

MOTILITY AND VISCERAL SENSATION

Visceral sensation and emotion: a study using hypnosis

L A Houghton, E L Calvert, N A Jackson, P Cooper, P J Whorwell

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See end of article for authors' affiliations

Correspondence to:
Dr L A Houghton,
Department of Medicine,
University Hospital of South
Manchester, Nell Lane,
West Didsbury,
Manchester M20 2LR, UK;
lahoughton@man.ac.uk

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Background and objectives: We have previously shown that hypnosis can be used to study the effect of different emotions on the motility of the gastrointestinal tract. These studies demonstrated that both anger and excitement increased colonic motility while happiness led to a reduction. The purpose of this study was to investigate the effect of hypnotically induced emotion on the visceral sensitivity of the gut. **Methods:** Sensory responses to balloon distension of the rectum and compliance were assessed in 20 patients with irritable bowel syndrome (IBS) (aged 17–64 years; 17 female) diagnosed by the Rome I criteria. Patients were studied on four separate occasions in random order either awake (control) or in hypnosis, during which anger, happiness, or relaxation (neutral emotion) were induced. **Results:** Hypnotic relaxation increased the distension volume required to induce discomfort ($p=0.05$) while anger reduced this threshold compared with relaxation ($p<0.05$), happiness ($p<0.01$), and awake conditions ($p<0.001$). Happiness did not further alter sensitivity from that observed during relaxation. There were no associated changes in rectal compliance or wall tension. **Conclusions:** Further to our previous observations on motility, this study shows that emotion can also affect an IBS patient's perception of rectal distension and demonstrates the critical role of the mind in modulating gastrointestinal physiology. These results emphasise how awareness of the emotional state of the patient is important when either measuring visceral sensitivity or treating IBS.

The pathophysiological mechanisms responsible for abnormal visceral sensation seen in patients with irritable bowel syndrome (IBS) are incompletely understood. However, the observations that hypnotherapy can normalise abnormal visceral sensitivity^{1,2} and concomitantly improve pain² would suggest that the central nervous system must play at least a modulatory, if not an aetiological, role in this abnormality. This is supported by the fact that there appears to be abnormal cerebral processing of visceral stimuli demonstrated by both positron emission tomography³ and functional magnetic resonance imaging.⁴

Mental stress (dichotomous listening) has been reported to alter rectal sensitivity in healthy volunteers⁵ although others have been unable to show any effect with either mental (mental arithmetic) or physical (cold pressor) stress.⁶ It is unknown whether patients with IBS have a different or exaggerated sensitivity response to stress, as appears to be the case for colonic motility where IBS patients exhibit an exaggerated motility response to stress compared with healthy volunteers.⁷ Any change in gastrointestinal motility and/or visceral sensitivity in response to stress may explain why some IBS patients report initiation or exacerbation of their symptoms at these times.⁸

The physiological response to stress may depend on the intensity of the accompanying emotion and the way with which it is coped. For instance, feelings of anger and aggression increase colonic motility^{7,9} while hopelessness leads to a decrease.⁹ We have recently used hypnosis to induce specific emotions in a reproducible and reliable way and have confirmed previous studies that anger increases colonic motility.¹⁰ In addition, our studies showed that excitement increased colonic motility while happiness had the opposite effect.¹⁰

In this study we sought to investigate the effect of hypnotic relaxation (neutral emotion) on both the sensory and motor responses to rectal distension, and to determine whether various hypnotically induced emotions, namely anger and happiness, altered these measurements.

MATERIALS AND METHODS

Subjects

Studies were carried out in 20 patients with IBS aged 17–64 years (mean 43.6 years; 17 female). Of these, the bowel habits

of five patients were classified as diarrhoea predominant (mean 38.0 years; four female), eight as constipation predominant (mean 44.9 years; six female), and seven as alternating between the two (mean 46.1 years; seven female). There were no age or sex differences between the groups. All patients had symptoms that met the Rome criteria I for a diagnosis of IBS¹¹ and had normal haematology, biochemistry, and sigmoidoscopy, together with a normal colonoscopy or barium enema if aged over 40 years. No patient was taking medications known to alter gastrointestinal function and all gave informed consent. The study was approved by the local research ethics committee.

