Attending away from the body predicts increased physical symptom reports at six months in primary care patients

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ABSTRACT

Objective: High symptom reporting (HSR) and medically unexplained symptoms (MUS) are associated with considerable distress, disability, healthcare utilization and costs, but are poorly understood, and current treatments are of limited benefit. Most models of HSR and MUS implicate cognitive-perceptual factors, such as increased body-focused attention, reduced perceptual thresholds and a tendency to experience somatic misperception, but little is known about the causal role of these variables. We investigated this issue by studying whether there is a longitudinal relationship between perceptual-attentional variables and later clinical outcomes in primary care patients.

Method: Primary care patients (N = 102) completed clinical (physical symptom reporting, health anxiety and healthcare utilization) and perceptual-attentional (body-focused attention, perceptual threshold, somatic misperception) measures at baseline and then again six months later (N = 72). Hierarchical regression was used to examine cross-lagged relationships between baseline and follow-up scores.

Results: Contrary to expectation, attending away from the body at baseline predicted increased not decreased symptom reporting six months later. Neither perceptual threshold nor somatic misperception predicted clinical outcomes at six months.

Conclusions: These findings suggest that body avoidance, rather than increased body focus, contribute to the development of HSR. Future studies should consider the potential clinical benefits of reducing bodily avoidance, via techniques that promote adaptive engagement with bodily sensations.

Keywords*:* high symptom reporting; medically unexplained symptoms; health anxiety; body-focused attention; somatic misperception; perceptual sensitivity

INTRODUCTION

The more physical symptoms a person reports, the more distressed and disabled they are, and the more healthcare resources they consume [1, 2]. The number of symptoms reported is only loosely coupled with the extent of any physical pathology, however, with many of the symptoms encountered in medical settings lacking a clear biomedical source (so-called functional or medically unexplained symptoms, MUS; e.g., [3, 4]). Even in well-defined diseases such as asthma [5], heart disease [6], and diabetes [7], some patients report more symptoms than others, even when the extent of their physical pathology is comparable. Although the personal and societal costs associated with MUS and high symptom reporting (HSR; i.e., reporting disproportionate numbers of symptoms) are well documented [8, 9], they remain poorly understood and existing interventions only produce modest improvements [10-13].

Studies suggest that state and trait negative affect are strongly associated with MUS and HSR [e.g., 14-16], predict symptoms better than physiological markers [e.g., 5, 17, 18] and can trigger a transient change in symptom perception in people with clear-cut organic disorders [19, 20]. Nevertheless, other studies have shown somatic symptom reports to be independent of these factors [e.g., 4, 21, 22]. Thus, while anxiety, depression, health anxiety and negative affect probably account for an important proportion of the variance in MUS and HSR, there are other factors that need to be understood if we are to manage these phenomena more effectively.

Most contemporary accounts of MUS/HSR rely on the concept of somatosensory amplification, a perceptual trait characterized by increased emotional reactivity, hypervigilance for somatic sensations and a tendency to attribute them to malign causes [e.g., 23, 24]. From this perspective, many of the symptoms reported

by individuals with MUS/HSR reflect benign variations in the body that would normally be filtered out as irrelevant, but which are afforded undue significance due to unhelpful illness beliefs [e.g., 25-27].

Numerous studies have found a correlation between self-reported somatosensory amplification and physical symptom reports [e.g., 23, 28-30]. The evidence from more objective measures of amplification is much less consistent, however. Numerous studies have found that individuals with MUS require less stimulation than controls to experience sensory inputs as aversive [e.g., 6, 18, 31, 32], although it is unclear whether these indicate a reduced perceptual threshold per se (i.e., increased sensitivity) or simply a negative response bias. When the latter is taken into account using signal detection methods, group differences tend to be much less consistent [e.g., 33, 34]. Katzer et al. [35], for example, found that tactile thresholds were not associated with MUS or health anxiety in students, whereas Katzer et al. [36] found that lower thresholds were associated with *reduced* symptom reports in patients with MUS, even though thresholds were lower overall compared to healthy controls.

Other studies have investigated the somatosensory amplification model using attentional bias paradigms, typically in the visual modality. Some studies have found an association between MUS and difficulties disengaging visual attention from neutral [37, 38] or threatening stimuli [39]. There is also evidence for increased cognitive interference on the emotional Stroop task in MUS patients [e.g., 40-42]. However, studies using dot-probe and attentional cueing paradigms have generally not found such differences [39, 42-46].

There has been less research investigating attentional biases in more body-relevant sensory modalities, such as touch. Brown et al. [47] found that high

symptom reporters were slower to disengage their attention from tactile cues than low symptom reporters under neutral conditions, but then displayed avoidance of tactile stimuli following a negative mood induction. In contrast, Brown et al. [48] found that non-clinical participants with high symptom reports were disproportionately faster than controls when responding to tactile versus visual targets (suggesting body bias), but only following presentation of threatening stimuli. In that study, self-reported somatosensory amplification was associated with reduced tactile bias, however, suggesting body avoidance. More recently, Brown [49] has argued that attention to "top-down" symptom representations in memory may be a stronger determinant of MUS and symptom reporting than attention to "bottom-up" signals coming from the body [also 50]. According to this integrative cognitive model, attention to expectations and predictions about illness may cause the system to misinterpret bodily information, creating a misperception that is more consistent with prior beliefs than somatic reality. The Somatic Signal Detection Task (SSDT; [51]) was developed to measure individual differences in the tendency to experience such somatic misperceptions, which might interact with other factors (e.g., symptom-focused attention) to produce increased symptom reports. In the SSDT, participants are presented with a series of trials where they judge whether a subtle vibration has been presented to their fingertip, which occurs on half of the trials. The tendency to experience somatic misperception is operationalized as the frequency with which the individual reports the presence of the vibration when no vibration has been given (i.e., false alarms or "illusory touch"). Evidence suggests this is a trait-like variable [52] that correlates with symptom reporting even when controlling for anxiety, depression, negative affect and health anxiety [35, 36, 53, 54].

The cross-sectional, correlational nature of most research in this area means that it is unclear whether attentional and perceptual factors play a causal role in the development of high symptom reporting and other related variables. The use of experimental methods to assess causality raises ethical issues, however, meaning that analogue or quasi-experimental studies are often the only way of enhancing knowledge about underlying disease mechanisms. Although still correlational, longitudinal methods are particularly useful in this regard as they provide information about temporal antecedence and thereby the likely direction of causality when two variables are related. With that in mind, the current study investigated whether tactile perceptual thresholds, body-focused attention and somatic misperception are predicted by somatic symptom reporting, health anxiety and healthcare utilization in primary care patients longitudinally. Following the amplification model, we expected lower perceptual thresholds and increased body-focus to predict greater symptom reporting, health anxiety and healthcare utilization over time. Following the integrative cognitive model, we predicted similar relationships between these outcome variables and the tendency to experience somatic misperception on the SSDT.

