Berry, J. and Drummond, P.D. (2014) Does attachment anxiety increase vulnerability to headache? Journal of Psychosomatic Research, 76 . pp. 113-120.

28 August, 2013

Does attachment anxiety increase vulnerability to headache?

Authors: Juanita K. Miller Berry, B.A. (Hons); Peter D Drummond, PhD

Author Affiliations: School of Psychology, Murdoch University, Perth, Western Australia, Australia

Address for correspondence: Professor Peter Drummond, School of Psychology, Murdoch University, Perth, 6150 Western Australia, Australia. Email: p.drummond@murdoch.edu.au

Conflict of Interest: None.

Key words: migraine, tension-type headache, attachment anxiety, attachment avoidance, psychological stress, personality

Abbreviations: T-TH: tension-type headache

ACC: anterior cingulate cortex

NEO-PI-R: NEO Personality Inventory – Revised

ECR: Experiences in Close Relationships

ABSTRACT

Objective. To determine whether adult insecure attachment dimensions were associated with headache or sensitivity to pain before, during or after stressful mental arithmetic in an episodic migraine and tension-type headache (T-TH) sample.

Background. The relationship styles of attachment insecurity, both anxious and avoidant, represent a vulnerability factor for chronic and acute pain but have not been investigated in relation to episodic headache sufferers or experimentally-evoked headache. These interpersonal styles are potentially important aspects of pain experience and management.

Methods. Thirty eight episodic migraine, 28 episodic T-TH and 20 headache-free participants intermittently received a mild electric shock to the forehead before, during and after stressful mental arithmetic. Encouraging feedback was provided by the experimenter before and after, but not during, the task.

Results. Attachment anxiety, but not attachment avoidance, was associated with the intensity of headache and forehead pain before and after, but not during the stressor. These relationships were independent of Five Factor Model personality traits. Neither attachment anxiety nor avoidance was associated with episodic migraine or T-TH.

Conclusions. Anxiously attached individuals may experience greater pain or show a stronger attentional bias toward painful sensations than securely attached individuals, even when emotional support is provided. However, distraction or pain-facilitation during psychological stress appears to override this attentional bias.

INTRODUCTION

Attachment style – an individual's habitual way of relating to a significant other - has been identified as a vulnerability factor in chronic headache [1, 2]. Headache sufferers are often anxiety-prone [3], possibly due to 'insecurity' in past and present attachments. Compared with secure attachment, insecure attachment, in either its anxious or avoidant form, predicted migraine-related disability in a chronic headache sample [1]. In addition, insecure styles were over-represented in a migraine, tension-type headache (T-TH) and chronic daily headache sample compared with controls (insecure 38.6% v 15.8%; avoidant 25.4% v 10.5%; anxious 13.2% v 5.3%) [2]. These findings are consistent with Meredith's Attachment Diathesis Model of Chronic Pain [4], in which attachment insecurity represents a vulnerability factor for both chronic and acute pain [5-7], as a temporary state and a more permanent trait [6, 8]. They are also consistent with a central tenet in attachment neurobiological research, wherein development of the regulatory functions of the experience-dependent (right) orbitofrontal cortex is compromised in individuals with an insecure attachment history [9, 10], an area which has been implicated in headache onset [11] and pain sensitivity in migraine sufferers [12].

Attachment theory, originally postulated by Bowlby [13], maintains that the quality of interactions with primary carers becomes internalized over time in the form of dispositional attachment orientations which guide affect regulation and support-seeking in situations of threat to the self [14]. Adult attachment styles are conceptualised along two dimensions [15]: *anxiety* regarding rejection or abandonment and *avoidance* of emotional intimacy or dependence. *Secure* individuals (low on both dimensions) are characterised by realistic threat appraisals, self-efficacy regarding threat-related management and outcomes, and effective regulation of affect [16]. In contrast, the negative model of self in *anxious* and *fearful* attachment results in hyper-vigilant scanning for, and selective attention to, threat-related stimuli, a tendency to interpret ambiguous stimuli as threatening and to recall threatening information [17, 18]. The negative model of others in attachment *avoidance* leads to orientation away from threat cues and under-utilisation of support [17]. *Fearful* individuals score high on both dimensions.

Theoretical models link attachment orientations to the development and maintenance of chronic pain [19] and this has been empirically supported. Secure attachment is associated with greater levels of control over pain [5], while attachment anxiety in pain-free samples was associated with heightened pain intensity, pain hypervigilance, increased pain-related fears, [20, 21], reduced pain threshold [4] and increased psychological distress [22, 23]. Since pain complaint may function as an attachment behaviour [24], avoidant individuals report less intense although more widespread pain [25], but only in the presence of an *unknown* assessor do they report higher pain intensity ratings and lower pain tolerances [7]. These associations are retained after controlling for measures of neuroticism, negative affect, age, and social desirability.

As attachment insecurity is associated with headache, it was hypothesised that attachment anxiety and avoidance would be greater in a community sample of migraine and T-TH sufferers than headache-free controls in the present study. A second hypothesis concerned the relationship of attachment insecurity to stress-related headache. The role of interpersonal stress/distress in headache onset was first alluded to by Wolff [26] for whom "the migraine headache represents a collapse of a way of dealing with life situations which are stressful to the individual" (p. 430). The neurologist Sacks [27] also described a migraine sub-type 'driven' by a chronic life situation in which the person feels caught in a 'malignant emotional bind' (p. 221). Experimental investigations have verified the link between psychological stress and headache onset. Cathcart et al. [28] reported that headache developed in 91% of patients with chronic tension-type headache (T-TH) during an hour-long stressful mental arithmetic task compared with only 4% of healthy controls. Similarly, Stronks et al. [29] observed that headache developed more frequently in patients with T-TH than in controls or migraine sufferers during stressful mental arithmetic.

A similar procedure was used in the present study. However, to counteract the possible influence of social support on stress or headache ratings during the arithmetic task, experimenter support was withdrawn during this phase of the experiment. Since psychological stress disrupts the individual's capacity to access mental representations of support [30], whereby "one feels in desperate need of immediate aid" [31, p.275], it was expected that insecure individuals would report greater headache and pain intensity than secure individuals during this stressful - uncontrollable and unpredictable [32] - laboratory task.

Neuroticism (negative affectivity) is a trait-related headache vulnerability factor identified in epidemiological studies [33, 34] - although infrequently measured by recommended [35] Five Factor Model measures such as the NEO-PI-R [36]. Since neuroticism correlates with attachment insecurity [37, 38], neuroticism may contribute to any relationship between attachment insecurity and headache. Research investigating the relationship of headache to other major personality factors is equivocal. A positive relationship is reported between extroversion (sociability) and pain threshold and tolerance [39-42] while other studies report no relationship, with pain [43-45] or with headache [46-51]. Low openness is associated with poor recovery in other health conditions [52] as well as in migraineurs visiting a neurology unit [53], and increased aggression-hostility is associated with migraine without (but not with) aura [49]. The relationship between migraine or T-TH and conscientiousness is unknown. Thus, a further aim of this study was to determine whether major personality traits contributed to any relationship between attachment insecurity and headache.