Protocol

Each patient was studied under fasting conditions on four separate occasions during which rectal sensitivity to balloon distension was assessed during hypnotically induced anger, happiness, and relaxation (neutral emotion), and under control awake conditions. The order in which the studies were carried out was randomised, and the studies were conducted at the same time of day. Furthermore, all patients completed a hospital anxiety and depression questionnaire.

Using a similar technique to that previously described to investigate anorectal physiology,¹² the patient, following defecation, was placed on their left side and a catheter incorporating a 6 cm long latex balloon was inserted into their unprepared rectum. The balloon was attached to the tubing between 5 cm and 11 cm from the anal verge and the pressure within it measured using a water filled non-perfused channel situated 8 cm from the anal verge via a water filled transducer connected to a polygraph recorder and visual display unit (PC-Polygraph; Synectics Medical, Stockholm, Sweden). After a 10 minute rest period, and five minutes after application of the test procedure (control awake conditions, or hypnotic anger, happiness, or relaxation), the rectal balloon was serially

Abbreviations: IBS, irritable bowel syndrome; C_{static} , static compliance; C_{dynamic} , dynamic compliance.

Table 1 Effect of hypnotic relaxation, anger, and happiness on volume thresholds (ml) in patients with irritable bowel syndrome

| | Awake (control) | Hypnotic relaxation | Hypnotic happiness | Hypnotic anger |
|--------------------|-----------------|---------------------|--------------------|---------------------|
| 1st sensation | 14 (12, 16) | 26 (19, 34)*** | 22 (16, 29)* | 17 (13, 23) |
| Desire to defecate | 50 (38, 66) | 65 (49, 85)** | 55 (43, 71) | 36 (25, 51)††† |
| Urgency | 86 (69, 109) | 114 (92, 142)* | 100 (81, 123) | 68 (54, 86) ††† |
| Discomfort | 132 (108, 160) | 156 (135, 179)** | 157 (134, 184) | 84 (64, 108)*** ††† |

Results are expressed as geometric mean (95% confidence interval).

* $p < 0.05$, ** $p = 0.05$, *** $p < 0.001$ compared with awake.

† $p < 0.05$ compared with relaxation.

†† $p < 0.01$ compared with happiness.

Table 2 Effect of hypnotic relaxation, anger, and happiness on pressure thresholds (cm H₂O) in patients with irritable bowel syndrome.

| | Awake (control) | Hypnotic relaxation | Hypnotic happiness | Hypnotic anger |
|--------------------|-----------------|---------------------|--------------------|-------------------|
| 1st sensation | 5 (0, 17) | 9 (2, 32) | 8 (2, 32) | 5 (0, 26) |
| Desire to defecate | 15 (3, 36) | 15 (2, 48) | 15 (3, 73) | 11 (2, 59) |
| Urgency | 24 (9, 48) | 29 (13, 109) | 26 (11, 73) | 15 (6, 44)* †††† |
| Discomfort | 29 (10, 44) | 36 (13, 122) | 36 (17, 66) | 21 (9, 59)** †††† |

Results are expressed as geometric mean (95% confidence interval).

* $p < 0.05$, ** $p = 0.06$ compared with awake.

†† $p < 0.01$ compared with relaxation.

††† $p < 0.01$ compared with happiness.

inflated with air at 10, 20, 40, 60, 80, 100 ml, and then in 25 ml increments until the patient experienced discomfort. Each inflation was maintained for a period of one minute, followed by a period of complete deflation lasting at least one minute. During inflations patients were asked to report the nature of any sensation they experienced (first sensation, desire to defecate, urgency, or discomfort). Although patients were informed of the nature of sensations they might experience at the beginning of the study, they were not aware of the timing of the balloon distensions or prompted about the sensations during the studies.

Pulse (bpm) and respiration rate (per minute) were recorded basally and at inflation volumes of 10, 125, 200, and 250 ml, in addition to the volume to discomfort if it occurred outside these volumes.

Hypnotic technique

Hypnosis was induced by the eye fixation method followed by standard deepening procedures,^{13, 14} and the emotions of anger and happiness were induced by direct suggestion from the therapist.¹⁰ As it is sometimes quite difficult for the patient to spontaneously create the required emotion, the therapist asked the patient in advance to describe various situations that would induce the appropriate emotional response. Using this technique¹⁰ the therapist was also able to constantly reinforce the emotion during the session. Following each session, patients were asked to mark on a visual analogue scale the intensity of the emotion that had been induced. When anger had been induced, patients were given relaxation and ego strengthening procedures before being woken.

