Emotion and pain: interactive technology to motivate physical activity in people with chronic pain

Abstract
Emotions are important in assessment and treatment of chronic (persistent) pain. In particular, anxiety about increasing pain or possible damage deters people with chronic pain from physical activity. An interactive system to support activity in people with chronic pain must take psychological barriers into account. The emo-pain project aims to create an interactive system to encourage people with chronic pain to engage in a programme to increase their physical activity and by extension their quality of life. This paper provides an overview of the emo-pain project and a brief analysis as a basis for discussing some emotional support needs for technology to motivate physical activity in people with chronic pain.

Keywords
Persuasive technology; emotion; chronic pain; interaction; healthcare; wellbeing; quality of life

ACM Classification Keywords

General Terms
Design
**Introduction**

Chronic musculoskeletal pain is affected by physical, psychological, and social factors and requires a multidisciplinary approach to its treatment, including psychological therapy and physiotherapy [5]. By addressing the psychological and physical problems of chronic pain and working towards more normal activities, multidisciplinary pain management programmes enable patients to improve their quality of life despite continuing pain. However, maintenance of these gains in the long term is often undermined by psychological factors.

Whereas a lot of interest is emerging in combining rehabilitation with serious games to bring fun into an activity that is often boring and tedious, not much work has been done in understanding how to design such materials for chronic lower back pain. The psychological aspects of chronic pain, such as pain-related fear of physical activity, affect levels of physical activity and are not well addressed by movement game technologies like Nintendo Wii, trialled in stroke rehabilitation [1]. However, recent developments in sensing technology and emotion recognition offer new avenues for addressing the difficulties patients face in building and maintaining treatment gains; they allow automatic emotion recognition and hence enable tailored responsive support from the system. Building on these new possibilities, the emo-pain project (www.emo-pain.ac.uk) is designing and developing an intelligent system (see Figure 1) to enable: a) the automatic detection of a patient’s emotional state (Emotion Recognition Module), and b) use of such information to provide personalised psychological and motivational support during physical activity sessions (Support Strategy Module).

The automatic emotion recognition module builds on previous work on emotion recognition [6-9] and aims to detect pain-related emotional states. Facial and vocal expressions are detected by a set of cameras and microphones placed before the patient. A wireless motion capture suit and wireless EMG probes are used to detect pain-related body behaviour and muscle recruitment [10].

Detecting the emotional state of people with chronic pain during self-directed exercise sessions will enable the technology to identify when and what support and feedback may be necessary. The question therefore is what kind/level of support is required or appropriate. We report here the results of a user study of people with chronic low back pain (CLBP) and physiotherapists on what physical movement-based feedback and emotional support and motivation would keep users engaged with a programme of physical activity.

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**Figure 1:** Emo-Pain system architecture. Top: the Multimodal Emotion Recognition Module. Bottom: the Support Strategy Module that provides tailored multi-modal feedback.
Physiotherapist1 explained: “If they were quite closed here (shoulders) I might get them to think about also doing some exercises to open up their chest a little bit more and think more globally. And it’s more with our patients I think the most important thing is that they are moving somehow”.

Patient2 said: "[When the user has more pain] I think there would be concerns about safety and the possibility of harm and making things worse, so reassurance and making it clear that whatever level of pain is recognized in what you’re supposed to do.”

Physiotherapist1-Simulated said, while (role-play) directing a patient to hold a stretch, “You want to just feel comfortable with the back. So there is no absolute perfect position. It’s about just feeling comfortable and feeling relaxed in that movement.”

**Figure 2: Reassurance vs Warnings**

**Methods and Results**

We first investigated how pain management physiotherapists motivate people with chronic pain to become more active. This was done through a role-play with two physiotherapists at a pain management clinic and observation of a physiotherapist directing physical exercise sessions for people with chronic pain. Next, we explored the expectations and requirements of CLBP through semi-structured interviews with seven individuals with CLBP and four physiotherapists with experience in treating chronic pain.

Analysis using grounded theory [3] identified emergent themes specifically around emotional and physical support people with chronic pain require from a technology designed to motivate physical activity. Some of the major themes around emotional support and feedback are summarised here.

**Reassurance vs. Warnings (see Figure 2):** One of the psychological obstacles to physical activity in people with chronic pain is the fear of provoking worse pain or further injury [4]. Most participants believed that people with CLBP must work towards maintaining correct postures in order to avoid injury and reap the benefits of exercise. However, pain management physiotherapists emphasised that people with CLBP should concentrate on moving and that continuous corrective feedback may reinforce the erroneous beliefs they have about the relation between pain signals and danger of injury in chronic pain. Physiotherapists tend to suggest alternative movements instead of (over)correcting. Although participants with CLBP suggested that the technology should provide corrective feed, they also desired reassurance that the exercises were safe. Since the movements recommended would do no harm, corrections could be minimized in favour of reassurance. The availability of sensors that detect body movements together with sensors that detect the emotional state of the person with CLBP would allow provision of reassurance at the appropriate point.

**Personalisation (see Figure 3):** Participants expressed the need for personalising the technology for their particular pain, individual ability, goals, and motivation preferences. They emphasised adapting goals and feedback to the user’s ability as s/he made progress. The main goal for CLBP is increased function. It is hence important to align goals to aims in daily life (e.g. gardening, shopping) and tailor the rewards to people’s personal goals. Goal setting is not necessarily about increasing physical activity, as in many ubiquitous applications for healthy populations (e.g. [2]), but may concern psychological or social goals such as assertiveness.

**Following a plan vs. Doing what you can (see Figure 4):** Evaluation of progress for people with CLBP is not a straightforward measure of increased physical activity over time, unlike technologies aimed at healthy people or rehabilitation. There are counteracting tendencies to do less on days with more pain and to try to do as much as possible on days with less pain, but in the long term this pattern does not lead to progress. Almost all participants agreed that encouragement and positive reinforcement were key factors in motivating them to maintain a programme of physical activity, particularly when they had more pain. Evaluation of the plan needs to be able to deal with non-completion without discouraging and demotivating
the person with CLBP; not being able to achieve a goal may have a much greater negative psychological impact than in a healthy person.

**Discussion**
While technology provides the possibility of addressing complex psychological needs of people with CLBP and facilitating self-management, current fitness technologies aimed at healthy populations and rehabilitation lack properties important to CLBP, as described. A lot of the focus of existing tools is on providing information about correctness of movement, tracking improvement and creating fun. All these are important, but in case of CLBP factors like personalised functional goals aimed at improving overall wellbeing and quality of life are more significant than simply improving fitness and tracking general improvement. Setbacks due to increased pain need to be taken into account and people need to be reminded of their achievements during these setbacks. Reassurance of the safety of exercise and movements needs to be emphasised and the person needs encouragement to stay active and mobile rather than to focus on perfecting movements. We are planning more studies on how technology can help to address these factors and create a multi-modal technology to engage people with CLBP in increasing their physical activity.

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**References**