METHODS

Design

A prospective cohort design with primary care attendees was employed. Perceptual-attentional (tactile perceptual threshold, somatic misperception, body-focused attention) and clinical (symptom reporting, health anxiety, healthcare utilization) variables were measured at baseline (T1) and six months later (T2). We studied longitudinal relationships between the perceptual-attentional and clinical variables, controlling for relevant covariates (age, gender, medical conditions,

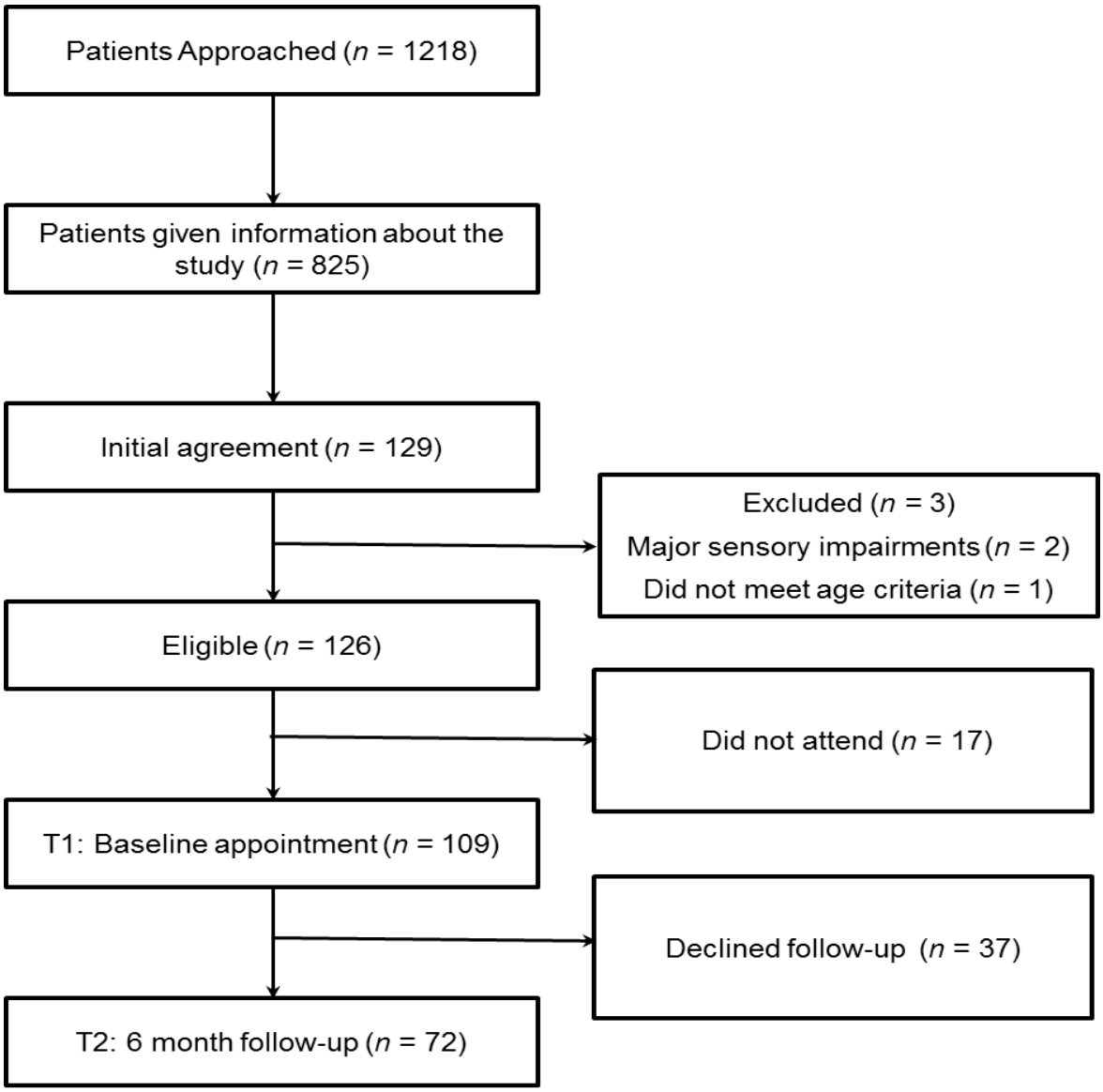

Figure 1. Participant flow through the study

state/trait anxiety, depression). Cross-lagged relationships were studied using hierarchical regression, with a view to identifying the likely direction of causality.

Participants

Individuals waiting to attend an appointment within one of seven general practices in NW England, UK, were approached to take part in the study between

October 2011 and January 2013. Those who agreed to take part and who met the inclusion criteria (primary care patients aged 18-50 years; no major [uncorrected] sensory impairment; able to read/write English) were booked a research appointment and sent a questionnaire pack to complete at home. We focused on people under the age of 50 to minimise the proportion of participants with significant medical pathology. Of 126 participants sent the questionnaires, 109 attended a baseline appointment (T1: 75.2% female;
mean [SD] age = 30.1 [10.0] years; 67% white British; 13.8% unemployed; 64% single; 99% educated to >= 16 years); of these, 72 (66.1%) returned for a second appointment six months later (T2: 70.8% female; mean [SD] age = 30.0 [9.6] years; 72.2% white British; 12.5% unemployed; 66.6% single; 98.6% educated to >= 16 years). Figure 1 illustrates participant flow.

Clinical variables

Symptom reporting. The 15-item patient health questionnaire (PHQ-15; [3]) was adopted as the most reliable measure of physical symptom reporting in this area [55]. Each item describes a common physical symptom (e.g. stomach pain); respondents rate the degree to which each symptom has bothered them in the past four weeks (‘0’ = not bothered at all; ‘1’ = bothered a little; ‘2’ = bothered a lot). Good reliability and validity have been demonstrated previously [3].

Health anxiety. The short-form health anxiety inventory measured health anxiety. The HAI consists of 18 items, each comprising four statements; respondents indicate which of each set of statements best describes how they felt in the preceding six months. Each statement is scored from zero to three, with increasing scores corresponding to higher levels of health anxiety. Scale reliability is excellent [56].

Healthcare utilization. A bespoke self-report measure of healthcare utilization (see supplementary materials) was developed to capture total self-reported healthcare utilization for each participant in the preceding six months. The measure consisted of 14 items, nine of which pertained to utilization of private and public healthcare services in primary, secondary and tertiary care settings, as well as complimentary services. A further five items pertained to costs to patients for health-related items, such as prescriptions and vitamins, although these were not considered here**.**

Perceptual-attentional variables

Body-focused attention. We measured body-focused attention using a modified version of the modality bias task (MBT; Brown et al [48]. This task varies the threat level and body-relevance of picture stimuli and measures their impact on attentional performance (operationalized as inverse efficiency) to stimuli in the visual and tactile modalities (Figure 2). Following Brown et al. [48], we studied the relationships between the clinical variables and a combined attentional performance measure (i.e., visual performance minus tactile performance), which provides a measure of tactile (i.e., body) bias. Preliminary analyses confirmed that tactile bias was significantly greater following body-relevant stimuli, indicating that the task is a valid measure of body-focused attention (see supplementary materials for more comprehensive information about the perceptual-attentional paradigms).

***Perceptual threshold*.** We calculated participants' perceptual threshold within the tactile modality, regarding this as more body-relevant than other modalities. Threshold was determined using a computerized, forced-choice, adaptive procedure, delivered both before and after the SSDT (test-retest reliability: T1, $r_{tt} = .74$, $p < .001$;

T2, r_{tt} = .71, p < .001). Mean threshold values at each time point were used in the analysis.

