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Highlights

- Goal-directed attention control may contribute to pain interference in adolescence
- We measured attention control with an face emotion priming visual search task
- Slower reaction times emerged on trials with pain face primes than neutral trials
- Low load conditions amplified effects of pain faces in youth with interfering pain

Greater response interference to pain faces under low perceptual load conditions in adolescents with impairing pain: A role for poor attention control mechanisms in pain disability?

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Abstract

Persistent pain in young people in the community is common but individuals vary in how much pain impacts daily life. Information-processing accounts of chronic pain partly attribute the fear and avoidance of pain, and associated interference to a set of involuntary biases, including the preferential allocation of attention resources towards potential threats. Far less research has focused on the role of voluntary goal-directed attention control processes, the ability to flexibly direct attention towards and away from threats, in explaining pain-associated interference. Using a visual search task, we explored a poor attention control account of pain interference in young people with persistent pain from the community. One hundred and forty five young people aged 16-19 categorised as non-chronic pain (n=68), low interfering persistent pain (n=40), and moderate-to-high interfering persistent pain (n=22) provided data to support our hypotheses that only adolescents with moderate-to-high interfering persistent pain were affected by pain (than neutral faces) presented before a visual search than the other two groups of adolescents, but only under low perceptual load conditions. Because low perceptual load conditions are thought to require more strategic attention resources to suppress the interfering effects of pain face primes, our findings are consistent with a poor attention control account of pain interference in young people. Analyses further showed that these differences in task performance were not explained by confounding effects of anxiety. If replicated, these findings may have implications for understanding and managing pain-associated disability in adolescent chronic pain.

Keywords: attention control; adolescent pain; interference; cognitive model

Perspective: Young people with moderately/highly interfering pain responded slower on an easy search task after seeing a pain face than a neutral face. If replicated, these findings could mean that boosting the ability to control attention towards and away from threatening cues is an effective strategy for managing interference from pain.

Chronic pain is common in young people [16]. Some adolescents with pain experience significant interruptions to functioning [9; 19] [28]. Yet, there are few interventions that effectively reduce pain-linked disability [8]. Better understanding of factors influencing disability within adolescent chronic pain could inform treatment innovation [7]. Information-processing accounts of chronic pain, which attribute fear and avoidance and disability to biases in early threat classification could provide this understanding [17].

Indirect support for attention-processing models of pain comes from research demonstrating an increased allocation of attention resources towards bodily 'threats' [6; 26] particularly in adults with chronic pain [4; 24]. Such biased attention patterns may emerge through involuntary bottom-up mechanisms that orient and evaluate the threatening value of stimuli and voluntary top-down inhibitory control mechanisms that serve to suppress attention to threatening stimuli when these are irrelevant and interfere with a primary goal [5; 27]. Both these involuntary and voluntary components of selective attention have been used to explain anxiety [2; 11; 21], which commonly co-occurs in adolescent chronic pain. Notably, anxious youth show increased attention-orienting for threat but also weak attention control [10; 22]. In youth with pain, evidence for biased attention-orienting for threat is mixed. Far fewer studies have measured attention control with conflicting findings. One study of 16-18 year olds showed that poor attention control exacerbated attention-orienting biases for threat in those with high pain catastrophising [14]. The same association was not found in a younger sample aged 8-17 years [13], possibly because attention control only matures in late adolescence [20]. Neither study investigated whether this attention-inhibitory process associated with pain disability.

This study assessed whether poor attentional control characterises young people with persistent interfering levels of pain. We used an emotion-priming visual search task [1; 11] to assess hypotheses around the ability of adolescents with no/low pain, and those with high and low-interfering pain to maintain goal-directed attention when confronted with primes symbolising pain. As pain-relevant stimuli attract attention, we expected all adolescents to show greater difficulties maintaining goal-oriented attention following pain-relevant primes than neutral primes. However, we predicted these difficulties to be exaggerated in adolescents with high-interfering pain, compared to non chronic pain participants and those whose pain produces little interference. We further explored these expected pain-related differences as a function of perceptual load. As perceptual load manipulations can affect processing capacity for pain-relevant distractors [18], this can influence engagement of attentional control mechanisms necessary to maintain goal-directed behaviour. Because low perceptual load conditions are less taxing, greater interference from pain-relevant primes would be expected, amplifying individual differences in attentional control. Therefore, those with high-interfering pain were hypothesised to show poorer task performance on trials containing pain-relevant primes (than trials containing neutral primes) during low-perceptual load conditions. As high accuracy rates have been found on this visual search task [11], we examined differences in reaction time. As earlier findings showed the effects of attention control in relation to pain catastrophising in 16-18 year olds, we also examined these questions in older adolescents. To assess the specificity of these findings to pain, anxiety was controlled for in these analyses.

