the two scales of 1.08 (SD=1.3) and a mean age of 43.3 (SD=9.3). The high-hypochondriacal subjects (6 women and 10 men) had a mean sum score of 7.1 (SD=2.1) and a mean age of 44.7 (SD=9.1). The two groups did not differ significantly with respect to gender and age. Eight subjects in the low- and five in the high-hypochondriasis group suffered from pain disorders. All subjects signed a consent form in accordance with the Helsinki Declaration.

Apparatus and procedure

The investigation took place in a sound-attenuated room from which all distracting visual stimuli had been removed. At the beginning of the session, patients were informed by the investigator about the experiment and signed the consent form. A short medical history was taken and the patients filled out the IAS [18].

The experiment reported here began subsequent to several psychological tests, which lasted about 35 minutes. Subjects sat upright at a table with the thenar eminence of the nondominant hand placed on a temperature-controlled contact thermode (stimulation surface: 1.6×3.6 cm^2) mounted on an articulated arm. Contact pressure could be adjusted and was held at 0.4 N/cm^2. The apparatus (PATH Tester MPI 100; for details see Galfe et al. [23]) also included a thermode controller with a microcomputer for managing thermal stimulation and a personal computer for controlling the procedures.

First, individual heat pain thresholds were assessed. Beginning at a temperature of 38°C, eight heat stimuli were applied with a rate of temperature change of 0.7°C/second. The subjects were instructed to press a button as soon as they felt pain. Each time they pressed the button, the temperature returned to the baseline value. The start of each trial was signaled visually and acoustically, but the stimulus was presented with a pseudo-randomized delay of 1–3 seconds. The intertrial interval lasted 10 seconds. The pain threshold was calculated as the mean of the peak temperatures of the last five trials.

Second, the effect of distraction on the perception of nonpainful and painful stimuli was assessed. In each of the two experimental conditions, "distraction" and "no distraction," 17 thermal stimuli (base temperature: 36°C; rate of temperature change: 1.5°C/second; sawtooth form) were given. Blocks always began with a standard stimulus of 44°C. The remaining 16 stimuli consisted of two series, the first with 8 temperatures from 40°C to 47°C in steps of 1°C, and the second with 8 temperatures from 41°C to 48°C also in steps of 1°C; this procedure with two series was chosen to present the more intense stimuli at the end of the test. The sequence of stimulus intensities was pseudo-randomized in each series with the restriction that large intensity differences between consecutive stimuli should be avoided to control for adaptation level effects.

Each trial consisted of two intervals, which were signaled by visual and acoustic cues: (i) the stimulation interval (at least 10 seconds and until the baseline temperature was re-established), which included the temperature stimulus; and (ii) the response delay interval (10 seconds). The subjects were asked to rate the pain intensity and pain unpleasantness of each stimulus on two separate visual analog scales (VASs) after the response delay interval.

The experimental variation in attentional control was achieved by means of a cognitive distractor called the Pauli test [24]. This test consists of columns of one-digit numbers. The subject is asked to repeatedly add two consecutive numbers and to enter the result. In the "distraction" condition, the subjects made calculations during both the stimulation interval and the response delay interval. In the "no distraction" condition, the subjects calculated only during the response delay interval.

The response delay interval was introduced for the following reason: In the "distraction" condition, two effects of the Pauli test were present. It diverted attention away from the stimulus and it intervened between perception and rating. We required subjects in both experimental conditions to calculate during the response delay interval to avoid differences between the two experimental conditions based on events intervening between perception and rating.

Each subject was tested under both the "distraction" and "no distraction" conditions. The order of the conditions was balanced so that half of the subjects started with the "distraction" condition and the other half with the "no distraction" condition.

The VASs consisted of 10-cm horizontal lines. The VAS for pain intensity was labeled "no pain" at the left end and "extremely strong pain" at the right end; the VAS for pain unpleasantness was bounded by "no pain" and "extremely unpleasant pain." To obtain interindividually comparable pain ratings, the subjects were told that the standard stimulus of 44°C represented exactly the median of all temperatures applied.