METHOD

Participants

A university undergraduate sample of 72 women and 14 men aged between 18 and 52 years were recruited by in-campus advertising to participate in "a study of the relationship between stress and head pain". Two groups were recruited separately - those who "regularly or frequently suffer from headaches", and those who "seldom experience headaches". Participants were excluded if they took headache or psychiatric medications, had a chronic medical or psychological condition or had used mood-altering drugs including alcohol in the previous 24 hours.

A standard clinical interview based on International Headache Society (I.H.S.) criteria [54] was used to assign people to the different diagnostic groups and, where appropriate, a medical opinion was sought. Thirty-eight participants met I.H.S. criteria for episodic migraine, 28 met criteria for episodic T-TH and 20 formed a headache-free control group (less than 6 headaches per year, with an average duration of less than an hour).

Participants provided informed consent for the procedures, which were approved by the Murdoch University Human Research Ethics Committee. Participants were paid $30 or awarded course credit points.

Assessment Instruments

The *Experiences in Close Relationships Questionnaire* (ECR) was used to measure attachment style. Participants were either currently in a romantic relationship or had been in one in the past. Each of the 36 items describes feelings generally experienced in intimate relationships and participants rate their agreement with each item on a 7-point Likert scale (1= *Strongly Disagree*; 7= *Strongly Agree*). This test is considered to have adequate validity and reliability [55, 56]. The Questionnaire, obtained from Martin Seligman at the Values in Action Institute, was scored at http://www.authentichappiness.sas.upenn.edu. This online scoring offers both categorical and continuous measures. The individual received a category measure in one of four attachment styles – Secure, Anxious (Preoccupied), Avoidant (Dismissing) and Fearful. We chose the more frequently used terms 'Anxious' and 'Avoidant' over 'Preoccupied' and 'Dismissing'. Continuous measures of attachment anxiety and attachment avoidance were also computed.

The NEO-PI-R [83] was used to measure five personality traits: neuroticism-emotional stability, extraversion-introversion, openness to experience-conservatism, agreeableness-antagonism and conscientiousness-impulsivity. The scales have good construct, convergent and discriminant validity, and test-retest reliabilities of between 0.75 and 0.83.

Procedures

Testing was conducted in two three-hour sessions, a week apart. In the first session, participants completed a structured headache interview and all psychological assessments. They were told that the following session would comprise a computer-scored "moderately stressful mental arithmetic task" designed to measure their "ability to handle mental stress".

In the second session, participants were seated in a quiet room maintained at 23° ± 2ºC. All participants initially were headache-free. A concentric electrode was attached to a cleaned site on the forehead on the usual side of headache for migraine sufferers and alternately on the left or right side for other participants. The electrode consisted of a copper wire cathode (0.5 mm diameter) centred within a stainless steel annular anode (internal diameter 10 mm and external diameter 20 mm), set to deliver monopolar square-wave pulses with a pulse width of 0.3 ms.

The experiment comprised three phases, each of 25 minutes duration – (i) preliminary (pre-stressor), (ii) stressful task and (iii) post-stressor. Procedures were presented by the same researcher (JB), and were similar during the pre- and post-stressor phases. In each phase, participants received three series of 2 mA electric shocks via the concentric electrode – the headache provocation procedure. Initially, ten shocks were delivered at 30 s intervals to minimize opportunity for habituation. These were followed by 20 shocks at 2 s intervals and another series of ten shocks at 30 s intervals.

In the preliminary phase, the experimenter interacted with the participant in a friendly manner, offering encouragement and engaging them in conversation about themselves and their work or studies. During the pre- and post-stressor phases, participants verbally rated headache, nausea and distress after each series of shocks between 0 and 10 where 0 corresponded to no sensation or distress, 1 to awareness of sensation or distress, 2-3 to mild, 4-6 to moderate, 7-8 to somewhat severe, 9 to severe, and 10 to extremely severe. Participants also rated electrically-evoked pain for each of the ten trials of the 30 s shock series (a mean pain rating was later computed). In addition, an overall pain rating was obtained following the series of 20 shocks delivered at 2 s intervals.

The second experimental phase, the stressful task, consisted of 25 minutes of difficult mental arithmetic. After two practice trials, participants were asked to rate headache and nausea on an electronic visual analogue scale by moving a cursor along a 10 cm line. Participants were told that their final score would be compared with those of others but were given no further information about the nature of the task, particularly its pre-determined 50%

maximum success rate. At no point during the arithmetic task did the experimenter interact with participants.

Mental arithmetic problems were delivered by a purpose-written computer program consisting of four five-minute sets of addition and subtraction exercises at three levels of difficulty (e.g., Level 1: 6 + 8 – 2; Level 2: 27 – 19 + 3; Level 3: 116 + 118 – 12). Participants were required to type answers within a designated time: 8, 12 and 15 s for each level of difficulty respectively. Incorrect answers or delay beyond the allotted time elicited a continuing unpleasantly loud beeping noise. Correct answers within the time frame earned a softer, more musical sound and terminated the beeping. Following three successful responses, subsequent arithmetic questions were automatically raised to the next difficulty level, or dropped a level following three incorrect answers. To maintain an overall 50% success rate, those participants who consistently scored correct responses within the time frame at the highest difficulty level were informed on screen that their responses were “too slow” and were subjected to aversive beeping regardless of their actual success.

To add to the stressfulness of the task, an audio recording of a crying baby was played, which steadily increased in volume and intensity. The 2mA shocks were delivered during each 5-minute arithmetic set, as follows: first set – no shocks; second set – ten shocks at 30 s intervals; third set – 20 shocks at 2 s intervals two minutes into the set; fourth set – ten shocks at 30 s intervals. Following each of the four arithmetic sets, participants again rated themselves on headache and nausea. To avoid interrupting the task, participants did not rate electrically-evoked pain. At the conclusion of the task, participants rated task stressfulness on a seven-point scale.

In the third (post-stressor) phase of the experiment, participants again rated headache, nausea and distress after each series of electric shocks and were debriefed by the experimenter.

Statistical approach

Questionnaire scores were compared among headache groups (migraine, T-TH, controls) with analysis of variance. Electrically-evoked pain was investigated in Group x Phase (preliminary, final) x Trial (the first 30s shock series, the 2s shock series, the second 30s shock series) analyses of variance. The multivariate solution (Wilks' Lambda) was used for factors with more than two levels. Headache, nausea and distress ratings during the preliminary and post-stressor experimental phases were investigated in similar analyses. Changes in headache and nausea during mental arithmetic were investigated in Group x Block (before arithmetic, and after each subsequent 5-minute block of arithmetic) analyses of variance. Effects of Anxious versus Secure Attachment on ratings of electrically-evoked pain, headache, nausea and distress were investigated in a similar series of analyses.