Analysis of data

The following measurements were derived: (i) the lowest balloon volume and pressure required for first sensation and to induce sensations of desire to defecate, urgency, and discomfort; and (ii) rectal compliance, calculated from both the volume/pressure relationship at 100 ml distension—static compliance “ C_{stat} ”; and from the slope of the compliance curve—dynamic compliance “ C_{dyn} ”.¹⁵ For each distension volume balloon pressure was measured as an average pressure over the last 30 seconds of the distension.

Statistical analysis

Statistical analysis of the effect of hypnotically induced emotion and relaxation on rectal physiology was performed using repeated measures analysis of variance on logged data, followed by paired *t* tests with Bonferonni's correction where significant differences were observed.

RESULTS

Rectal sensation

Hypnotic relaxation (neutral emotion) significantly increased rectal distension volumes required to induce the sensations “first sensation”, “desire to defecate”, “urgency”, and “discomfort” compared with awake conditions ($p = 0.05$) (table 1). Induction of anger during the hypnotic state reduced these volume thresholds to levels which were significantly different from relaxation and happiness for the sensations of “desire to defecate”, “urgency”, and “discomfort” ($p < 0.05$), and from the awake state for the sensation of “discomfort” ($p < 0.001$) (table 1). Happiness appeared to have little effect on volume thresholds compared with either relaxation or awake conditions, although the volume for “first sensation” was significantly increased compared with the awake state ($p < 0.05$) (table 1).

Similar observations were made for differences in pressure thresholds although statistical significance was only achieved for the sensations of “urgency” and “discomfort” when comparing anger with the awake ($p \leq 0.06$), relaxation ($p < 0.01$), and happiness ($p < 0.01$) states (table 2).

Whether patients had a diarrhoea, constipation, or alternating bowel habit did not appear to affect their response to the various hypnotic states (table 3).

Likewise, whether patients were clinically anxious (anxiety score ≥ 9 ; $n = 9$) and/or depressed (depression score ≥ 9 ; $n = 1$) did not influence their sensory response to hypnotic relaxation or anger.

Rectal compliance and wall tension

Neither hypnotic relaxation nor the emotions of anger and happiness had any effect on rectal compliance (change in dV/dP configuration or slope of curve) or wall tension (change in C_{stat} without change in C_{dyn}) (table 4, fig 1).

Table 3 Comparison of the effects of hypnotic relaxation, anger, and happiness on the discomfort thresholds (volume and pressure) in irritable bowel syndrome patients with a diarrhoea or constipation predominant, or alternating bowel habit

| | Awake (control) | Hypnotic relaxation | Hypnotic happiness | Hypnotic anger |
|--|-----------------|---------------------|--------------------|-------------------|
| Diarrhoea predominant bowel habit (n=5) | | | | |
| Volume (ml) | 134 (90, 200) | 164 (122, 200)** | 181 (148, 221)* | 100 (67, 164)**† |
| Pressure (cm H ₂ O) | 30 (20, 49) | 30 (16, 55) | 45 (30, 60)* | 45 (33, 55) |
| Constipation predominant bowel habit (n=8) | | | | |
| Volume (ml) | 134 (67, 221) | 148 (100, 200) | 164 (134, 221)† | 90 (45, 164)††† |
| Pressure (cm H ₂ O) | 27 (20, 40) | 22 (15, 33) | 37 (25, 49) | 33 (22, 49)* |
| Alternating bowel habit (n=7) | | | | |
| Volume (ml) | 122 (90, 181) | 164 (122, 221)* | 122 (90, 181)† | 67 (40, 122) *††† |
| Pressure (cm H ₂ O) | 30 (20, 49) | 20 (15, 27) | 33 (30, 40) | 37 (22, 60) *††† |

Results are expressed as geometric mean (95% confidence interval).

*p<0.05, **p<0.09 compared with awake.

†p<0.05, ††p<0.08 compared with relaxation.

††p<0.01 compared with happiness.