Material and methods

Sample

Two-hundred and forty-three participants aged 16-19 years were recruited to a study of pain experiences in the community from five schools in London. However, the current study only reports on data from the visual search task from 145 of these young people (see **Figure 1** for details of data attrition). Technical difficulties in one of the five schools meant that 41 participants were not able to complete the visual search task, leaving only 202 participants with data on this task. Of these 202, 57 did not have enough ‘valid’ trials after a process of data cleaning (i.e. removing trials with missing data, inaccurate responses or responses that were too fast/too slow relative to that particular participant). Demographic characteristics, pain group allocation and subsequent task performance are therefore reported for these 145 young people only (Table 1). Of note, these 145 young people did not differ from the initial 243 participants on any demographic characteristic, or in pain group (all p's > 0.05). Many young people were unable to or preferred not to report on household income; of those who did, 12.4% reported incomes of under £20,000; 13.8% incomes of between £20,000 and £40,000; 5.5% incomes of between £40,000 and £60,000; 5.1% of between £60,000 and £100,000; and 9% above £100,000.

Pain group was determined using self-reported items taken from a measure used previously to quantify the presence of pain experiences and their impact in daily life amongst young people in the community [12]. Participants were allocated to the ***Non chronic pain comparison*** group (n=68) on the basis of responding 'no' to the item 'Have you been feeling any pains for longer than 3 months?' and who experienced pain less than once a week in response to the item 'How often have you felt aches or pains in the last 3 months?'. As we were interested in the role of attention control in explaining variation in the impact of pain rather than pain intensity, we identified ***adolescents with pain but with no or low interference to daily life*** (n=40) as those who responded 'yes' to the item 'Have you been feeling any pains for longer than 3 months?' but who gave a rating of between 1 and 4 (out of 10) when asked 'How much has pain interfered with you doing activities that other people your age do, in the last 3 months?'. Finally, ***adolescents with pain and with moderate to high levels of interference*** (n=22) were defined as those who also responded 'yes' to the item 'Have you been feeling any pains for longer than 3 months?' but who gave a rating of between 5 and 10 (out of 10) when asked 'How much has pain interfered with you doing activities that other people your age do, in the last 3 months?'. We selected '5' as a cut-off score as previous studies have shown that a score of at least 4-5 on a scale of 10 reflects at least moderate levels of a pain experience [15]. To confirm the validity of these categories, we sought to assess whether there were significant differences between the three groups on other indices of pain, for example, average levels of pain over the last 4 weeks, $F(2,100) = 23.79, p < .001$; last 3 months, $F(2,100) = 28.48, p < .001$; the intensity of the most amount of pain experienced, $F(2,128) = 18.84, p < .001$; and pain effects on missing school $F(2,124) = 5.27, p < 0.01$ (pair-wise comparisons, 0.001 < all p's < 0.05 with exception to the high and low-interfering pain group on missing school).