In addition, the association between continuous questionnaire measures (attachment anxiety, attachment avoidance, Neuroticism, Extraversion, Openness, Agreeableness and Conscientiousness) and mean headache, nausea, pain and distress ratings before and after mental arithmetic was explored with Pearson's correlation coefficient.

Results are presented as the mean ± standard error, and $p<0.05$ was considered to be statistically significant.

RESULTS

Attachment classifications for the 86 subjects were: Secure (n=57, 22 migraine, 20 T-TH, 15 controls); Anxious (n = 19; nine migraine, five T-TH, five controls); Avoidant (n = 6; three migraine, three T-TH) and Fearful (n = 4; all migraine). Small numbers within the Avoidant and Fearful categories precluded separate analysis of these attachment categories.

The task was rated as “moderately stressful” by most participants.

Headache groups

None of the assessed personality traits or attachment styles differed significantly among the migraine, T-TH and control groups (Table 1).

Headache ratings: Headache ratings were similar in each headache group during the pre- and post-stressor phases of the experiment (Table 1), but increased significantly during stressful mental arithmetic [main effect for Block, $F(4, 80) = 40.3$, $p<0.001$]. During the arithmetic task, moderate or severe headache developed in 43 participants (50%). Another 30 participants (35%) reported mild increases in headache, whereas headache was minimal or decreased in 13 participants (15%) (8 migraine, 2 T-TH, 3 controls). The proportion of participants who developed a moderate or severe headache was similar in the three headache groups (40% with a history of migraine, 54% with T-TH and 65% of controls).

Facial pain: Electric shocks at 2s intervals evoked greater facial pain than shocks at 30s intervals [main effect for Trial, $F(2, 85) = 54.0$, $p<0.001$] (Figure 1). Pain ratings to the 30s- interval shocks decreased across the course of the experiment whereas ratings to the 2s-interval shocks remained stable [interaction between Phase and Trial $F(2,85) = 8.84$, $p<0.001$] (Figure 1). Pain ratings were similar in each headache group (none of the main effects or interactions that involved Group achieved statistical significance).

Nausea: Ratings of nausea increased during stressful mental arithmetic [$F(1, 82) = 167.55$, $p < .001$], but were similar across the three headache groups throughout the experiment (Table 1).

Distress and perceived task stressfulness: Pain-related distress and task stressfulness ratings were similar in the three headache groups (Table 1).

Attachment insecurity and symptom ratings

During the pre- and post-stressor phases, participants in the Anxious attachment category reported greater headache and electrically-evoked pain than Secure participants [for headache, $F(1, 79) = 8.62$, $p<0.01$; for pain ratings, main effect for Category, $F(1, 81) = 13.5$, $p<0.001$] (Figures 1 and 2). As Figure 3 shows, pain-related distress before and after the task was also greater in the Anxious than Secure attachment category [$F(1, 81) = 4.57$, $p <.05$]. However, task stressfulness was similar in Secure and Anxious participants.

As shown in Table 2, both attachment anxiety and neuroticism were associated with pain, headache and pain-related distress before and after the task. However the relationship between attachment anxiety and pain ratings and headache was maintained after controlling for neuroticism in analyses of covariance [for headache, main effect for Category, $F(1, 75) = 6.44$, $p<0.05$; for electrically-evoked pain, main effect for Category, $F(1, 75) = 8.90$, $p<0.05$].

In contrast, increases in headache during stressful mental arithmetic were similar in the Anxious and Secure participants (Figure 2). Ratings of nausea were similar in both attachment categories across the experiment.

Attachment avoidance was unrelated to headache, nausea, pain ratings, or pain-related distress at any stage of the experiment (Table 2).

DISCUSSION

This study aimed to investigate whether insecure (anxious or avoidant) attachment was associated with episodic migraine or T-TH and with higher experimental pain and headache ratings during a headache provocation procedure (a) before and after a stressful task when experimenter support was offered; and (b) during an unpredictable and uncontrollable mental arithmetic stressor when experimenter support was absent. We also assessed whether the relationship between attachment styles and headache was independent of major personality traits.

Differences among headache groups

Our study failed to replicate findings of previous studies [1, 2, 57] in that neither categorical or continuous measures of attachment anxiety and attachment avoidance, nor Five Factor Model personality traits differed significantly among the migraine, T-TH and control groups at any point in the experiment.

These findings may reflect differences in sample age and composition. The mean age of our episodic migraine sample was 25 years compared with a mean age of 36.6 ± 8.8 years for chronic sufferers in a previous clinical study [1]. Savi and colleagues [2] combined results for episodic and chronic migraineurs. Our study excluded participants with depression or other Axis 1 disorders and those on medication of any kind, whereas the cited studies drew participants from headache clinics which also treated depression. Selection bias may thus be considerable [58], and headache chronicity a confound.

Our sample also differed markedly from large-scale population samples in attachment category membership, where 59% of adults were classified as secure, 25% as avoidant and 11% as anxious ambivalent, leaving 4.5% ‘unclassified’ [59]. Since attachment avoidance may be particularly under-represented in psychology undergraduate samples [60], our results may generalise only to equivalent undergraduate populations.

Also, contrary to other studies [61, 62], migraine and T-TH participants were no more likely than controls to develop a stress-related headache. This may relate to the provocation procedure itself, as stimulus strength was not manipulated. For example, the use of 2 mA stimuli to evoke head pain is in contrast with other studies which used a multiple of the sensory or pain threshold [63, 64]. In addition, our modifications to the arithmetic task, already a recognised stressful procedure in headache research [28, 29], may have "overshot the mark" in terms of stress induction, as the addition of the sound of a crying baby, electric shocks in the forehead, loud, unpleasant beeping and an ambiguous failure manipulation added to an already uncontrollable and time-pressured task produced a headache even in normally headache-free participants.

Secure versus anxious attachment and provoked headache

Compared with Secure attachment, participants in the Anxious attachment category had heightened vulnerability to pain, pain-related distress and headache before and after, but not during the arithmetic stressor. This effect of attachment anxiety was specific to headache and pain ratings, as the same effect was not found for nausea. These results were surprising because we expected that experimenter support before and after the stressful task would operate as a general protective factor or a stress-buffering mechanism [65, 66].