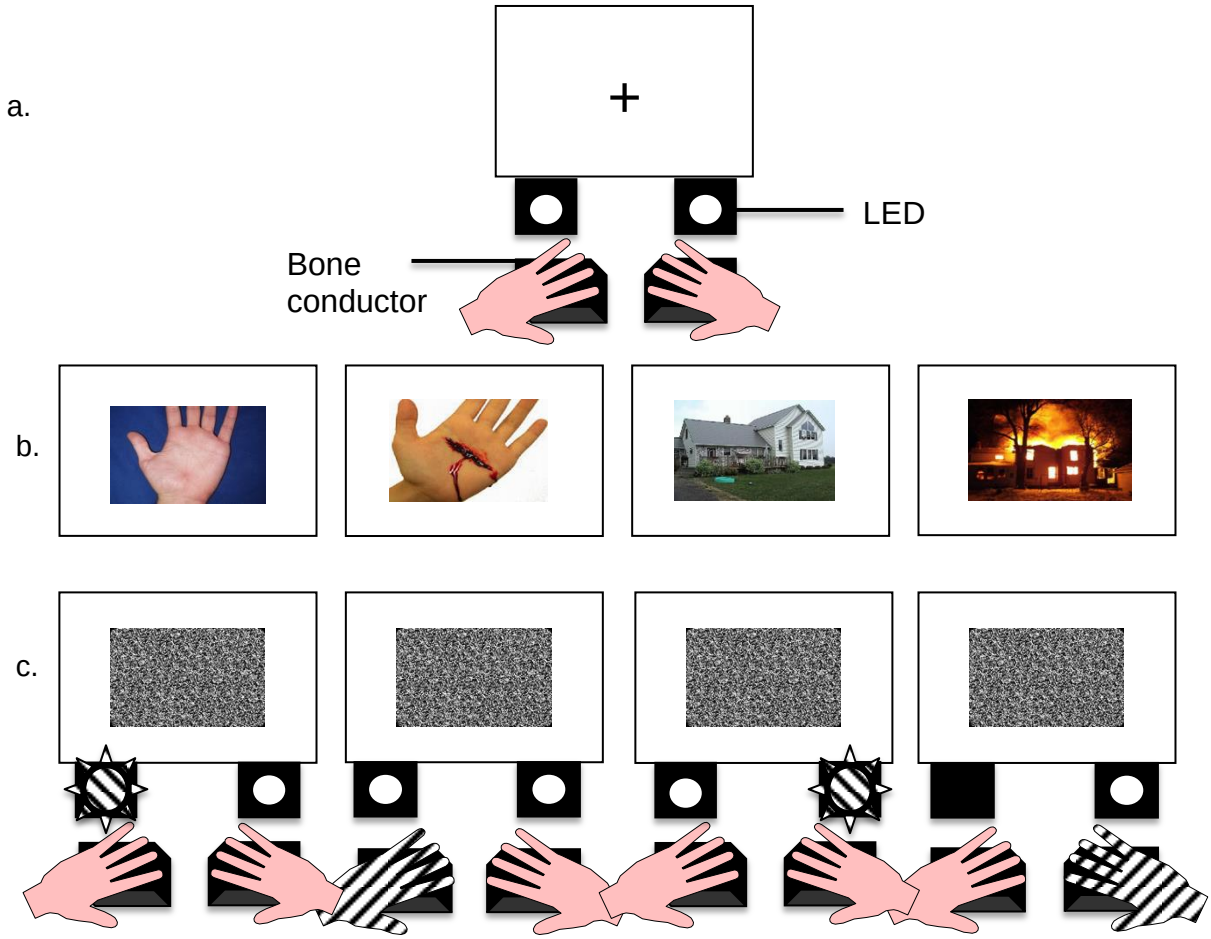

Figure 2. Schematic of the MBT adapted from Brown et al (2007). On each trial, a central fixation cross (a) was presented for 700-1000ms followed by a picture cue (b) and then replaced 200ms later by a visual white noise mask (c). Either 250ms or 500ms after the onset of the picture cue, a tactile target (a vibration produced via a bone conductor to the left or right hand indicated by the black and white striped hand) or a visual target (an LED flash near to the left or right hand indicated by black and white striped LED) was presented

***Somatic misperception*.** We operationalized somatic misperception as false

alarm (FA) rate on the SSDT [51]. The experimental phase of the SSDT consisted of two 80-trial blocks (with a break between), with each trial consisting of a single interval in which one of four trial types was presented. Trial types were determined by crossing the presence or absence of a vibration to the fingertip with the presence or absence of a light flash presented near to the same finger. The participant's task was to indicate whether they felt a vibration using keys: 1 = “definitely yes”, 2 = “maybe yes”, 3 = “maybe no” and 4 = “definitely no”. Preliminary analyses confirmed that SSDT data were consistent with previous studies showing that the light reliably increased hit rate and shifted response bias towards yes but had more variable effects on FA rate and tactile sensitivity [35, 51, 52, 54].

Covariates

We controlled for several variables known to be predictors of symptom reporting, health anxiety and healthcare utilization. In addition to age and gender, these were:

Chronic medical conditions, as measured using the Charlson Comorbidity Index (CCI; [57]). Respondents responded either ‘no’ or ‘yes’ to 14 items assessing the presence of 12 chronic conditions. The CCI can be used to give a weighted measure of the risk of mortality. As very few people in this study had chronic health conditions, and if they did they typically had only one condition, it was used as a dichotomous variable representing whether a chronic condition was present or absent.

Trait anxiety, as measured using the trait-component of the State-Trait Anxiety Inventory [STAI-T; 58]. This measure asks respondents how they ‘generally feel’ in response to 20 items pertaining to anxiety, which are rated on a scale of 1 (‘almost never’) to 4 (‘almost always’). Scale reliability is excellent [58].

Depression and anxiety, as measured by the relevant sub-scales of the Brief Symptom Inventory [BSI; 59]. The BSI asks respondents to indicate the degree to which they have been bothered by 53 symptoms that relate to nine psychological dimensions in the last seven days. Respondents use a 5-point scale ranging from 0 ('not at all') to 4 ('extremely'). Responses are scored from 0-4 with higher scores indicating greater distress. Scale reliability is good [60].

Procedure

All procedures were approved by NHS and University of Manchester ethical committees. At the first research appointment, participants provided written informed consent and returned questionnaire pack one, which contained a demographics form, the healthcare utilization measure, the CCI and the STAI-T. They then completed a second questionnaire pack containing the PHQ-15 and HAI, followed by the perceptual thresholding procedure and the SSDT. Participants then had a short break before completing the BSI and the MBT. The same procedure was followed at 6-month follow-up. Appointments lasted ~two hours and participants received a £10 shopping voucher at the end of each session.

RESULTS

Data screening

Data were screened for missing and outlying scores. Non-normally distributed variables were transformed using Box-Cox transformations [61]. T1 anxiety and T2 anxiety and depression, T1 and T2 SSDT variables, T1 threat-scene and T2 neutral-body tactile bias could not be normalized; non-parametric tests were used in the analyses of these variables wherever possible.

Sample characteristics

At T1, data from all 109 participants who took part in the study were included in the final SSDT sample. Data from 104 participants were included in the final MBT sample; four participants did not complete the MBT, two because they felt unwell, one because of time constraints and one because the equipment failed during testing. One participant's MBT data was removed because they made the incorrect response ten times in one stimulus condition, suggesting they were unable to follow the task instructions (mean total errors for the whole sample = 0.91). One participant did not complete the BSI because they felt unwell. Therefore in analyses involving the anxiety and depression subscales of the BSI, data from 108 participants were included in the final sample. At T2, 72 participants returned for follow-up, of whom two did not complete the SSDT or MBT, one because they were unwell, and one because of time constraints. Therefore 70 participants were included in the final T2 SSDT and MBT sample. Seven participants did not complete the second tactile threshold measure because of time constraints and so 63 participants were included in the final T2 tactile threshold sample.

Clinical characteristics of the sample are presented in Tables 1 and 2. At T1, 26 (23.9%) participants reported clinically relevant levels of symptom reporting (PHQ-15 ≥ 10; [62]), compared to 20 at T2 (27.8%; Table 2). At T1, 32 (29.4%) participants reported clinically relevant levels of health anxiety (HAI ≥ 18; 56), compared to 17 at T2 (23.6%). Levels of trait anxiety, recent anxiety and recent depressive symptoms were relatively low at both time points. Measure reliability was high (α range = .78-.94).

MANOVA found no significant differences between those who did and did not attend at T2 on the clinical, behavioral and psychological characteristics (all *p*s >.05). For those participants who attended both T1 and T2 appointments, levels of

healthcare utilization ($t(70) = 2.52$, $p = .014$, $r = .28$, M = 0.08, SE = 0.03, 95% CI [0.02, 0.15]) were significantly higher at T1. There were no other significant changes between T1 and T2 for these participants.