Emotion-Priming Visual Search Task

The current task (Figure 2) was a conjunction visual search task, in which participants were instructed to identify a target amongst arrays of distractors, after the presentation of a face prime displaying pain or neutral emotion, or a non-face scrambled control stimulus. Each trial started with a fixation cross (500ms), followed by the face (pain, neutral) or non-face (scrambled) stimulus (300ms). Images of four male and four female actors [25] displaying pain or neutral expressions were selected from a standardised database; the actors were presented in a random order across trials across participants. The pictures depicting the faces were all presented at a size of 2.9 by 4.2 inches and centred on the computer screen so that the nose of the stimulus replaced the previously presented crosshair. All faces were grey scaled, and cropped to fit within a 2.9 by 4.2 inches oval, thus controlling for variations in colour. The scrambled face used was a picture of a female actor presenting a neutral face, divided into various small squares and changing the position of each square so that the face appeared scrambled. Moreover, these faces never overlapped with the locations of any of the visual search targets (targets are on average approximately 1.65 inches from the nearest edge of the face oval). This was to ensure that no target location was inhibited or primed by prior visual stimuli. Consistent with prior studies [1; 11], there was another fixation for a 600ms duration between the face prime and visual search onset. This was to allow for disengagement from the face prime stimuli prior to the visual search. A visual search array including a target and distractors was then presented for 2000ms. The target was a slanted black bar embedded amongst white vertical bars, white slanted bars, and black vertical bars. Participants had to find this target and indicate the direction that it is slanted (left or right) via the keyboard to record accuracy and response time (RT). If the participant failed to make a response in this time or pressed a key that was not the left or right arrow key, this was recorded as missing for both accuracy and RT. As well as varying in face emotion, trials also differed in perceptual load, based on the number of distractors present in the array, with 1 distractor (low load), 4 distractors (intermediate load), or 29 distractors (high load). There were 20 trials of each face emotion (pain, neutral, non-face control) by distractor number (low, intermediate, high) condition, with 180 trials in total. E-prime software created a random order of trials per each participant so that no two participants saw the same presentation of trials.

We adapted the current task from that of Haas and colleagues [11] who presented face primes displaying anger, fear, happy, surprise, or neutral expressions, or were scrambled, to adults high and low in social anxiety, under 4 perceptual load conditions (0 distractors, 4 distractors, 14 distractors and 29 distractors). Timing for the presentation of the different events in the Haas study were the same as those reported here, and were based on an earlier visual search task designed by Becker [1], which was designed to assess whether fear face primes facilitated search efficiency for non-threatening objects over neutral and happy face primes in neurotypical adults.

To clean the data, we began with 202 participants who completed this task. A total accuracy score across trials and for each of the 9 trial types was computed. Overall accuracy across the 202 participants was 85% (SD = 24%) but 16% (n=32) of individuals had an accuracy of less than 75% (across trials). Of note, 23 of these individuals came from one school. For the analysis of RT data, we first distinguished ‘invalid’ trials from ‘valid’ trials at the participant level. Where the response was inaccurate, missing or where the RT fell outside of the mean ± 3SD for each individual (across trials) were considered 'invalid'. Next, across all participants, we removed trials which were not maximally reliable (i.e. internally consistent) for that trial-type (pain low load, pain intermediate load, pain high load, neutral low load, neutral intermediate load, neutral high load) using a confirmatory factor modelling approach in MPlus to exclude trials that did not load onto a single factor with other trials [23]. More specifically, we specified that all trials would load onto a single factor for each trial-type, and in subsequent models, removed items that had a factor loading of less than 0.40. These removed, for all participants, trials thought to reflect measurement error. Using this approach for pain trials, two trials were removed (for all participants) for the low distractor conditions. For both the intermediate and high distractor conditions, no trials were discarded for computation of mean RT scores. For neutral trials, again two trials were removed (for all participants) for the low distractor condition but none for the intermediate and high distractor conditions. For the non-face scrambled trials, no trials were discarded. Overall model fits of the one-factor models without removing any trials were adequate: CFI values varied from 0.73 to 0.96; TLI values varied from 0.70 to 0.95; and RMSEA varied from 0.05 to 0.10 More particularly, for the two conditions where discrepant trials were removed, fit statistics were: Pain low distractor condition, CFI = 0.73, TLI = 0.70, RMSEA = 0.10 while for the Neutral low distractor condition, CFI = 0.80, TLI = 0.78, RMSEA = 0.09). Because the purpose of model fitting was to identify trials that did not cohere with others (to boost the reliability of trials that would subsequently be averaged) rather than for hypothesis-testing, no other models were tested. This approach is analogous to removing items from a questionnaire scale on the basis of internal consistency statistics. This left 18 trials for each of the low distractor conditions and all 20 trials for the other conditions, upon which mean RTs were calculated. However, mean RTs for each trial type were only calculated for participants who had valid data on 75% of these selected trials (at least 13 of the 18 trials on each of the low distractor conditions; at least 15 on the 20 trials for the remaining conditions); this ensured that there were an adequate number of trials per condition to generate a meaningful average. This left the 145 young people who are reported, in the final analysis.