Evaluation

For temperatures between 41°C and 47°C, the two ratings available at each intensity level were averaged before further computations; for 40°C and 48°C, only one rating was used for further evaluations. The effects of the individual level of hypochondriasis ("low-" vs. "high-hypochondriacal subjects") and the attentional control ("distraction" vs. "no distraction") on the VAS ratings of pain intensity and pain unpleasantness for the nine stimulus temperatures were analyzed by a 2 (group)×2 (attentional control)×9 (temperature) analysis of variance. Paired *t*-tests were used for *post hoc* comparisons. Two-sample *t*-tests were applied to evaluate the group differences in the heat pain thresholds. The α-level was set to 0.01 to control for multiple testing.

RESULTS

The two groups did not differ in their baseline pain sensitivity as assessed by the heat pain thresholds ("low-hypochondriacal": 45.7±2.8°C, "high-hypochondriacal": 46.9±2.7°C; $p=0.244$, *t*-test).

Effect of distraction

The analysis of variance revealed no significant main effects of the factor "attentional control" on the pain ratings (see Table I). Hence, distraction did not affect the ratings of pain intensity and pain unpleasantness in general. However, the interaction between "attentional control" and "temperature" was significant (see Table I). Upon further inspection, distraction appeared to lower the ratings of both pain intensity and pain unpleasantness beginning at a stimulus temperature of 46°C (see Fig. 1). The corresponding *t*-tests resulted in $p=0.001$ at 47°C and $p<0.001$ at 48°C for the ratings of pain intensity and in $p=0.003$ at 47°C and $p<0.001$ at 48°C for the ratings of pain unpleasantness. The significant *t*-test finding at 40°C, which was obtained for the rating of pain unpleasantness ($p=0.007$; see Fig. 1B), appears to be a chance finding.

Effect of hypochondriasis

The main effect of the factor "group" on the pain ratings and the interactions including the factor "group" were not significant (see Table I). Hence, the ratings of pain intensity and pain unpleasantness, both with and without distraction, could not be explained by grouping the patients into "low-" and "high-hypochondriacal subjects." Thus, the effectiveness of distraction for the reduction of pain perception did

Table I.—Results of the analysis of variance for the effects of group membership (“low-” vs. “high-hypochondriacal subjects”), attentional control (“distraction” vs. “no distraction”) and stimulus temperature (40° to 48°C) on ratings of pain intensity and pain unpleasantness

	df	*F*-value	*p*-Value
Pain intensity			
Group (G)	1	0.442	0.512
Attentional control (AC)	1	3.642	0.067
Temperature (T)	8	44.973	< 0.001
G × AC	1	1.235	0.277
G × T	8	0.268	0.976
AC × T	8	4.644	< 0.001
G × AC × T	8	0.409	0.915
Pain unpleasantness			
Group (G)	1	0.045	0.834
Attentional control (AC)	1	1.687	0.205
Temperature (T)	8	37.217	< 0.001
G × AC	1	0.840	0.368
G × T	8	0.542	0.824
AC × T	8	5.951	< 0.001
G × AC × T	8	0.731	0.664

not differ between “low-” and “high-hypochondriacal subjects.” The small sample size placed some limit on the conclusions, but there was not even a small tendency toward group differences. As noted earlier, there were also no group differences in pain threshold.

Effect of temperature

The significant main effect of the factor “temperature,” indicating that higher temperatures led to higher ratings of both pain intensity and pain unpleasantness, was expected (see Table I).