Why might this be so? The participant's relationship with the support provider, a previously unknown experimenter, may have been salient. Attachment is essentially a relational rather than trait-like construct, measured in relation to a particular individual with whom the person is intimate. The social bonding system is believed to "borrow" the pain system to signal when important relationships are threatened [31, 67]. For example, functional imaging studies show increased activity in the insula and dorsal anterior cingulate cortex (ACC) during situations of social threat or reduced social support [67, 68], but attenuated ACC activity generally requires the physical or emotional presence [68, 69] or availability [70] of a *significant* other. Hence the provision of support from an experimenter who was previously unknown to the participant may have lacked ecological validity in assessing the effect of attachment anxiety on headache and pain [9, 10, 71].

Related to this, an impersonal stressor such as arithmetic, compared with an interpersonal stressor such as rejection, is unlikely to activate attachment-related cognitions [9, 10, 71]. Within a self-regulation framework [72-74], stress theory predicts that psychological stress only occurs in the context of a threat to important life goals, which for most people includes belonging and participation in daily life [75], areas which are problematic for insecure individuals. Future research in this area should utilise interpersonal stressors, such as those which simulate social exclusion in an everyday context [67] or which measure partner effects in a dyadic context [6].

Finally, the type of ‘received support’ is salient [76], optimally functioning to actively direct the sufferer’s attention away from sensory and affective pain dimensions and towards pain self-efficacy [77]. In this study, despite her verbal encouragement of the participant, the experimenter frequently asked the participant to rate headache, pain, nausea and distress levels, potentially increasing their pain focus.

Thus, attentional factors rather than attachment anxiety *per se* may offer the best explanation as to why attachment anxiety predicted headache before and after but not during the stressor. Unless attention is *actively* directed elsewhere, painful stimuli will take precedence over competing painless stimuli [78]. Importantly, attentional biases towards threatening stimuli have been shown in anxiously attached individuals [79-81]. Furthermore, anxiety and attentional focus interact – for example, high anxiety participants were least pain tolerant in an *undirected* as compared with a distracted condition, while low anxiety participants were most pain tolerant [82].

Before and after the task no external distractions were available to participants. In contrast, the stressful task, even its failure manipulations [82], may have functioned as an attention-distractor from the sensory and/or affective aspects of the pain stimuli, over-riding the more subtle effects of attachment anxiety. Thus, in the pre- and post stressor phases, the combination of experimenter-directed attention to pain and a context devoid of other distractions may account for the elevated headache and pain reports in anxiously attached participants. In addition, secure individuals might be more able than anxious individuals to use internal distraction methods for managing pain, but this is a topic for future research.

CONCLUSIONS

This study appears to be the first to assess the components of attachment insecurity (anxiety and avoidance) in relation to headache diagnostic category in a non-clinical sample of episodic headache sufferers during headache provocation. Although attachment anxiety was similar in migraine, T-TH and control groups, it predicted headache, pain ratings and pain-related distress before and after a cognitive stressor. Results are consistent with Bowlby's [13] view of attachment as a psychobiological system of emotion regulation in which the anxiety component of insecure attachment plays a role in threat perception, as well as models in which attachment anxiety can operate as a vulnerability factor for chronic and acute pain and for headache [4, 5, 7].

This study aids in understanding the role of interpersonal factors in headache onset, originally described by Wolff [83]. Given the ubiquity of, and disability occasioned by, primary headaches [84], an understanding of headache vulnerability factors such as attachment insecurity is important. Insecurely attached individuals may not only be more susceptible to headache, but attachment style also affects pain beliefs, pain-related psychological distress [22] and exacerbates headache-related disability [1]. In addition, it impacts significantly on the patient-physician relationship [24], affecting treatment adherence and effectiveness in a range of chronic pain conditions [4]. Thus, knowledge of a patient's attachment style may aid in headache management and optimise treatment effectiveness in a variety of ways. In particular, our findings suggest that under certain conditions attachment anxiety exacerbates headache, pain, and pain-related distress. Therefore, managing this source of anxiety may help to reduce headache and associated distress.

STATEMENT OF AUTHORSHIP

Category 1

- **(a) Conception and Design** Peter Drummond, Juanita K. Miller Berry
- **(b) Acquisition of Data** Juanita K. Miller Berry
- **(c) Analysis and Interpretation of Data** Peter Drummond, Juanita K. Miller Berry

Category 2

- **(a) Drafting the Manuscript** Juanita K. Miller Berry, Peter Drummond
- **(b) Revising It for Intellectual Content** Juanita K. Miller Berry, Peter Drummond

Category 3

- **(a) Final Approval of the Completed Manuscript** Peter Drummond, Juanita K. Miller Berry

REFERENCES

[1] Rossi P, Di Lorenzo G, Malpezzi M, Di Lorenzo C, Cesarino F, Faroni J, et al. Depressive symptoms and insecure attachment as predictors of disability in a clinical population of patients with episodic and chronic migraine. Headache 2005;45:561-70.

[2] Savi L, Buccheri R, Tambornini A, De Martino P, Albasi C, Pinessi L. Attachment styles and headache. J Headache Pain 2005;6:254-7.

[3] Drahovzala D, Stewartab S, Sullivanc M. Tendency to Catastrophize Somatic Sensations: Pain Catastrophizing and Anxiety Sensitivity in Predicting Headache. Cogn Behav Ther 2006;35:226-35.

[4] Meredith P, Ownsworth T, Strong J. A review of the evidence linking adult attachment theory and chronic pain: presenting a conceptual model Clin Psychol Rev 2008;28:407-29.

[5] Meredith P, Strong J, Feeney J. The relationship of adult attachment to emotion, catastrophizing, control, threshold and tolerance, in experimentally-induced pain. Pain 2006;120:44-52.

[6] Wilson CL, Ruben M. A pain in her arm: Romantic attachment orientations and the tourniquet task. Pers Relationship 2011;18:242-65.

[7] Andrews N, Meredith P, Strong J. Adult attachment and reports of pain in experimentally-induced pain Eur J Pain 2011;15:523-30.

[8] Rowe A, Carnelley K, Harwood J, Micklewright D, Russouw L, Rennie C, et al. The effect of attachment orientation priming on pain sensitivity in pain-free individuals. J Soc Pers Relat 2012;DOI: 10.1177/0265407511431189.

[9] Schore A. Affect Dysregulation and Disorders of the Self: WW Norton; 2003b.

[10] Schore A. Affect Regulation and the Repair of the Self: WW Norton; 2003a.

[11] Henry É. Céphalées chroniques quotidiennes d'origine migraineuse et abus médicamenteux : le rôle central du cortex orbitofrontal. Douleurs 2011;12:272.

[12] Lev R, Granovsky Y, Yarnitsky D. Enhanced Pain Expectation in Migraine: EEG-Based Evidence for Impaired Prefrontal Function. Headache 2013;53:1054-70.

[13] Bowlby J. Attachment and loss: Vol. 1 Attachment. NY: Basic Books; 1969/1982.

[14] Hazan C, Shaver P. Romantic love conceptualized as an attachment process. J Pers Soc Psychol 1987;52:511-24.