Procedure

Ethical approval for this study was sought from the King's College London Research Ethics Committee. All testing was conducted during class-time at school. After obtaining consent from participants, they were tested simultaneously as a group with at least two experimenters present to ensure that participants were able to ask questions if they did not understand the task and to minimise any conversations between participants during completion of tasks and questionnaires. After obtaining informed consent, participants were instructed to complete a demographic form containing information about their date of birth, gender identity, ethnicity group, their first language, and if known, their parental educational levels and income. Participants then completed the cognitive control task followed by a questionnaire containing items around pain experiences and the Revised Child Anxiety and Depression Scale. Participants were then thanked for their time and emailed a £5 gift voucher, together with a brief summary of the findings around two weeks after data collection.

Statistical analysis

Pain groups were first compared on the non-face scrambled stimuli to ensure no accuracy and RT differences on a baseline condition across groups. Next, we performed 2x3x3 mixed design ANOVA with face emotion (pain, neutral) and perceptual load (low, intermediate, high) as within-subject factors and pain group (non chronic pain, no/low-interfering chronic pain, moderate/high-interfering chronic pain) as the between-subject factor on RT. Because our error rates were higher than previous studies, we also performed analysis on accuracy. To explore whether any of the pain group differences were driven by anxiety, these analyses were repeated with anxiety symptoms as a continuous covariate.

Results

There were no differences between pain groups in terms of age *F* (2,111) = 0.31, *p* = 0.74, gender $X^2(2) = 1.39$, *p* = 0.50, ethnicity $X^2(10) = 6.81$, *p* = .74, school attended $X^2(6) = 9.58$, *p* = .14, or native language $X^2(2) = 0.81$, *p* = .67 (**Table 1**). Mean anxiety T-scores for each of the three groups are also presented in Table 1. Significant differences emerged across groups, F(2,135) = 8,75, *p* < 0.001 with significant comparisons between the high and low-interference groups and the non chronic pain group (both p's < 0.05) but a non-significant difference between the high and low pain interference groups (p = 0.10).

Pain analysis

Scrambled non-face primes (RTs and accuracy): Analyses performed on **RTs** and **accuracy scores** to trials containing the scrambled non-face baseline stimuli showed only a main effect of perceptual load on RT, F(2,272) = 404.40, p < 0.001. There was a graded effect of load on RT where the fastest RTs were observed to the condition with the fewest number of distractors, followed by the intermediate number of distractors, and the slowest RTs to the high load (all pairwise p's < 0.001). There were no significant effects predicting accuracy and no effects of group on RT or accuracy.

Pain and neutral face primes (RTs): The 2x3x3 mixed design ANOVA performed on **RTs** of accurate, range-corrected, and internally consistent trials revealed significant main effects of face emotion, *F(1,254) = 9.34, p=0.003* and perceptual load, *F(2,254) = 465.05, p < 0.001,* as well as a significant 2-way interaction between these, *F(2,254) = 9.57, p<0.001*. The 3-way face emotion x load x pain interaction was also significant, *F(4,254) = 2.79, p < 0.035*. There were no 2-way interactions between pain group with face emotion or perceptual load, nor a main effect of pain group (all p's > 0.57). Main effects of emotion were driven by longer RTs to pain versus neutral trials, while main effects of perceptual load reflected increasing RTs with increasing number of distractors as described above (all pair-wise p's < 0.001). We decomposed the 3-way interaction by investigating emotion and pain group effects on RTs for each perceptual load condition (**Figure 3**). For the high perceptual load condition, there was only a significant main effect of emotion, $F(1,135) = 13.74$, $p < 0.001$, indicating longer RTs for pain than neutral trials. For the intermediate perceptual load condition, there were neither main nor interaction effects between emotion and pain group (all p's > 0.08). Finally, for the condition with the lowest perceptual load, a significant interaction between emotion and pain group emerged, $F(1,138) = 5.14$, $p = 0.007$. Examining each group separately, the face emotion effect was only significant for the moderate/high-interfering pain participants, $t(22) = 3.17$, $p<0.01$ where slower RTs were found for pain than neutral trials. No pain group differences were significant when examining pain trials and neutral trials separately.