Table 1: Clinical characteristics of study sample at T1 ($N = 109$) and T2 ($N = 72$)

Characteristic	T1: *N* (%)	T2: *N* (%)
Currently taking prescribed medication (top three listed below)	71 (65.1)	43 (59.7)
- Anti-asthma	28 (25.7)	14 (19.4)
- Anti-depressants	18 (16.5)	16 (23.2)
- Oral-contraception	18 (22.0)	12 (24.5)
Self-reported medical conditions	31 (28.4)	22 (30.6)
- Diabetes	4 (3.7)	3 (2.8)
- Kidney disease	1 (0.9)	1 (1.4)
- Stomach ulcer	2 (1.8)	2 (1.8)
- Cancer:	2 (1.8)	2 (1.8)
- Lung (current)	1	1
- Brain tumour (past)	1	1
- Asthma	22 (20.2)	14 (19.4)
- Rheumatic/connective tissue disease	4 (3.7)	1 (1.4)

Table 2: Behavioral and psychological characteristics of study sample at T1 (n= 109) and T2 (n= 72; Cronbach's α shown)

	T1:			T2:			
Measure	**Median± IQR**	**α**	**Range**	**Median ±IQR**	**α**	**Range**	**Possible range**
HCU	8.00±11.00	-	0-89	7.00±12.00	-	0-62	-
PHQ-15	7.00±5.00	.77	0-26	7.00±6.25	.80	0-23	0-30
HAI	14.00±8.00	.82	2-33	13.50±8.50	.87	0-34	0-54
STAI-T	43.00±17.00	.92	24-68	41.00±16.00	.94	22-75	20-80
BSI-A	4.00±8.00	.86	0-24	3.00±5.50	.88	0-24	0-24
BSI-D	4.00±7.00	.89	0-24	4.00±7.00	.91	0-24	0-24

[a] *T1, BSI-A & BSI-D, n=108*

Reference key for measures: HCU = health care utilisation; PHQ-15 = symptom reporting; HAI = health anxiety; STAI-T = trait anxiety; BSI-A = anxiety; BSI-D = depression.

Longitudinal relationships between perceptual-attentional and clinical variables.

A series of hierarchical regression analyses were conducted investigating whether T1 perceptual-attentional variables predicted clinical scores at T2, and whether T1 clinical scores predicted perceptual-attentional performance at T2, when controlling for T1 covariates (including the T1 counterpart of the variable being

predicted at T2). Analyses were conducted using SPSS version 20.0 (IBM SPSS Inc., Chicago, IL). Two-tailed tests are reported throughout (alpha = .05).

Table 3: Summary of hierarchical regressions predicting T2 symptom reporting, health anxiety and healthcare utilisation from T1 tactile bias, tactile threshold, and FA rate when controlling for T1 covariates.

	T2								
	PHQ-15			**HAI**			**HCU**		
	β	***SE β***	***95% CI β***	***β***	***SE β***	***95% CI β***	***β***	***SEβ***	***95% CI β***
T1									
Tactile bias *(N = 70)*									
- *Neutral-body*	**-0.211***	0.000	-0.212, -0.210	-0.086	0.001	-0.088, -0.084	-0.088	0.000	-0.088, -0.088
- *Neutral-scene*	**-0.204***	0.000	-0.204, -0.204	-0.091	0.000	-0.091, -0.091	-0.038	0.000	-0.038, -0.038
- *Threat-body*	**-0.223***	0.000	-0.223, -0.223	-0.124	0.000	-0.124, -0.124	-0.006	0.000	-0.006, -0.006
- *Threat-scene*	**-0.199***	0.000	-0.199, -0.199	-0.128	0.000	-0.128, -0.128	0.035	0.000	0.035, 0.035
Threshold (N = 71)	0.017	0.000	0.017, 0.017	0.087	0.000	0.087, 0.087	-0.057	0.000	-0.057, -0.057
FA rate (N = 71)	0.002	4.681	-9.360, 9.364	0.124	12.590	-25.056, 25.304	0.054	0.589	-1.124, 1.232

*p< .05. ** p < .01

Reference key for measures: PHQ-15 = symptom reporting; HAI = health anxiety; HCU = health care utilisation; Threshold = tactile threshold; FA rate = false alarm rate.

Neither T1 tactile threshold nor FA rate were significant predictors of T2 symptom reporting, health anxiety or healthcare utilization (Table 3). In contrast, T1 tactile bias was a significant negative predictor of T2 PHQ-15 scores across all picture types, despite not being a cross-sectional predictor at baseline (see supplemental table S5). None of the clinical variables were significant predictors of T2 perceptual-attentional performance (see supplemental tables S6-S9).

DISCUSSION

The amplification model suggests that body-focused attention is a key driver of symptom reporting, health anxiety and healthcare utilization. In that account, excessive body-focus is thought to increase the salience of benign sensations by lowering the threshold for somatic perception, resulting in illness worry and behavior [23, 24]. In the earliest instantiation of the integrative cognitive model, body-focused attention was also proposed to increase the activation of illness representations in memory, distorting perception accordingly [63]. Contrary to these approaches, our findings suggest that body-focused attention has quite a different relationship with symptom reporting and related variables, such as health anxiety. Tactile bias in all four of the picture conditions (body relevant/irrelevant, threatening/neutral) were negative predictors of symptom reporting six months later, when controlling for relevant covariates. In other words, increased body-focus consistently predicted *lower* symptom reports at a later date. Although the effect sizes are relatively modest, the consistency across stimulus types makes it unlikely that these findings are spurious, particularly given their congruence with other findings and concepts within this area (see below). Although experimental studies are ultimately required to test hypotheses concerning causality, these longitudinal relationships are consistent with the notion that body-focus has an impact on symptom reporting, albeit not

in the direction predicted by the amplification model and the initial assumptions of the integrative cognitive model.

Although contrary to some predictions, the negative relationship between body-focus and symptom reporting described here has several precedents in the literature. Indeed, Brown et al. [48] found a negative correlation between the same tactile bias measure and self-reported somatosensory amplification. Furthermore, Brown et al. [52] found that high symptom reporters exhibited reduced attention to the body following a negative mood induction. Those findings were interpreted as evidence for avoidance of, rather than excessive engagement with, bodily sensations under conditions of threat. Our longitudinal findings suggest that such a tendency to avoid the body, which may serve the function of decreasing acute anxiety, has the paradoxical effect of increasing symptom reports in the long-term (also 64). This suggests that the well-documented association between MUS and cognitive interference on the emotional Stroop task [e.g., 40-42] might actually reflect a tendency to avoid rather than engage with illness stimuli [65]. More recent elaborations of the integrative cognitive model [e.g., 49, 54, 66, 67) suggest that a tendency to avoid bodily sensations is likely to reduce the precision of somatosensory information within the cognitive system, resulting in a greater reliance on top-down information (i.e., beliefs and expectations about the body/illness) in somatic perception. As a result, there is more scope for discrepancies between perceptual experience and sensory evidence (such as HSR and MUS) to arise. Consistent with this, evidence suggests that somatic symptom reports are associated with reduced interoceptive accuracy in patients with somatoform disorders (e.g., 68). Nevertheless, other studies suggest that increased engagement with and/or decreased disengagement from illness stimuli are also associated with MUS and symptom reporting [37- 39, 48, 53], pointing to a complex role for attentional factors in these phenomena and the likelihood that a range of treatment strategies will be required [66].

We found no longitudinal relationships between tactile threshold, symptom reporting, health anxiety or healthcare utilization. The wider literature regarding perceptual thresholds is mixed. For example, Katzer et al., [35] found no relationship between perceptual threshold, MUS or health anxiety in non-clinical participants. In contrast, Katzer et al., [36] found that patients with MUS had reduced thresholds compared to healthy controls, but that lower thresholds were associated with reduced symptom reports. Our study adds to a growing evidence base suggesting that perceptual thresholds are not directly associated with symptom reporting or health anxiety, casting further doubt on key aspects of the amplification model.