[15] Brennan K, Clark C, Shaver P. Self-report measurement of adult attachment: An integrative overview. In: Simpson J, Rholes W, editors. Attachment theory and close relationships (pp 46-76). NY: Guilford Press; 1998.

[16] McWilliams L. Evaluating attachment theory as a framework for understanding pain-related appraisals and interpersonal concerns: University of Manitoba 2004.

[17] Mukilincer M. Adult attachment style and affect regulation: strategic variation in self-appraisals. J Pers Soc Psychol 1999;75:420-35.

[18] Mukilincer M, Shaver P. Attachment in adulthood: Structure, dynamics and change. NY: Guilford; 2007.

[19] Anderson D, Hines R. Attachment and pain. In: Grzesiak R, Ciccone D, editors. Psychosocial vulnerability to chronic pain (pp 17-152). NY: Springer; 1994.

[20] McWilliams L, Asmundson G. The relationship of adult attachment dimensions to pain-related fear, hypervigilance and catastrophizing. Pain Res Manag 2007;127:27-34.

[21] MacDonald G, Kingsbury R. Does physical pain augment anxious attachment? J Soc Pers Relat 2006;23:291-304.

[22] Ciechanowski P, Sullivan M, Jensen M, J R, Summers H. The relationship of attachment style to depression, catastrophizing and health care utilization in patients with chronic pain Pain 2003;104:627-37.

[23] Meredith P, Strong J, Feeney J. Adult attachment variables predict depression before and after treatment for chronic pain. . Eur J Pain 2007;11:164–70.

.

[24] Kolb L. Attachment behavior and pain complaints. Psychosomatics 1982;23:413-25.

[25] Davies K, Macfarlane G, McBeth J, Morriss R, Dickens C. Insecure attachment style is associated with chronic widespread pain. Pain 2009;143:200-5.

[26] Wolff H. Headache and other head pain (2nd ed). NY: Oxford University Press; 1963.

[27] Sacks O. Migraine (rev ed): Vintage Books; 1992.

[28] Cathcart S, Petkov J, Winefield A, Lushington K, Rolan P. Central mechanisms of stress-induced headache. Cephalalgia 2010;30:285-95.

[29] Stronks D, Tulen JH, Verheij R, Boomsma F, Fekkes D, Pepplinkhuizen L, et al. Serotonergic, Catecholaminergic, and Cardiovascular Reactions to Mental Stress in Female Migraine Patients. A Controlled Study. Headache 1998;38:270-80.

[30] Porges S. The Polyvagal Theory: Neurophysiological foundations of emotions, attachment, communication and self-regulation. NY: W.W. Norton & Co.; 2011.

[31] Panksepp J. Affective Neuroscience: The Foundations of Human and Animal Emotions: Oxford University Press; 1998.

[32] Koolhaas J, Bartolomucci A, Buwalda B, de Boer S, Flügge G, Korte S, et al. Stress revisited: a critical evaluation of the stress concept. Neurosci Biobehav Rev 2011;35:1291-301.

[33] Breslau N, Andreski P. Migraine, Personality and Psychiatric Comorbidity. Headache 1995;35:382-6.

[34] Breslau N, Chilcoat H, Andreski P. Further evidence on the link between migraine and neuroticism. Neurology 1996;47:663-7.

[35] Smith TW, Williams PG. Personality and health: Advantages and limitations of the five-factor model. . J Pers 1992;60:395–423.

[36] Costa PJ, McCrae R. The NEO Personality Inventory manual. Odessa, FL: Psychological Assessment Resources; 1985.

[37] Ognibene T, Collins N. Adult attachment styles, perceived social support and coping strategies. J Soc Pers Relat 1998;15:323-45.

[38] Anders S, Tucker J. Adult attachment style, interpersonal communication competence and social support. Pers Relationship 2000;7:379-89.

[39] Barnes GE. Extraversion and pain. Br J Soc Clin Psychol 1975;14:303-8.

[40] Lynn R, Eysenck H. Tolerance for pain, extraversion and neuroticism. Percept Motor Skills 1961;12:161-2.

[41] Petrie A, Collins W, Solomon P. The tolerance for pain and for sensory deprivation. Amer J Psychol 1960;73:80-90.

[42] Ramirez-Maestre C, López Martínez A, Zarazaga R. Personality Characteristics as Differential Variables of the Pain Experience. J Behav Med 2004;27:147-65.

[43] Wade JB, Dougherty LM, Hart RP, Rafii A, Price DD. A canonical correlation analysis of the influence of neuroticism and extraversion on chronic pain, suffering, and pain behavior. Pain 1992;51:67-73.

[44] Ben Debba M, Torgerson W, Long D. Personality traits, pain duration and severity, functional impairment and psychological distress in patients with persistent low back pain. Pain 1997;72:115-25.

[45] Harkins SW, Price DD, Braith J. Effects of extraversion and neuroticism on experimental pain, clinical pain, and illness behavior. Pain 1989;36:209-18.

[46] Belojević G, Jakovljević B, Aleksić O. Subjective reactions to traffic noise with regard to some personality traits. Environ Int 1997;23:221-6.

[47] Jahanshahi M, Hunter M, Philips C. The Headache Scale: an Examination of its Reliability and Validity. Headache 1986;26:76-82.

[48] Zuckerman M. Zuckerman-Kuhlman Personality Questionnaire (ZKPQ): An alternative five factorial model (Chapter 16, pp 377-396). In: De Raad B, Perugini M, editors. Big Five Assessment: Hogrefe & Huber; 2002.

[49] Cao M, Zhang S, Wang K, Wang Y, Wang W. Personality traits in migraine and tension-type headaches: a five-factor model study. Psychopathology 2002;35:254–8.

[50] Wang G, Ding X, Wang W, Wang Y. Personality and Response To Repeated Visual Stimulation in Migraine and Tension-Type Headaches. Cephalalgia 1999;19:718-24.

[51] Huang X-Q, Zhang Q, Yang X-L, Li Z-Y, He X-B, Luo L, et al. Personality traits, coping style and psychological locus of control of military patients with tension-type headache. Chin J Clin Rehab 2005;9:54-5.

[52] Cole S, Kemeny M, Fahey J, Zack J, Naliboff B. Psychological Risk Factors for HIV Pathogenesis: Mediation by the Autonomic Nervous System. Biol Psychiatry 2003;54:1444–56.

[53] Mateos MV, García-Moncó J, Gómez-Beldarrain M, Armengol-Bertolín S, Larios C. Personality factors, degree of disability and therapeutic management of patients with

migraine visiting a neurology unit for the first time (Psicomig study). Rev Neurología 2011;52:131-8.

[54] Headache Classification Subcommittee of the International Headache Society. The international classification of headache disorders, 2nd edition. Cephalalgia 2004;24:7-151.