Pain and neutral face primes (accuracy): Analyses performed on **accuracy scores** to the pain and neutral face trials revealed a significant main effect of perceptual load, $F(1.83,330) = 3.75$, $p = 0.028$ and a significant interaction between face emotion and pain group, $F(2,330) = 3.42$, $p = 0.035$. All other main effects and interactions were not significant (all p's > 0.102). The main effect of perceptual load was driven by greater accuracy in the condition with the fewest number versus greatest number of distractors, $t(191) = 2.65$, $p = 0.009$, but non-significant differences between the other conditions (p's > 0.054). To unpack the face-emotion-by-pain-group interaction, we first compared accuracy scores to pain trials versus neutral trials (collapsed across perceptual load) in each group separately. The low-interfering pain group performed significantly more accurately on pain relative to neutral trials, $t(48) = 2.30$, $p = 0.026$. The other groups did not vary in accuracy across trial types (p's>0.10). Unpacking the interaction by comparing groups on accuracy for pain and neutral trials (collapsed across perceptual load) separately, we found no significant group differences on each trial (all ps > 0.945).

Anxiety analysis

All the 2x3x3 mixed ANOVA with pain groups on accuracy and RT data were re-run as ANCOVAs with anxiety as a continuous covariate. While the two-way interaction between face emotion and perceptual load was no longer significant, the critical three-way interaction between face emotion, perceptual load and pain group remained significant (p = 0.03). Breaking this down revealed the crucial 2-way interaction in the low perceptual load condition between pain group and face emotion, suggesting that the pain group differences were not driven by anxiety. There was also no significant main effect of anxiety or interactions between anxiety and other factors (all p's > 0.14).

Discussion

The goal of this study was to investigate cognitive factors that could potentially explain variability in the impact of persistent pain on daily functioning. To probe attention control differences between adolescents with varying degrees of interfering pain, we compared effects of task-irrelevant (pain and neutral) primes on subsequent visual search performance under different levels of perceptual load (task difficulty). Participants generally performed in a way that conformed to task expectations: showing slower RTs and lower accuracy under high relative to low perceptual load conditions, and slower RTs to trials containing pain relative to neutral primes. However, levels of pain-related functioning also predicted task performance. When primed with faces displaying pain emotions, adolescents with persistent pain reporting moderate to high impairment were slower at identifying a target amongst distractors, under low-load task conditions, relative trials that were preceded by a neutral face prime – a pattern that did not characterise the other two groups of adolescents. Because faces displaying pain may be more likely to be processed further under low perceptual load conditions, arguably, more attentional resources may be required to suppress their effects during the visual search task. Thus, these findings can be interpreted as being consistent with a weak attentional control account of pain interference in adolescents with more persisting pain in the community. However, a more positive finding was that when task demands increased, that is, under intermediate and high perceptual load conditions, even adolescents with pain that imposed moderate to high levels of interference, a pain-related prime did not result in modulations in speed (or accuracy) of target detection. Importantly, the same findings associated with pain emerged even after controlling for a continuous measure of anxiety.

Before study implications are discussed, caveats that limit interpretations should be considered. First, demographic characteristics of this sample constrain the generalizability of these findings. Only young people aged 16-19 years were assessed, due to their availability for testing during school hours. As rates of some chronic pain conditions may increase across adolescence [16], and as attention control and its neural substrates show protracted maturation across this juncture [3; 20], different associations between pain, disability and cognitive control may characterise other ages within adolescence. Future studies should explore these interactions with age. Similarly, our sample was largely female, and although we had some male participants, we were still inadequately powered to examine interactions between gender and pain group on task performance across trial type and perceptual load. Related to issues around sample representativeness, it is worth noting that of the study sample administered this task (n=202), around 28% of participants' data was excluded because of high rates of inaccuracy. These participants were mainly from one school, with several reasons for the high error rates, including but not limited to inattention due to group testing conditions, poor comprehension of instructions, and low cognitive ability. Although we did not collect data on school attainments or cognitive ability of participants, it is noteworthy that this school was an under-performing school in a deprived area in London. Future studies should assess visual search performance under individual testing conditions. These exclusions also raise questions over the degree to which these findings generalise to all young people. Second, we did not assess whether young people recognised the pain face expressions as representing pain. To attribute these findings to pain faces, one should ask participants to identify the expressions in a post-task assessment. However, dynamic versions of these facial expressions have been discriminated from faces displaying other face emotions on the basis of the Facial Action Coding System and on volunteer rating data [25], confirming the distinct configuration and recognition of pain amongst observers. A separate issue is that as we only presented participants with three trial types: those containing pain, neutral or scrambled faces, the absence of other negative but non-pain faces, such as fear or anger meant we could not inform the specificity of our findings to pain. Third, pain group and associated functional interference were determined on a few questions rather than a diagnostic tool to establish chronic pain and/or the use of a more comprehensive questionnaire on the domains of functional interference. Our participants were also recruited through schools, suggesting that interference levels were likely to be far milder than a clinical sample. The work would be augmented if these preliminary findings were extended to patient samples meeting clinical diagnosis for pain chronicity and clinically-relevant functional impairment. Finally, recent criticisms of experimental tasks have focused on the lack of consideration for psychometric properties. Although, we are yet unsure of the inter-time reliability of the present task, the use of a factor modelling approach to exclude trials that did not cohere with other trials in the same condition was conducted to maximise scale reliability.