There were also no significant longitudinal relationships between FA rate on the SSDT and symptom reporting, health anxiety or healthcare utilization. Several previous studies have found a relationship between FAs on the SSDT and physical symptom reports [53, 54, 35, 36), although the relationship is modest and somewhat unreliable [e.g., 36, 69-71]. One possible explanation for this pattern of findings is that the SSDT mainly captures the effect of state and contextual variables on somatic perception, rather than the putative individual differences suggested by the integrative cognitive model. Other factors, such as a somatosensory filtering deficit, may also result in misperception on the SSDT, and could be the source of the relationship sometimes found between symptom reporting and performance on that task. Such a deficit has been cited as a possible explanation for MUS and excessive symptom reporting [25, 26] and is also likely to result in an increased reliance on top-down factors in body perception to resolve the inherent ambiguity of bodily inputs, such as those delivered in the SSDT.

The main strengths of this study are its longitudinal design, its use of objective measures of body-focused attention, perceptual threshold and somatic misperception, and its application to a substantial sample of patients recruited from primary care. As a result, the study provides a new perspective on the relationships between these perceptual-

attentional processes and clinical variables that are the source of considerable distress, disability and expenditure. Nevertheless, the study has certain limitations. Although the use of a longitudinal design is a significant advance in this area of research, for example, it is only possible to establish temporal precedence definitively with an experimental design [72]. Similarly, our group of patients was a relatively young, self-selected sample, with little evidence of multi-morbidity, and only a small proportion of the people approached agreed to take part. Similarly, we did not record our participants' reasons for their original medical consultation or why others declined to participate; we speculate that the requirement to attend the study at a separate, city centre location without access to parking may have been a factor in relation to the latter. Nevertheless, our take-up rate was similar to comparable studies and we managed to retain two-thirds of participants at six-month follow-up, which is a relative strength in a non-treatment study. Despite its relatively small size, the sample itself was fairly representative of symptom reporting in primary care with comparable distributions to those found in epidemiological studies of the PHQ-15 in primary care settings [e.g. 3, 73]. Around a quarter of the sample reported clinically relevant levels of symptom reporting and around a third of the sample reported clinically relevant levels of health anxiety. However, self-reported symptoms were not diagnosed by a medical doctor as being medically explained or unexplained, meaning that we are unable to comment on how many participants in this study had MUS. It therefore remains possible that our findings are driven by a subset of individuals with a particular symptom profile, which should be considered in future studies.

The findings reported here are consistent with the use of treatment strategies that encourage adaptive engagement with bodily sensations in individuals experiencing HSR/MUS, such as mindful body scanning or heart beat perception training tasks, which have been found to be effective for reducing physical symptoms [e.g., 74-76], somatic misperception [77] and health anxiety [78]. Our findings suggest that practicing mindful

body scanning and heart beat perception training tasks may be effective in part because they increases adaptive body-focused attention and reduce bodily avoidance. Future clinical and cost effectiveness studies of mindful body scanning or heart beat perception training tasks in primary care patients could incorporate the methods used here to test the causal impact of body-avoidance on symptom reporting.

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SUPPLEMENTARY MATERIALS: ADDITIONAL METHODOLOGICAL INFORMATION

Healthcare Utilization Questionnaire

This section asks about your use of different health services in the last <u>SIX MONTHS</u>. Please think carefully about the last six months and answer the questions accordingly in BLOCK CAPITALS. Don't worry if you are not 100% certain of the exact details in each case - please just give us your best estimate. Please do not hesitate to contact the study researcher for help if needed.

<u>Part 1. Health care use</u>

1. How many times in *the last six months* have you visited your GP?
_____

2. How many times in *the last six months* have you visited your practice nurse? _____

3. How many times in *the last six months* have you visited your dentist? _____

4. In *the last six months* have you visited any other practitioner at your GP surgery? **Yes ☐ No ☐**
If so please specify their job title below and how many times you have seen them in the *last six months*.
_____
_____

5. How many times in *the last six months* has your GP visited you at home? _____

6. How many times in *the last six months* have you visited a hospital Accident & Emergency department?
_____

7. Have you been treated in hospital in *the last six months*? **Yes ☐ No ☐**
a. If yes, then how many times have you been an in-patient in the last six months?_____

b. And how long were you an in-patient for each time (If more than once please indicate e.g. Visit 1: 3 days; Visit 2: 4 days)?
_____

8. Have you been an out-patient at hospital? **Yes ☐ No ☐**
a. If yes, how many appointments in *the last six months* have you had at hospital as an out-patient?

_____

9. This question concerns your use of other health care services . If you have used any of the services listed below in *the last six months* then please tick the corresponding box and indicate how many appointments you have had (or, for inpatient stays, how long it lasted) in the column on the right.

	Tick all that apply	Number of Appointments / how long in the last six months?
Optician	☐	_____
Pharmacist	☐	_____
Private doctor/consultant	☐	_____
Private hospital as an inpatient	☐	_____
Private hospital as an outpatient	☐	_____
Emergency doctor's clinic	☐	_____
NHS walk in	☐	_____
Sexual health clinic	☐	_____
Mental health clinic	☐	_____
Dental hospital	☐	_____
Midwife	☐	_____
Physiotherapist	☐	_____
Speech and language therapist	☐	_____
Occupational health visitor	☐	_____
Health visitor	☐	_____
Chiropractor	☐	_____
Osteopath	☐	_____
Complementary practitioner (e.g. Acupuncture)	☐	_____
Psychotherapist	☐	_____
Other: _____		_____
_____		_____

Part 2. Medication

Are you currently taking any prescribed medication? **Yes ☐ No ☐**

If yes what are the names of the medication(s)?

_____
_____
_____
_____
_____

2. Have you been prescribed any medication in *the last six months* that you are not currently taking now? **Yes ☐ No ☐**
If yes what type of medication was it? And how long were you taking it for?

_____
_____

3. Roughly how much have you spent on your prescriptions in *the last six months*? If you use a prepayment card please state whether it is 3 monthly, 6 monthly or yearly?_____
_____
_____
_____

4. Have you taken any over-the-counter medicines in *the last six months* (e.g. ibuprofen, antihistamines)? **Yes ☐ No ☐**
If so what are they called?_____
_____
_____
_____

5. Roughly how much have you spent in *the last six months* on over the counter medications (things like ibuprofen/paracetamol/ antihistamines)?

_____
_____
_____
_____

Modality bias task

Procedure. The task consisted of a series of trials where a picture stimulus was presented, followed by either a visual (light flash) or tactile target (vibration to the fingertip) to the left or right. The participant positioned their left and right feet pressing down on two foot pedals. Their task was to indicate the location of the stimulus as quickly and as accurately as possible by lifting their left or right toes to release the corresponding foot pedal. The valence (neutral vs. threatening) and content (body stimuli vs. scene stimuli) of the pictures was varied to produce four picture categories: neutral-scene, threat-scene, neutral-body and threat-body. The pictures were digital color photographs (500 x 368 pixels), with eight different pictures in each category (see supplementary materials).

Participants were seated in front of a computer monitor with their hands positioned 4.5cm either side of the centre of the monitor. In each hand, they held a rectangular foam cube (65 x 55 x 25mm), attached to the table (Figure 2, main text). The pad of the participant's left and right index fingers were placed on bone conductors (Oticon Ltd., B/C 2-PIN, 100 Ohm, Hamilton, UK) with a 16mm × 24mm vibrating surface mounted in each of the foam cubes, which were used to present suprathreshold vibrotactile targets (200Hz vibration for 300ms). The tactile targets presented to each hand were individually matched for subjective strength for each participant. Two red LEDs (10mm diameter) were mounted on a plastic cube (25 x 25 x 25mm) and attached to the bottom of the computer monitor, in line with the handheld foam cubes. The LEDs were used to present the visual targets (300ms light flash).