Table 4 Effect of hypnotic relaxation, anger, and happiness on rectal compliance

| | Awake (control) | Hypnotic relaxation | Hypnotic happiness | Hypnotic anger |
|--|------------------|---------------------|--------------------|------------------|
| All patients (n=20): | | | | |
| C _{stat} (ml/cmH ₂ O) | 3.9 (3.2,4.8) | 4.5 (3.5,5.1) | 4.5 (3.7,5.5) | 4.9 (3.7,6.5) |
| C _{dyn} (ml/cmH ₂ O) | 0.66 (0.37,1.12) | 0.66 (0.47,0.92) | 0.67 (0.53,0.89) | 0.59 (0.50,0.77) |
| Diarrhoea predominant bowel habit (n=5): | | | | |
| C _{stat} (ml/cmH ₂ O) | 4.5 (2.0,6.1) | 4.5 (2.2,5.2) | 4.5 (3.6,5.2) | 4.5 (2.7,6.3) |
| C _{dyn} (ml/cmH ₂ O) | 0.69 (0.38,0.99) | 0.70 (0.57,0.83) | 0.62 (0.49,0.75) | 0.62 (0.53,0.71) |
| Constipation predominant bowel habit (n=8) | | | | |
| C _{stat} (ml/cmH ₂ O) | 5.5 (3.0,7.2) | 6.0 (4.1,5.9) | 4.5 (3.0,5.5) | 5.5 (3.0,6.5) |
| C _{dyn} (ml/cmH ₂ O) | 0.63 (0.44,0.81) | 0.67 (0.53,0.80) | 0.71 (0.62,0.80) | 0.59 (0.50,0.67) |
| Alternating bowel habit (n=7) | | | | |
| C _{stat} (ml/cmH ₂ O) | 3.0 (1.6,4.1) | 4.0 (2.5,5.5) | 4.0 (2.5,5.5) | 4.9 (2.9,6.6) |
| C _{dyn} (ml/cmH ₂ O) | 0.61 (0.52,0.70) | 0.61 (0.53,0.69) | 0.65 (0.60,0.71) | 0.58 (0.50,0.66) |

Results are expressed as geometric mean (95% confidence interval).

C_{stat}, compliance measured from the volume:pressure relationship at 100 ml; C_{dyn}, slope of volume:pressure curve.

Subjective and objective measures of emotion

All subjects reported that they had experienced high levels of relaxation (8.9 (7.8,9.9), geometric mean (95% confidence interval), visual analogue), anger (7.5 (6.4,8.7)), and happiness (8.4 (7.3, 9.5)) during the studies.

Table 5 shows the effect of hypnotic relaxation, anger, and happiness on cardiorespiratory variables. Hypnotic relaxation reduced both pulse (p<0.001) and respiration (p<0.05) rates. Conversely, induction of anger increased heart rate compared with both relaxation (p<0.001) and happiness (p<0.01), and increased respiration rate with respect to both relaxation (p<0.001) and control conditions (p<0.05). Happiness had little effect on cardiorespiratory parameters other than heart

rate which was reduced during happiness compared with control conditions (p<0.05).

DISCUSSION

These results have shown for the first time that altering the emotional state of a patient with IBS using hypnosis can lead to a change in rectal sensation. The high subjective rating of the emotions induced in conjunction with anticipated changes in both pulse and respiration rates would suggest that a true reproduction of the emotion had been achieved. This supports our previous observations showing that hypnosis can be successfully used to induce different emotions, many of which are very difficult to reproduce under laboratory conditions.¹⁰

Changes in visceral sensitivity, similar to those induced by hypnotic anger, have been reported in response to anxiety⁵ and attention¹⁶ in healthy volunteers. In addition, sadness¹⁷ and anxiety¹⁸ have also been shown to decrease somatic pain thresholds. Thus it is clear that the emotional state of a subject can have significant effects on how they process visceral stimuli and this may have a role in symptom reporting in patients, such as those with IBS. The predominant bowel habit type (diarrhoea, constipation, or alternating) of the patient does not appear to affect the response to the various hypnotic states tested but this might be because it is influenced more by the patient's basal visceral sensitivity levels than their bowel habit. In this study all three groups had similar sensory thresholds under basal awake conditions. Furthermore, the number of subjects in each group was small (n=5, 7, and 8) which would have made it difficult to identify any difference between these groups.