Despite these limitations, our findings raise some new considerations for information-processing accounts of interference, and potentially disability in adolescent pain. As with adults, cognitive models of chronic pain in children and young people attribute fear and avoidance within pain trajectories to biases in the early classification of pain [17]. Becoming increasingly attentive and vigilant towards threats (and interpreting ambiguous cues as threatening), are thought to maintain fear and anxiety, and drive avoidance, leading to a vicious cycle of disability and chronic pain. These models have rarely considered whether other more voluntary and strategic processes such as attention control could also play a role in pain-linked interference and disability. Our data provide preliminary support that weaker attention control is associated with functional impairment and potentially disability in adolescent chronic pain. However, these findings cannot shed light on the direction of effects: whether weak attention control precedes pain and influences impairment, or whether pain disrupts attention control by depleting processing resources. These findings also do not inform how attention control co-acts with more involuntary, automatic attention and interpretation biases on pain outcomes. It is possible that attention control is an independent factor, but is correlated with information-processing biases, perhaps because pain experiences influence both these aspects of cognitive processing. A second possibility is that low attention control interacts with other relevant trait factors such as pain catastrophising, to give rise to biased interpretation and attention. Indeed, data has shown that individuals with low attention control, but also high pain catastrophising, could be more likely to manifest involuntary biases in attention [14]. These complex inter-relationships will require further empirical verification, but preferably, within studies that also aim to replicate our initial pattern of findings to other independent samples.

In summary, previous approaches to studying variability in pain experiences have tended to conflate pain intensity ratings and pain-associated functioning in youth. Here, we investigated cognitive factors in pain-associated functioning, by assessing differences between those with persistent pain who reported low versus moderate-to-high interference. We provide preliminary data testing whether attention control capacities during the presentation of goal-irrelevant pain information are weaker in young people with pain with moderate to high impact. We found that only under low perceptual load conditions, when goal-irrelevant pain primes are more salient and require greater attention control, did subtle group differences emerge. Those with moderate/high-interfering pain struggled to respond as quickly on a probe search task in trials that contained pain face primes, than to trials containing neutral face primes. These findings did not extend to those with little or no chronic pain symptoms or those with no/low-interfering pain – and were also independent of anxiety symptoms. Although future studies should first aim to reproduce our findings using the current tasks, it is noted that attention control could be measured using different behavioural tasks and possibly other psychophysiological and neural indices of task performance as well. Another finding that also requires further replication is whether under conditions of intermediate and high perceptual load conditions, young people with pain reporting moderate to high levels of functional impairment, indeed respond as quickly to a primary task following the presence of a pain prime relative to the presence of a neutral prime. This could have implications for pain management strategies and/or rehabilitation efforts, where the setting of more effortful goals could temporarily allow suppression of irrelevant pain cues.