On each trial, a central fixation cross was presented for 700-1000ms, after which the picture cue was presented for 200ms. This was then replaced by a visual white noise mask that remained on screen for the remainder of the trial. The target was presented 50ms after the offset of the picture (250ms later in catch trials, to minimise anticipatory responding). The trial ended once the participant made their response. The screen was

then blank for 200ms prior to the start of the next trial; if the participant's response was incorrect then ‘wrong’ was displayed in red during this interval. Participants were also asked to respond verbally to 12 rare probe (neutral scene) pictures, which were not part of the main experimental stimuli. Each probe picture had a centrally located fluorescent green digit (font size, 48). Participants were asked to say these numbers out loud and the experimenter recorded their responses. A mean accuracy rate of 96% for these pictures confirmed that participants were attending to the stimuli throughout.

The main experiment consisted of four blocks of 40 trials; each block contained 32 trials with a stimulus onset asynchrony (SOA; i.e., delay between picture and target onset) of 250ms and 8 catch trials (SOA 500ms). Each experimental picture was displayed once per block, except in one block where it was also displayed in a catch trial. Across the experiment, each individual picture was followed twice by the target stimulus on the left and twice on the right, with half of these being visual and half tactile. Three probe trials appeared in every test block and the reaction times obtained in these trials were not analyzed. Before the main experiment, participants completed a practice block of 27 trials (two each of 12 pictures of neutral household objects [e.g. spoon] and three probe trials).

Trials on which errors were made were excluded from the analysis (T1 = 5.7%; T2 = 5.0%). These included anticipatory (<150ms) and incorrect left/right responses; there was no upper limit for response times. The remaining RTs for each participant in each condition (neutral-scene; neutral-body; threat-scene; threat-body) were then subjected to an outlier removal procedure [76], and mean RTs were calculated for each participant in each condition for visual and tactile targets separately. The mean RTs were then combined with error rates (proportion of wrong errors) to calculate inverse efficiency (IE) for each participant in each sub-condition [RT/(1-proportion wrong error)]. This measure combines speed and accuracy and allows comparisons between conditions without contamination by potential speed-accuracy trade-offs [77]. A tactile bias score was calculated for each

participant in each picture condition (Visual IE – Tactile IE). Positive tactile bias scores indicate that responses were slower/less accurate for the visual modality compared to the tactile modality, suggesting body bias.

Picture stimuli. Neutral and threatening pictures of each content type were matched; for example, a picture of a car (neutral-scene) was matched with that of a car crash (threat-scene). Neutral-body pictures consisted of: four hands (two left, two right), one right arm, one left toes, one leg and one leg and foot. Threat-body pictures consisted of: four injured hands (cut to hand, severed thumb, nail injury, finger wound), one wounded arm, one wounded left toes, one wounded leg, and one wounded foot and ankle. Neutral-scene pictures consisted of: four cars, one train, one lorry, one airplane, one house. Threat-scene pictures consisted of: four car crashes, one train crash, and one lorry, one airplane and one house all on fire. There were no people or any other living organism shown in any of the scene pictures.

Manipulation check. Threat pictures were rated as significantly more threatening than neutral pictures in each category at both T1 and T2 with large effect sizes (T1: mean neutral-scene rating = 0.00, mean threat-scene rating = 6.00; *T(104)* = 8.77, $p < .001$, $r = .61$, M = 5.56, 95% CI [5.06, 6.06]; neutral-body = 0.00, threat-body = 5.43; *T(104)* = 8.85 $p < .001$, $r = .61$, M = 4.81, 95% CI [4.50, 5.13]; T2: neutral-scene = 0.06, threat-scene = 6.50; *T(70)* = 7.15, $p < .001$, $r = .60$, M = 5.63, 95% CI [5.06, 6.13]; neutral-body = 0.13, threat-body = 4.75; *T(70)* = 7.27, $p < .001$, $r = .61$, M = 4.63, 95% CI [4.13, 5.00]). There were significant differences in threat ratings for body-relevant and body-irrelevant pictures at T1, but these were comparatively small effects (neutral-scene vs. neutral-body, *T(104)* = -2.48 $p < .05$, $r = -.17$, M = -0.06, 95% CI [-0.19, 0.00]; threat-body vs. threat-scene *T(104)* = -3.36, $p < .01$, $r = -.23$, M = 0.63, 95% CI [0.31, 1.00]). At T2, threat-scene pictures were rated as significantly more threatening than threat-body pictures, with a medium effect (*T(70)* = -3.44, $p < .01$, $r = -.29$, M = -.94, 95% CI [-1.50, -0.44); there was no effect for the

neutral pictures (*T(70)* = -0.81 *p* > .05). A 2 (Time: T1 vs. T2) x 2 (picture-valence: neutral vs. threatening) x 2 (picture-type: body vs. scene) within-participants repeated measures ANOVA revealed a non-significant main effect of time (*F*, (1, 69) = 3.28, *p* > .05) and a non-significant three-way interaction between time, picture-type and picture-valence (*F*, (1, 69) = 1.44, *p* > .05) upon the participants threat ratings. However there was a significant interaction between time and picture-type (*F*, (1, 69) = 5.14, *p* < .05, η^2 = .07), with scene pictures being rated as significantly more threatening at T2 than at T1 (T1 scene mean = 3.04; vs. T2 scene mean = 3.34; *T(70)* = -2.26, *p* < .05, *r* = -.15).

Somatic signal detection task

Perceptual threshold. Participants were presented with a series of trials consisting of two time periods (1020ms), identified by an arrow cue on the computer screen (pointing to the fingertip where the stimulus was to be presented) overlaid by either a ‘1’ or ‘2’. On each trial, a short (20ms) 100Hz vibration was presented in the middle of one of the two time periods, which was determined randomly; no stimulus was presented in the other time period. A prompt then appeared on the screen and participants were instructed to press keys (“1” for period one and “2” for period two) to report when they judged the vibration to have occurred. If participants could not feel a vibration in either time period they were instructed to guess which time period the vibration had occurred in.

The vibration level was selected using parameter estimation by sequential testing (PEST; [78]). The same thresholding procedure was repeated at the end of the experimental trials to assess reliability.

Tactile threshold was determined by delivering a vibration level equal to 274 m/s (as measured by an accelerometer attached to the bone conductor). This vibration level was painless but quite strong and was chosen so it could be clearly felt by participants. The intensity of the vibration was defined using a scale of arbitrary units that ranged from 0 (maximal stimulation that was equal to the initial vibration level of 274 m/s) to a minimum

of -10,000. A Wald sequential probability ratio test (SPRT) was used to define when to change the vibration strength [N(c) (no. of correct responses) - Pt.N (T) (probability threshold value (0.75) multiplied by current trials completed) ≥ W (W's limits were: 1 to -1)]. The selection of the vibration level depends on the responses given on all trials since it reached its current level. When the participant's correct responses were greater than 75%, this caused the Wald SRPT to be greater than W = 1 and a weaker vibration level was selected (step-down). When participants' correct responses were less than 75% this caused the Wald SRPT to be less than W= -1 and a stronger vibration level was selected (a reversal). Initial step size (the difference between vibration levels) was set at 800, minimum step size at 50 and maximum step size at 3200.

Step size was determined according to the following rules: (1) The second step in a given direction is the same size as the first; (2) After each reversal, halve the step size unless it follows a double; (3) After each reversal that follows a double, no change to the step size; (4) If the third step in a row is in the same direction then double the step size; (5) The fourth and subsequent steps in a given direction are each double their predecessor; (6) End when the minimum step size is reached. The computer algorithm was programmed to complete a maximum of 250 trials and, if this limit was reached, an average of the last 50 trials was taken as the participant's threshold (see Poole et al., [79] for a similar approach).