[55] Conradi H, Gerlsma C, van Duijn M, de Jonge P. Internal and external validity of the Experiences in Close Relationships Questionnaire in an American and two Dutch samples. Eur J Psychiat 2006;20.

[56] Wei M, Russell D, Mallinckrodt B, Vogel D. The Experiences in Close Relationship Scale (ECR)-Short Form: Reliability, Validity, and Factor Structure. J Personal Assess 2007;88:187-204.

[57] Martin P, Theunissen C. The role of life event stress, coping and social support in chronic headaches Headache 1993;33:301-6.

[58] Rasmussen BK. Epidemiology of headache. Cephalalgia 2001;21:774-7.

[59] Mickelson K, Kessler K, Shaver P. Adult attachment in a nationally representative sample. J Pers Soc Psychol 1997;71:1092-106.

[60] Hazan C, Shaver PR. Love and Work, An Attachment-Theoretical Perspective. J Pers Soc Psychol 1990;59:270-80.

[61] Cathcart S, Petkov J, Pritchard D. Effects of induced stress on experimental pain sensitivity in chronic tension-type headache sufferers. Eur J Neurol 2008;15:552-8.

[62] Stronks DL, Tulen JH, Pepplinkhuizen L, Verheij R, Mantel G, Spinhoven P, et al. Personality traits and psychological reactions to mental stress of female migraine patients. Cephalalgia 1999;19:566-74.

[63] Giffin N, Katsavara Z, Pfundstein A, Ellrich J, Kaube H. The effect of multiple stimuli on the modulation of the 'nociceptive' blink reflex. Pain 2004;108:124-8.

[64] Katsavara Z, Giffin N, Diener H, Kaube H. Abnormal habituation of 'nociceptive' blink reflex in migraine - evidence for increased excitability of trigeminal nociception. Cephalalgia 2003;23:814 - 9.

[65] Landerman R, George L, Campbell R, Blazer D. Alternative models of the stress buffering hypothesis. Am J Commun Psychol 1989;17:625 - 42.

[66] Uchino BN. Social Support and Health: A Review of Physiological Processes Potentially Underlying Links to Disease Outcomes. J Behav Med 2006;29:377-87.

[67] Eisenberger N. Why rejection hurts: What social neuroscience has revealed about the brain's response to social rejection. In: Decety J, Cacioppo J, editors. The Handbook of Social Neuroscience. NY: Oxford University Press; 2011. p. (p. 586-98).

[68] Master S, Eisenberger N, Taylor S, Naliboff B, Shirinyan D, Lieberman N. A picture's words: Partner photographs reduce experimentally-induced pain. Psychol Sci 2009;20:1216-318.

[69] Gump BB, Polk DE, Kamarck T, Shiffman S. Partner interactions are associated with reduced blood pressure in the natural environment: Ambulatory monitoring evidence from a healthy, multiethnic adult sample. Psychosom Med 2001;63:423-33.

[70] Seltzer LJ, Ziegler TE, Pollak SD. Social vocalizations can release oxytocin in humans. Proc R Soc Lond [Biol] 2010 277:2661-6.

[71] Schore A. Affect Regulation and the Origin of the Self: The Neurobiology of Emotional Development 1994.

[72] Bouffar T, Bouchard M, Goulet G, Denoncourt L, Couture N. Influence of achievement goals and self-efficacy on students' self-regulation and performance. Int J Psychol 2005;40:373-84.

[73] Massey EK, Garnefski N, Gebhardt WA. Goal frustration, coping and well-being in the context of adolescent headache: a self-regulation approach. Eur J Pain 2009;13:977-84.

[74] Carver C, Scheier M. Stress, coping and self-regulatory processes. In: Pervin L, John O, editors. Handbook of personality: Theory and research (2nd ed, pp 553-575). NY: Guilford; 1999.

[75] Cantor N, Sanderson C. Life task participation and well-being: The importance of taking part in daily life. In: Kahneman D, Nener E, Schwarz N, editors. Well-Being: The Foundations of Hedonic Psychology: Russell Sage; 1999.

[76] Uchino B. Understanding the links between social support and physical health: A life-span perspective with emphasis on the separability of perceived and received support. Perspect Psychol Sci 2009;4:236-55.

[77] Boston A, Sharpe L. The role of threat-expectancy in acute pain: effects on attentional bias, coping strategy effectiveness and response to pain. Pain 2005;119:168-75.

[78] Eccleston C, Crombez G. The attentional control of pain - methodological and theoretical concerns. Pain 1999;63:3-10.

[79] Dewitte M, De Houwer J, Koster EH, Buysse A. What's in a name? Attachment-related attentional bias. Emotion 2007;7:535-45.

[80] Vrticka P, Andersson F, Grandjean D, Sander D, Vuilleumier P. Individual attachment style modulates human amygdala and striatum activation during social appraisal. PLoS One 2008;3:e2868.

[81] Vrticka P, Vuilleumier P. Neuroscience of human social interactions and adult attachment style. Front Hum Neurosci 2012;6:212.

[82] Arntz A, Dreesen L, De Jong P. The influence of anxiety on pain: Attentional and attributional mediators. Pain 1994;56:307-14.

[83] Wolff H. Personality factors and reactions of subjects with migraine. Arch Neurol Psychiatry 1937;37:895.