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List of figures

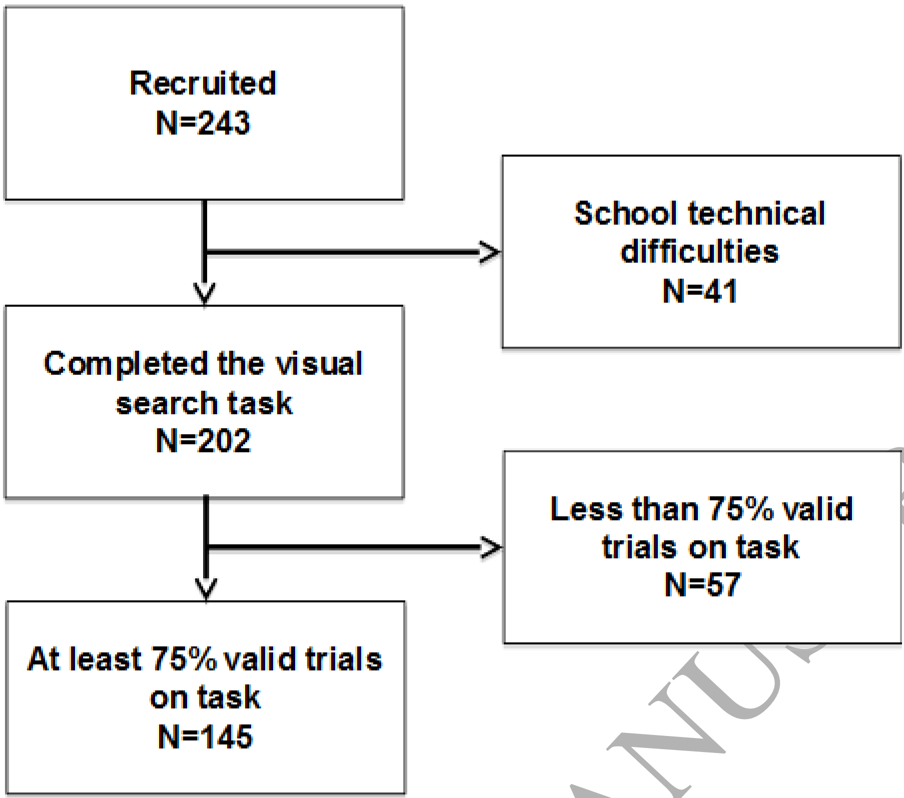

Figure 1: Summary of data attrition across participants.

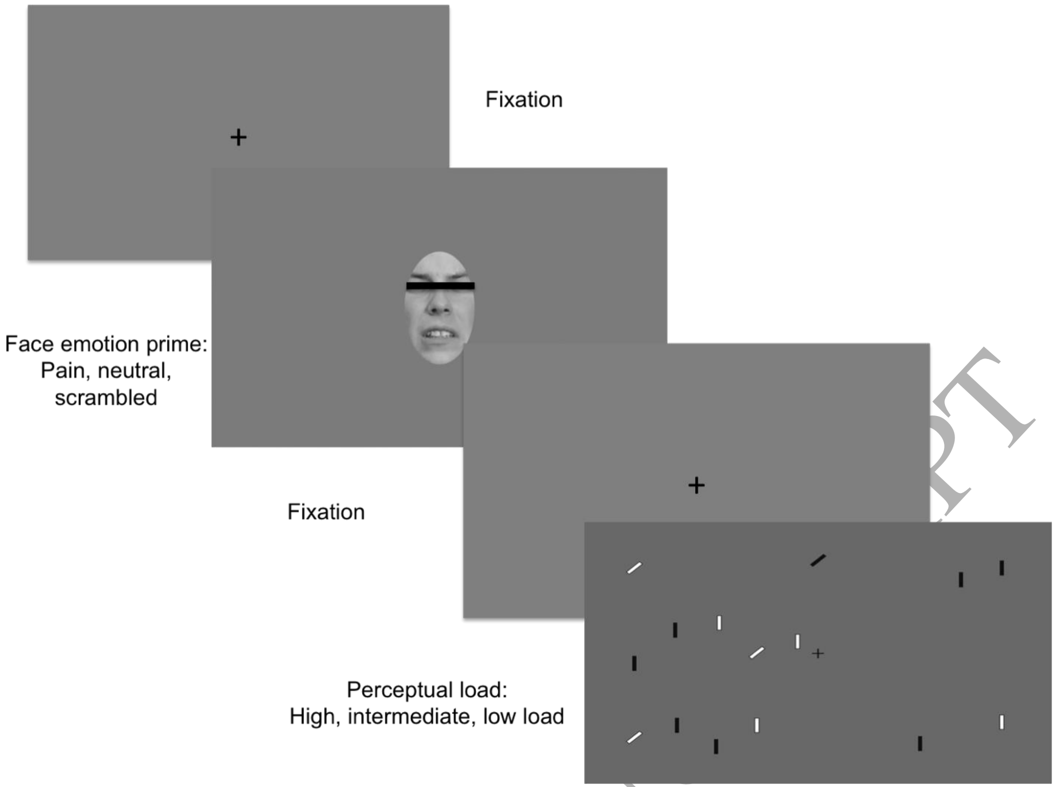

Figure 2: Schematic of visual search task. Each trial begins with a fixation cross (500ms), followed by a face prime (pain, neutral) or non-face (scrambled) stimulus (300ms). After this, another fixation of 600ms duration appears to allow for disengagement from the face prime stimuli prior to the visual search. A visual search array including a target and distractors is then presented for 2000ms.