Procedure. During the task, participants sat with their non-dominant hand resting on a table in front of, and central to, a computer monitor. The pad of their non-dominant index finger was attached using an adhesive double-sided pad to a bone conductor, mounted on a foam wedge with a vibrating surface 1.6cm wide × 2.4cm long (Oticon Ltd, B/C 2-PIN, 100 Ohm, Hamilton, UK). The bone conductor was used to present the tactile vibrations. Tactile vibrations were produced by amplifying sound files from the computer via a custom built amplifier (Dancer Design). The volume dial on the amplifier was set at

the quarter-to-twelve position for each participant. A red LED (5mm) was also mounted on the foam cube close to the end of the participant's finger to provide the visual stimulus (light). The monitor was used to deliver instructions and a centrally presented visual cue (962 x722 pixel green arrow pointed downwards towards the finger adhered to the bone conductor) that signalled the start of each trial. Participants responded via the keyboard, using their dominant hand.

Each trial type [vibration (present, absent) x light (present, absent)] was presented 20 times per block in a random order. Vibrations were presented at the intensity determined in the perceptual thresholding procedure. In vibration present trials, a 20ms tactile stimulus (100Hz) was delivered with a delay of 500ms before and after. In light present trials, a 20ms visual stimulus (LED flash) was presented in the middle of the 1020ms stimulus period, either on its own (vibration absent) or at the same time as the tactile pulse (vibration present). When both stimuli were absent, an empty 1020ms period occurred. Participants completed 10 practice trials prior to commencing the task proper, to familiarize them with the response protocol and the light stimulus. Participants were naive to the significance of the visual stimulus and were informed that a vibration would not be present on all trials. No other instructions were given.

Data from each block were initially analyzed separately to investigate differences between blocks; the mean of the two blocks was then calculated. As not all participants used all four-response types, responses were collapsed into simpler "yes" and "no" categories for the purposes of analyses (See Mirams, Poliakoff, Brown and Lloyd, [80]). Responses on each trial were classified as hits (vibration present, "yes" response), misses (vibration present, "no" response), FAs (vibration absent, "yes" response) and correct rejections (vibration absent, "no" response). Hit rate, FA rate, tactile sensitivity (*d*') and response bias (c) were calculated using the log linear correction ([81]; hit rate = [{number of hits + 0.5}]/{number of hits + number of misses + 1}] and FA rate = [{number of FAs +

0.5}/{number of FAs + number of correct rejections + 1}]). These were then used to calculate the signal detection theory test statistics *d'* (Z [hit rate] – Z [FA rate]), which estimates the participant's perceptual sensitivity, and *c* (-0.5[Z {hit rate} + Z {FA rate}]), which estimates the participant's response criterion (i.e., overall tendency to report the vibration as present).

SUPPLEMENTARY MATERIALS: ADDITIONAL RESULTS

Preliminary analyses

Modality bias task

Figure S1 presents mean tactile bias (IE) scores in each of the picture conditions at T1 and T2. For T1, 2 (picture-valence: neutral vs. threatening) x 2 (picture-type: body vs. scene) within-participants repeated measures ANOVA revealed a significant main effect of picture-type (F, (1, 103) = 11.64, p = .001, η^2 = .10; body mean = 28.10; scene mean = 11.24), suggesting that tactile bias was significantly greater following body-relevant stimuli (neutral-body vs. neutral-scene: $t(103)$ = 3.83, p < .001, r = .35, M = 24.09, SE = 6.29, 95% CI [11.61, 36.58], threat-body vs. neutral-scene: $t(103)$ = 2.24, p < .05, r = .22, M = 14.51, SE = 6.48, 95% CI [1.67, 27.35]; neutral-body vs. threat-scene: $t(103)$ = -2.89, p < .01, r = -.26, M = 19.22, SE = 6.34, 95% CI [6.65, 31.79]). There were no other significant main effects or interactions. At T2, none of the main effects or interactions were significant (all p's > .05), although the overall pattern of responses was similar to that of T1 (pre-planned Wilcoxon Signed Rank Tests; T2 neutral-body vs. neutral-scene: T(69) = -2.38, p < .05, r = -.20 M = -12.32, 95% CI [-22.32, -2.50], ; T2 neutral-body vs. threat-body T(69) = -2.01, p < .05, r = -.17, M = -9.51, 95% CI [-18.44, -0.17]). A 2 (time: T1 vs. T2) x 2 (picture-valence: neutral vs. threatening) x 2 (picture-type: body vs. scene) within-participants repeated measures ANOVA revealed no significant main effects or interactions for time (all p's > .05). In sum, tactile bias was larger for body-relevant than

body-irrelevant stimuli, which was most evident for neutral-body stimuli.

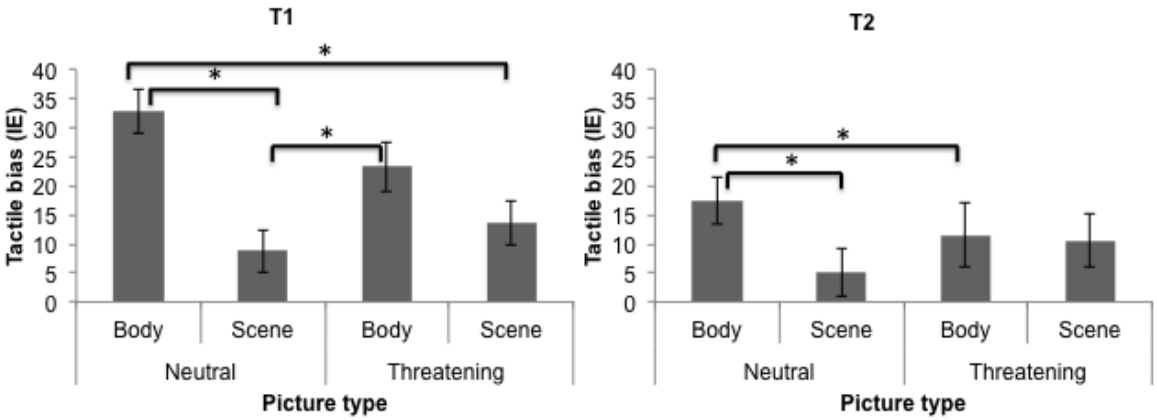

Figure S1: T1 adjusted mean (SE) tactile bias (IE) for each stimulus type on the MBT. Larger tactile bias scores indicate better performance for tactile relative to visual targets (* *p< .05)*

SSDT

Table S1 presents descriptive statistics for the SSDT data. The average block 1 light-absent hit rate was within the 40-60% range at both T1 and T2, which is considered to represent tactile threshold [51]. This indicates that the threshold procedure was effective.

Tests of difference are presented for the SSDT data at T1 and T2 in Tables S2 and S3 respectively. At T1 in both blocks 1 and 2, participants' hit rate, tactile sensitivity (*d'*) and tendency to say yes (*c*) were all significantly increased by the presence of the light. However, FA rate was not significantly increased by the presence of the light. At T2, in block one, participants' hit rate and tendency to say yes (c) were significantly increased by the presence of the light. However, there were non-significant increases in FA rate and tactile sensitivity. In block two, participants' hit rate, FA rate and tendency to say yes were

significantly increased by the presence of the light. However, tactile sensitivity was not significantly increased by the presence of the light.

Table S1: T1 and T2 median (IQR) hit rate, false alarms (FAs), d' (tactile sensitivity) and c (response bias) in light-absent (LA) and light-present (LP) conditions of the SSDT.

	% hits		**% FAs**		***d'***		***c***	
	LA	LP	LA	LP	LA	LP	LA	LP
T1 (N=109)								
Block 1	59.52 (45.00)	69.05 (33.00)	11.90 (19.00)	11.90 (14.00)	1.42 (1.26)	1.59 (1.34)	.55 (.81)	.34 (.69)
Block 2	59.52 (48.00)	69.05 (45.00)	7.14 (14.00)	11.90 (17.00)	1.48 (1.44)	1.83 (1.70)	.55 (.85)	.34 (.73)
T2 (N=70)								
Block 1	54.76 (33.00)	66.67 (35.00)	11.90 (19.00)	11.90 (20.00)	1.41 (1.54)	1.43 (1.39)	.55 (.64)	.31 (.68)
Block 2	57.14 (35.00)	64.29 (44.00)	7.14 (14.00)	11.90 (19.00)	1.34 (1.43)	1.45 (1.43)	.46 (.66)	.25 (.75)

Table S2: Test of difference (Mean/Median, [95% CI] and effect size = r) for effect of light on hits, false alarms (FAs), tactile sensitivity (d'), and tendency to say yes (c) at T1.