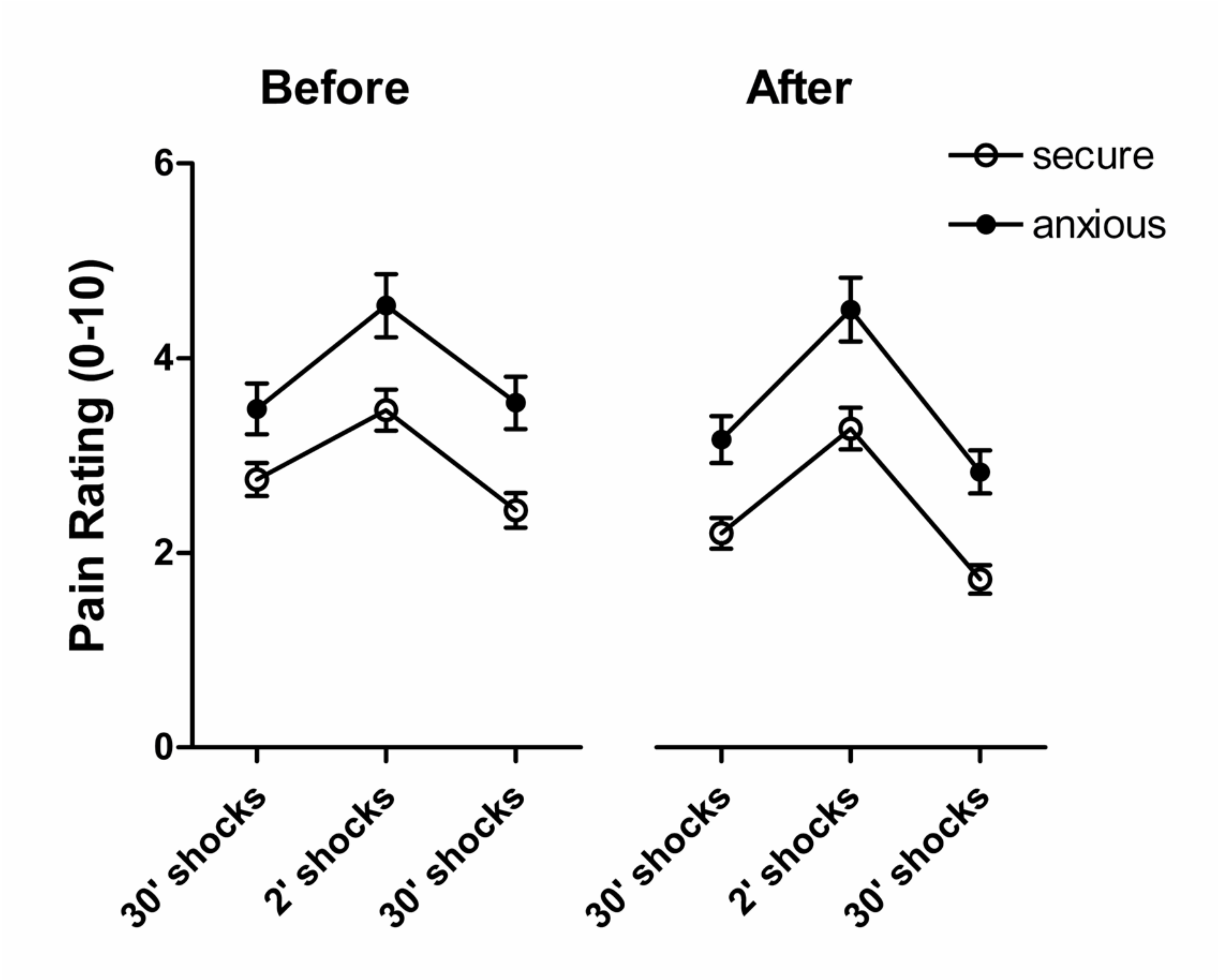
[84] Stovner L, Hagen K, Jensen R, Katsarava Z, Lipton R, Scher A, et al. The global burden of headache: a documentation of headache prevalence and disability worldwide. Cephalalgia 2007;27:193-210.

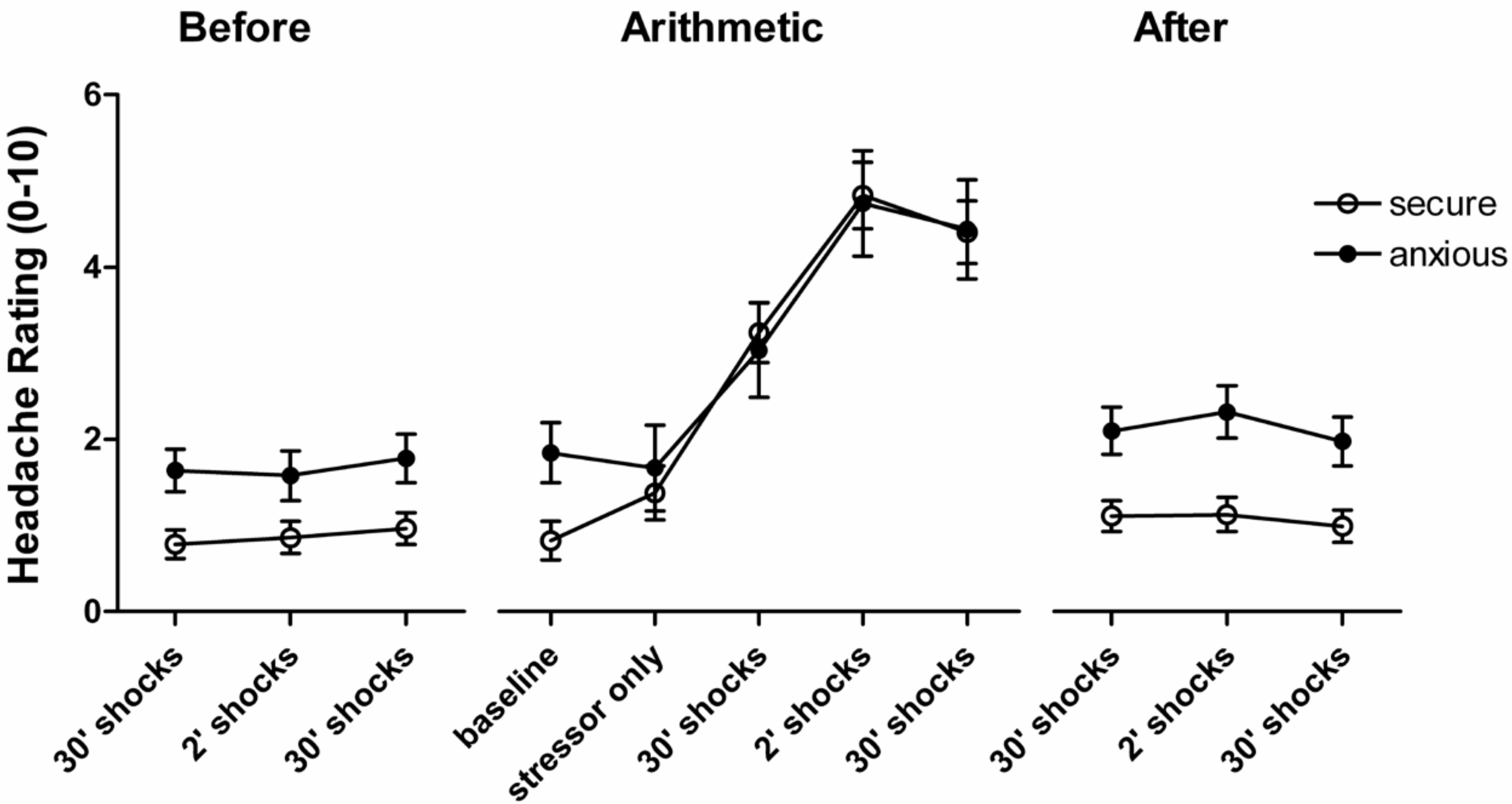
Figure legends

Figure 1. Electrically-evoked pain (± S.E.) before and after stressful mental arithmetic in 57 securely attached participants and 23 anxiously attached participants. Pain ratings were greater in anxiously than securely attached participants before and after arithmetic.

Figure 2. Headache ratings (± S.E.) before, during and after stressful mental arithmetic in 57 securely attached participants and 23 anxiously attached participants. Headache ratings were greater in anxiously than securely attached participants before and after arithmetic.