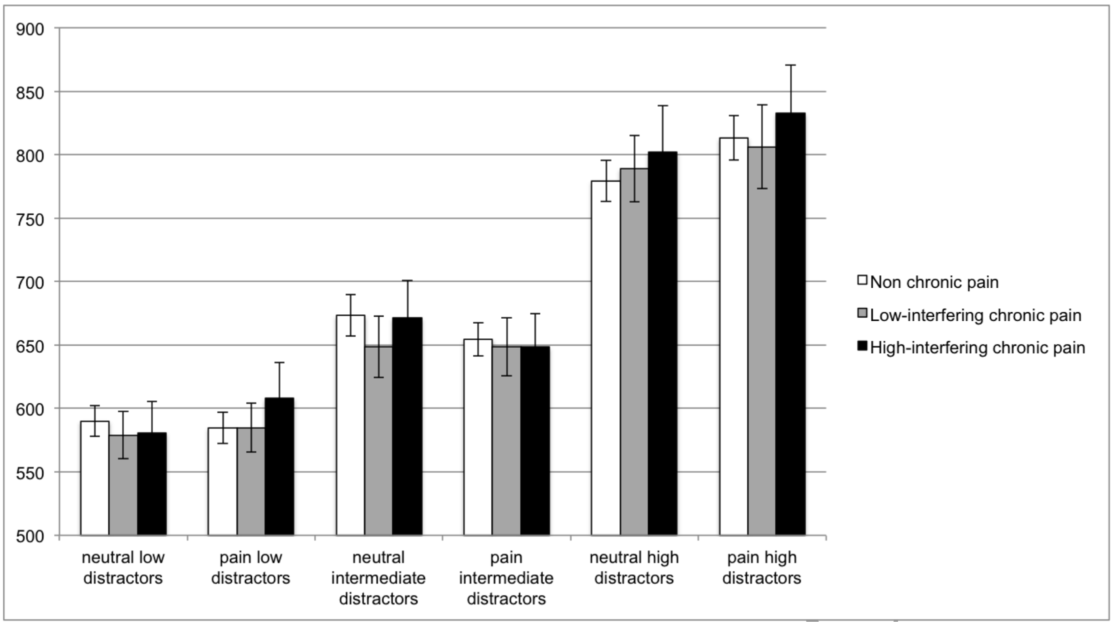

Figure 3: Reaction times in milliseconds to identify the target following the presentation of different distractor types (pain, neutral) under different perceptual load conditions for each pain group

Table 1: Demographic and pain characteristics for the whole sample and each group

	All (n=145)	Pain-free comparison (n=68)	Chronic pain with no/low effects on functioning (n=40)	Chronic pain with moderate/high effects on functioning (n=22)
Mean age (SD)	17 years 3 months (5 months)	17 years 3 months (5 months)	17 years 4 months (5 months)	17 years 3 months (5 months)
% Females	67.1	63.6	67.5	77.3
Ethnicity				
%White	39.2	38.8	45.0	36.4
%Mixed	9.1	7.5	12.5	9.1
%Asian	10.5	11.9	10.0	4.5
%Black	39.2	40.3	27.5	50.0
%Arab	.7	1.5	2.5	36.4
%Other	1.4	38.8	2.5	0
Average level of pain in the last 4 weeks	3.84 (1.92)	2.59 (SD = 1.57)	4.03 (SD = 1.59)	5.55 (SD = 1.79)
Average level of pain in the last 3 months	3.90 (2.08)	2.67 (1.71)	3.98 (1.61)	6.05 (1.76)
Level of pain when in the most amount of	6.14 (2.37)	5.13 (2.41)	6.43 (2.06)	8.27 (1.03)

pain in the last 3 months				
Days of school missed because of pain in the last 3 months	1.66 (0.99)	1.39 (0.72)	1.80 (1.16)	2.10 (1.18)
Mean anxiety T-score	51.18 (11.85)	47.06 (10.05)	52.54 (11.84)	57.74 (10.40)