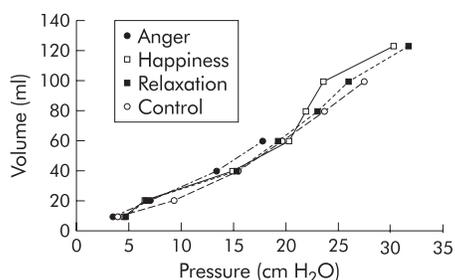


Figure 1 Relationship between mean balloon volume and pressure during hypnotically induced anger, happiness, and relaxation, and under control awake conditions. Data only plotted if at least 80% of patient data were available.

Table 5 Effect of hypnotic relaxation, anger, and happiness on cardiorespiratory parameters

| | Pulse (beats/min) | | Respiration (/min) | |
|------------------------|----------------------|--------------|--------------------|--------------|
| | Basal conditions | During study | Basal conditions | During study |
| Control | 71 (66, 76) | 73 (69, 77) | 17 (16, 19) | 17 (16, 19) |
| Change basal to during | 2.5 (0.3, 4.6) | | -0.1 (-1.0, 1.0) | |
| Hypnotic relaxation | 75 (72, 79) | 68 (66, 70) | 18 (17, 19) | 16 (15, 17) |
| Change basal to during | -7.7 (-10.5, -4.8)** | | -2.0 (-3.1, -1.0)* | |
| Hypnotic happiness | 72 (69, 74) | 69 (66, 71) | 16 (15, 18) | 16 (15, 18) |
| Change basal to during | -3.1 (-6.1, -0.2)* | | 0 (-1.2, 1.1) | |
| Hypnotic anger | 73 (70, 77) | 82 (77, 88) | 17 (15, 18) | 20 (17, 22) |
| Change basal to during | 9.1 (4.3, 14.0)†††† | | 2.9 (1.1, 4.8)*††† | |

Results are expressed as mean (95% confidence interval).

* $p < 0.05$, ** $p < 0.001$ compared with control.

††† $p < 0.001$ compared with relaxation.

†† $p < 0.01$ compared with happiness.

The mechanisms responsible for changes in visceral sensitivity however cannot be elucidated from the present study but do not appear to involve changes in rectal compliance or wall tension. They could involve alteration in pain processing and/or changes in cognitive functioning, such as vigilance of the patient to the distension procedure. Some patients with IBS have been shown to be hypervigilant to expected visceral stimuli¹⁹ and it may be that this can be further increased by emotions such as anger or decreased during relaxation or happiness. It is noteworthy however that those patients who were clinically anxious and/or depressed did not show any greater sensory response to the emotion than those who were not. It is also possible that the processing of emotions by the brain might modulate descending inhibitory pain pathways leading to a change in visceral afferent output and sensitivity.²⁰ Further work would be needed in order to attempt to identify the mechanisms involved in these observed changes in rectal sensitivity. These might include studies using pressure rather than volume distension of flaccid balloons to assess more accurately rectal compliance and tension, along with protocols that reduce response bias, such as the tracking or double random staircase techniques. In addition, approaches using psychological questionnaires, such as the pain anxiety symptoms scale²¹ which attempts to assess factors such as cognitive anxiety, fear, and escape/avoidance of pain/discomfort may be helpful.

Interestingly, happiness resulted in no additional change in sensitivity than that seen with relaxation. This may be because the reduction in sensitivity induced by the latter could not be altered further. Alternatively, happiness may not have significant effects on sensory processing.

We have shown that hypnotherapy is particularly helpful in treating patients with IBS.²²⁻²⁴ Studies in our laboratory have shown that patients who respond to this form of gut focused hypnotherapy experience normalisation of sensory thresholds with those who are hypersensitive becoming less sensitive and vice versa.^{1,2} The findings in this study suggest that an additional benefit of hypnosis, when used therapeutically, might be the ability to modify negative emotions that could have adverse effects on gut physiology.

Finally, with the growing interest in functional brain imaging, further studies using both the therapeutic and investigative potential of hypnosis may help in the better understanding of functional gastrointestinal disorders.