Figure 3. Pain-related distress ratings (± S.E.) before and after stressful mental arithmetic in 57 securely attached participants and 23 anxiously attached participants. Distress ratings were greater in anxiously than securely attached participants before and after arithmetic.


Before
After
secure
anxious
Pain Rating (0-10)
6
4
2
0
30' shocks
2' shocks
30' shocks
30' shocks
2' shocks
30' shocks


Before
Arithmetic
After
Headache Rating (0-10)
6
4
2
0
secure
anxious
30' shocks
2' shocks
30' shocks
baseline
stressor only
30' shocks
2' shocks
30' shocks
30' shocks
2' shocks
30' shocks

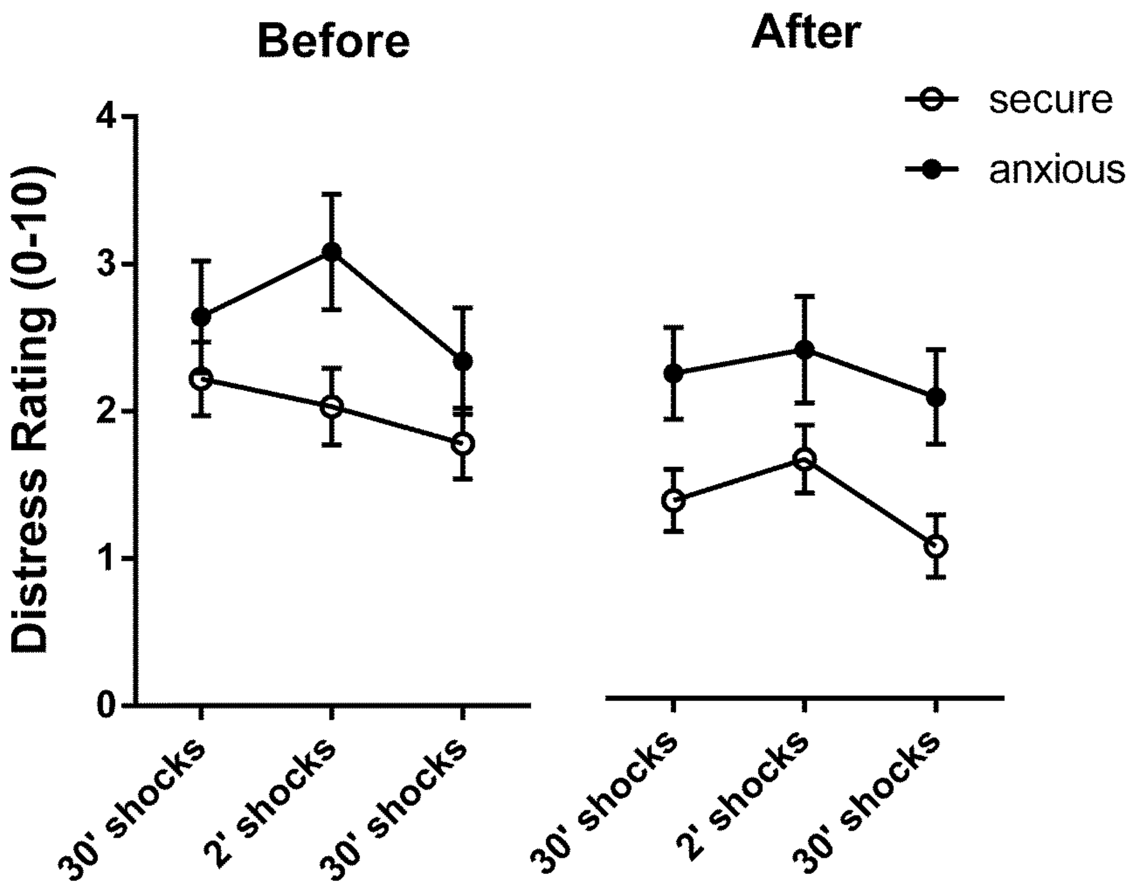

Before
After
secure
anxious
Distress Rating (0-10)
4
3
2
1
0
30' shocks
2' shocks
30' shocks
30' shocks
2' shocks
30' shocks

Table 1 Headache categories in relation to attachment, personality, evoked headache and nausea

	Migraine		T-TH		Headache-free Controls	
	Mean	*SE*	*Mean*	*SE*	*Mean*	*SE*
Attachment anxiety	3.31	0.17	2.98	0.2	3.43	0.26
Attachment avoidance	2.96	0.16	2.93	0.19	2.74	0.22
Neuroticism	97.72	3.86	96.5	4.55	98.17	5.42
Extraversion	116.59	2.87	119.18	3.38	118.39	4.51
Openness	129.23	3.09	125.29	3.65	124.89	4.49
Agreeableness	117.69	3.11	119.07	3.67	121.5	4.62
Conscientiousness	114.41	2.79	113.36	3.29	114.61	4.45
Headache before task	1.34	.22	.95	.23	1.0	.28
Headache during task	3.08	.33	3.0	.37	3.18	.45
Headache following task	1.86	.28	1.29	.28	1.27	.34
Pain before task	3.12	.20	2.68	.24	3.31	.30
Pain after task	2.69	.22	2.15	.25	2.68	.31
Nausea before task	.63	.16	.30	.19	.26	.23
Nausea during task	3.06	.31	2.97	.37	3.35	.45
Nausea after task	.82	.24	.77	.28	.42	.34
Distress before task	2.25	.28	1.93	.33	2.78	.41
Distress after task	1.67	.26	1.40	.31	1.86	.38
Rated stressfulness of task	4.52	.22	4.48	.26	4.30	.32

Table 2 Pearson Correlations between attachment dimensions, personality traits, headache, pain, distress, nausea and task stress

Trait	Headache before task	Headache during task	Headache after task	Pain before task	Pain after task	Pain distress before task	Pain distress after task	Nausea before task	Nausea during task	Nausea after task	Perceived task stress
Attachment anxiety	.258*	-.011	.275**	.265*	.308**	.310**	.297**	.040	.023	-.028	.117
Attachment avoidance	-.099	-.093	.110	.092	.138	.117	.116	.078	-.128	-.031	.013
Neuroticism	.248*	.169	.241*	.108	.151	.277*	.240*	.177	.168	.218*	.149
Extraversion	.009	.139	-.130	.169	.093	.108	-.083	-.077	.121	-.100	.195
Openness	-.108	-.187	-.068	-.162	-.162	-.157	-.220*	.022	-.229*	-.138	.043
Agreeableness	-.013	.080	-.008	.045	.033	.121	.014	-.005	.140	-.029	.096
Conscientiousness	.009	-.077	.052	.076	.129	-.064	.141	-.078	-.066	-.042	-.154

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).