T1 (N=109)	**% Hits**	**% FAs**	***d'***	***c***
Effect of light				
Block 1	5.29***	-1.81	-2.27**	5.60***
	(0.08, [0.05, 0.11], .36)		(-0.17, [-0.32, -0.02], -.21)[a]	(0.21, [0.14, 0.28], .46)[a]
Block 2	6.18***	-0.98	-5.66***	6.11***
	(0.10, [0.07, 0.12], .47)		(-0.36, [-0.48, -0.23], -.38)[a]	(0.23, [0.15, 0.30], .50)[a]

*** *p* < .001. Significant differences are Wilcoxon signed-ranks test because of non-normal distributions of the data

Table S3: Test of difference (Mean/Median, [95% CI] and effect size = r) for effect of light on hits, false alarms (FAs), tactile sensitivity (d'), and tendency to say yes (c) at T2.

T2 (N=70)	**% Hits**	**% FAs**	***d'***	***c***
Effect of light				
Block 1	-4.11***	-1.90	-1.16[a]	-3.64***
	(0.07, [02, .10], -.50)			(-0.19, [-0.30, -0.09], -.31)
Block 2	-4.46***	-2.53**	-1.77[a]	-4.23***
	(0.07, [0.05, 0.12], -.54)	(0.02, [-0.05, 0.00], -.31)		(-0.20, [-0.28, -0.12], -.36)

*** p < .01. *** p < .001. Significant differences are Wilcoxon signed-ranks test because of non-normal distributions of the data and [a] indicates t-test because data were normally distributed.*

Zero-order correlations between variables at time 1 and 2.

Table S4 presents zero-order correlations between the clinical variables, tactile threshold and average FA rate at T1 and T2. Table S5 presents zero-order correlations between the clinical variables and tactile bias at T1 and T2

Table S4: *Correlations (95% CI) between tactile threshold (T1 N = 109; T2 N = 63), average false alarm (FA) rate (T1 N = 109; T2 N = 70), symptom reporting, health anxiety and healthcare utilization at T1 and T2.*

	T1:			**T2:**		
	PHQ-15	**HAI**	**HCU**	**PHQ-15**	**HAI**	**HCU**
Tactile threshold[a,b]	-.11 (-.28, .06)	.04 (-.13, .21)	-.00 (-.13, .12)	-.04 (-.28, .23)	.05 (-.23, .32)	.25 (-.02, .45)
Ave. FA rate	.13 (-.07, .33)	.18 (-.01, .36)	-.05 (-.24, .14)	.13 (-.11, .35)	.03 (-.18, .27)	.00 (-.23, .24)

**p < .05. ** p < .01. Correlations are Spearman because of non-normal distributions of the data, [a] indicates Pearson because data were normally distributed and [b]* indicates at T2 N = 63.

There were no significant correlations between tactile threshold, FA rate, tactile bias and the clinical measures at either T1 or T2 apart from correlations between tactile bias for neutral scene pictures and HCU at T1 and PHQ-15 scores at T2.

Table S5: Correlations (95% CI) between tactile bias in neutral and threatening body-relevant and symptom reporting, health anxiety and healthcare utilisation at T1 (N = 104) *and T2* (N = 70)*.*

	Neutral		**Threatening**	
	Body	**Scene**	**Body**	**Scene**
T1				
PHQ-15	-.03 (-.24, .19)	-.15 (-.40, .12)	-.08 (.26, .13)	-.00[a] (-.23, .19)
HAI	.02 (-.18, .23)	-.11 (-.34, .18)	-.09 (-.32, .12)	-.01[a] (-.20, .19)
HCU	.03 (-.16, .20)	-.21* (-.38, -.03)	-.14 (-.34, .08)	-.19[a] (-.39, .02)
T2				
PHQ-15	-.18[a] (-.43, .08)	-.26* (-.47, .16)	-.22 (-.41, .00)	-.23 (-.45, .01)
HAI	.03[a] (-.24, .28)	-.22 (-.46, .06)	-.01 (-.46, .06)	-.12 (-.35, .16)
HCU	-.18[a] (-.41, .05)	-.14 (-.38, .11)	-.15 (-.40, .13)	-.21 (-.40, .02)

[a]*Spearman's rho due to non-normality of data. *p < .05.*

Reference key for abbreviations: PHQ-15 = symptom reporting; HAI = health anxiety; HCU = health care utilisation.

Hierarchical regressions taking clinical variables at T1 as predictors and T2 perceptual-attentional variables as targets

None of the clinical variables at T1 were significant predictors of any of the perceptual attentional variables at T2 when controlling for relevant covariates.

Table S6: Summary of hierarchical regressions predicting T2 Threshold from T1 symptom reporting, health anxiety and healthcare utilization controlling for T1 covariates.

	T2		
	Threshold (N = 63)		
	β	***SE β***	***95% CI β***
T1			
PHQ-15	-0.025	249626.368	-499252.761, 499252.711
HAI	-0.156	53204.474	-106409.104, 106408.792
HCU	-0.199	684512250.498	-1369024501.190, 1369024500.800

*p < .05. ** p < .01.

Reference key for abbreviations: PHQ-15 = symptom reporting; HAI = health anxiety; HCU = health care utilisation.

Table S7: Summary of hierarchical regressions predicting T2 FA rate from T1 symptom reporting, health anxiety and healthcare utilization controlling for T1 covariates.

	T2 FA rate (N = 70)		
	β	***SEβ***	***95% CI β***
T1			
PHQ-15	0.201	0.010	0.181, 0.221
HAI	-0.093	0.002	-0.097, -0.089
HCU	0.131	24.080	-48.029, 48.291

*$p < .05$. ** $p < .01$.

Reference key for abbreviations: PHQ-15 = symptom reporting; HAI = health anxiety; HCU = health care utilisation.

Table S8: Summary of hierarchical regressions predicting T2 tactile bias in the neutral condition from T1 symptom reporting, health anxiety and healthcare utilization controlling for T1 covariates

	T2 *(N = 69)* **Tactile bias**					
	Neutral-body			**Neutral-scene**		
	β	***SE β***	***95% CI β***	***β***	***SE β***	***95% CI β***
T1						
PHQ-15	-0.110	107.285	-214.680, 214.460	-0.057	1744.001	-3488.059, 3487.945
HAI	0.106	20.594	-41.082, 41.294	-0.012	334.547	-669.106, 669.082
HCU	0.185	250828.808	-501657.431, 501657.801	-0.002	4235176.300	-8470352.602, 8470352.598

*$p < .05$. ** $p < .01$.

Reference key for abbreviations: PHQ-15 = symptom reporting; HAI = health anxiety; HCU = health care utilisation.

Table S9: Summary of hierarchical regressions predicting T2 tactile bias in the threat condition from T1 symptom reporting, health anxiety and healthcare utilization controlling for T1 covariates

	T2 *(N = 69)* **Tactile bias**					
	Threat-body			**Threat-scene**		
	β	***SE β***	***95% CI β***	***β***	***SE β***	***95% CI β***
T1						
PHQ-15	-0.229	2236.421	-4473.071, 4472.613	-0.013	1535.853	-3071.719, 3071.693
HAI	0.213	428.664	-857.115, 857.541	-0.031	294.245	-588.521, 588.459
HCU	0.235	5184288.702	-10368577.169, 10368577.639	0.201	3652102.068	-7304203.935, 7304204.337

*$p < .05$. ** $p < .01$.

Reference key for abbreviations: PHQ-15 = symptom reporting; HAI = health anxiety; HCU = health care utilisation.