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Authors' affiliations

L A Houghton, E L Calvert, N A Jackson, P Cooper, P J Whorwell, Department of Medicine, University Hospital of South Manchester, Manchester M20 2LR, UK

REFERENCES

- Prior A, Colgan SM, Whorwell PJ. Changes in rectal sensitivity after hypnotherapy in patients with irritable bowel syndrome. *Gut* 1990;**31**:896-8.
- Houghton LA, Larder S, Lea R, et al. Gut focused hypnotherapy normalises rectal hyper-sensitivity in patients with irritable bowel syndrome. *Gastroenterology* 1999;**116**:A1009 (G4382).
- Silverman DHS, Munakata JH, Ennes H, et al. Regional cerebral activity in normal and pathological perception of visceral pain. *Gastroenterology* 1997;**112**:64-72.
- Mertz M, Morgan V, Tanner G, et al. Regional cerebral activation in irritable bowel syndrome and control subjects with painful and non-painful rectal distension. *Gastroenterology* 2000;**118**:842-8.
- Ford MJ, Camilleri M, Zinsmeister AR, et al. Psychosensory modulation of colonic sensation in the human transverse and sigmoid colon. *Gastroenterology* 1995;**109**:1772-80.
- Houghton LA, Prior A, Whorwell PJ. Effect of acute stress on anorectal physiology in normal healthy volunteers. *Eur J Gastroenterol Hepatol* 1994;**6**:389-92.
- Welgan P, Meshkinpour H, Beeler M. Effect of anger on colon motor and myoelectric activity in irritable bowel syndrome. *Gastroenterology* 1988;**94**:1150-6.
- Ford MJ, Miller PM, Eastwood J, et al. Life events, psychiatric illness and the irritable bowel syndrome. *Gut* 1987;**28**:160-5.
- Almy T, Kern F, Tulin M. Alteration in colonic function in man under stress. II: experimental production of sigmoid spasm in healthy persons. *Gastroenterology* 1949;**12**:425-36.
- Whorwell PJ, Houghton LA, Taylor EE, et al. Physiological effects of emotion: assessment via hypnosis. *Lancet* 1992;**340**:69-72.
- Thompson WG, Creed F, Drossman DA, et al. Functional bowel disease and functional abdominal pain. Working team report. *Gastroenterol Int* 1992;**5**:75-91.
- Jackson NA, Houghton LA, Whorwell PJ, et al. Does the menstrual cycle affect anorectal physiology? *Dig Dis Sci* 1994;**39**:2607-11.
- Whorwell PJ. Hypnosis and the gastrointestinal system. *Br J Hosp Med* 1991;**45**:27-9.
- Waxman D. *Hartland's medical and dental hypnosis*, 3rd edn. London: Bailliere Tindall, 1989.
- Lembo T, Munakata J, Mertz H, et al. Evidence for hypersensitivity of lumbar splanchnic afferents in irritable bowel syndrome. *Gastroenterology* 1994;**107**:1686-96.
- Accarino AM, Azpiroz F, Malagelada JR. Attention and distraction: effects on gut perception. *Gastroenterology* 1997;**113**:415-22.
- Weisenberg M, Raz T, Hener T. The influence of film-induced mood on pain perception. *Pain* 1998;**76**:365-75.
- Rhudy JL, Meagher MW. Fear and anxiety: divergent effects on human pain thresholds. *Pain* 2000;**84**:65-75.
- Naliboff BD, Munakata J, Fullerton S, et al. Evidence for two distinct perceptual alterations in irritable bowel syndrome. *Gut* 1997;**41**:505-12.
- Mayer EA. Spinal and supraspinal modulation of visceral sensation. *Gut* 2000;**47** (suppl 4):69-72.
- McCracken LM, Zayfert C, Gross RT. The pain anxiety symptoms scale: development and validation of a scale to measure fear of pain. *Pain* 1992;**50**:67-73.
- Whorwell PJ, Prior A, Farragher EB. Controlled trial of hypnotherapy in the treatment of severe refractory irritable bowel syndrome. *Lancet* 1984;ii:1232-3.
- Whorwell PJ, Prior A, Colgan S. Hypnotherapy in severe irritable bowel syndrome: further experience. *Gut* 1987;**28**:423-5.
- Houghton LA, Heyman DJ, Whorwell PJ. Symptomatology, quality of life and economic features of irritable bowel syndrome—the effect of hypnotherapy. *Aliment Pharmacol Ther* 1996;**10**:91-5.