DISCUSSION

The present study produced two important findings: (i) The distraction of attention away from pain influenced pain perception, reducing the ratings of both pain intensity and pain unpleasantness. This effect of distraction was most prominent at painful temperatures (>46°C) and negligible at nonpainful temperatures (≤46°C). Because the mean heat pain threshold for all subjects was 46.4°C, most of the temperatures below this value were perceived as nonpainful heat and most of the temperatures above this value as heat pain. (ii) There were no differences in pain perception or in the ability to reduce pain perception by attentional control related to the individual level of hypochondriasis, according to the IAS [18].

It is generally accepted that attentional manipulations can influence pain perception. For example, Bushnell et al. [5] and Miron et al. [7] observed that attentional control influenced the perception of pain intensity and pain unpleasantness and the ability to discriminate between noxious stimuli of different intensities, leaving none of the basic dimensions of pain perception unaffected. Miltner et al. [25] demonstrated that the attentional control of pain perception is already apparent at the early stages of pain processing, as reflected by changes in pain-related cerebral potentials. Attentional control seems to not only change the expression of pain but also pain perception starting from the early stages of processing.

The effect of distraction, shown by a reduction of about 10% in the pain ratings for the two highest temperatures, is substantial. Price et al. [26] produced a similar reduction in a comparable experimental paradigm by application of about 6 mg of morphine.

Our observation that distraction of attention changed the perception of painful temperatures to a greater extent than perception of nonpainful temperatures appears surprising at first. Intuition might tell us the opposite, that the processing of a strong signal is not as dependent on the state of attention as is the processing of a weak signal. However, Bushnell et al. [5] made observations comparable to our findings. They proposed a modality specificity by saying "nociceptive pathways are

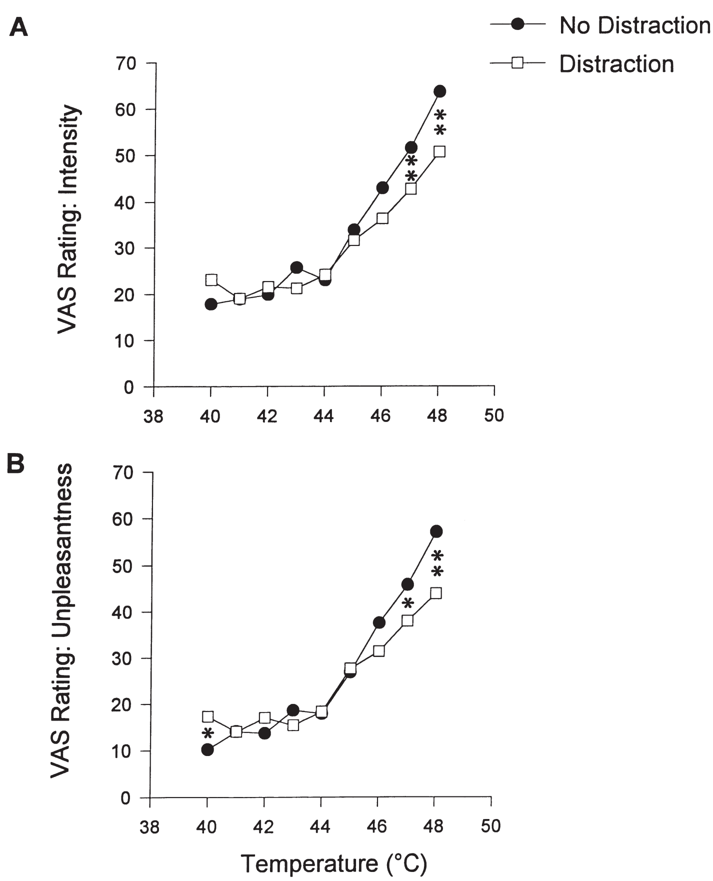

Fig. 1. Means of the ratings on visual analog scales (VAS) for pain intensity (A) and pain unpleasantness (B) in the two conditions "distraction" and "no distraction" of 28 psychosomatic patients, *$p \leqslant 0.01$, **$p \leqslant 0.001$ for differences between conditions (paired *t*-test). Filled circles: no distraction; empty boxes: distraction.

more sensitive to attentional factors than innocuous thermal pathways." However, this is largely a description of the findings.

McCaul and Malott [3] hypothesized that attentional manipulations act because they consume some degree of the attentional capacity that would otherwise have been devoted to pain perception. It is reasonable to assume that pain perception takes more attentional capacity than temperature perception. If so, not as much distraction may be necessary to reduce pain perception as is needed to reduce temperature perception. This might be the reason why we found that distraction had a stronger effect on heat pain perception than on pure heat perception. In other words, because painful stimuli capture more attentional capacity, the perception of these stimuli is more likely to be influenced by distraction. This hypothesis should be tested in future studies.

Contrary to our expectations, we found that individual levels of hypochondriasis did not affect the ability to reduce pain perception by distraction. The notion that hypochondriacal subjects are attentionally fixed to pain perception to such a degree that it is almost impossible to distract their attention away from pain is appealing. However, we failed to corroborate this assumption in psychosomatic patients. Stevens and Turner [15] reported similar findings with students. Furthermore, Pauli et al. [16] demonstrated that the anticipation of pain does not affect information processing in high-hypochondriacal individuals. Hence, there is not much empirical evidence for the assumption that the attention of hypochondriacal individuals is totally absorbed by the processing of pain.

The alternate view that controlled attention to pain and serial processing of noxious stimuli by high-hypochondriacal individuals are more vulnerable to distracting influences than automatic attention and parallel processing by low-hypochondriacal individuals was also not supported in the present study. The individual level of hypochondriasis and the ability to reduce pain perception by attentional distraction appeared unrelated as far as our limited sample size allowed this conclusion. There are at least three possibilities to explain our observation.

First, constructs such as hypochondriasis or private body consciousness, as used by Stevens and Terner [15], might not be suitable to explain individual differences in attentional control of pain perception. The findings obtained thus far support this, although the description of hypochondriasis as heightened awareness and preoccupation with bodily symptoms [12, 13] suggests the opposite. It is of interest that the "low-" and the "high-hypochondriacal" subjects did not differ in their basic pain sensitivity before any attentional manipulation. However, this lack of effect on pain perception does not exclude effects of hypochondriasis on pain behavior and pain expression.

Second, differences between hypochondriacal and nonhypochondriacal subjects regarding attentional control of pain perception may be limited to pain sensations that are seen as disease-related and therefore ego-threatening. Such pain sensations cannot be generated by the available experimental pain models. If this is true, it would be necessary to seek more suitable experimental pain models, possibly involving prolonged (tonic) pain stimulation.

Third, the attentional aspect of hypochondriasis might not be perfectly represented by the IAS [18], which we used, or the Private Body Consciousness Scale

[27], which was used by Stevens and Terner [15]. Perhaps, individuals scoring high on these scales are not attentionally absorbed by the processing of pain although truly hypochondriacal persons would be absorbed. To test this hypothesis in future studies, subjects with the clinical diagnosis of hypochondriasis and no other psychological problems should be compared with healthy control subjects.

This points to a shortcoming of the present study. Our patients were not clinically diagnosed hypochondriacs. They were selected on the basis of a sum score for two scales of the IAS, which have been shown to reliably differentiate between patients with DSM-III-diagnosed hypochondriasis and various other patient groups [22]. Furthermore, the patients suffered from various psychiatric and pain disorders and formed a heterogeneous sample. For these reasons, the present findings allow conclusions regarding the effects of hypochondriasis as a symptom or a trait but not as a distinct pathological entity.

In summary, it was demonstrated in the present study that distraction of attention profoundly reduces pain perception; that is, the perception of pain intensity and pain unpleasantness. This effect of attention was evident for pain perception but not for subthreshold temperature perception. However, individual differences in attentional control of pain perception could not be explained by the individual level of hypochondriasis.

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