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Short-term prospective memory deficits in chronic back pain.

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## Short-term prospective memory deficits in chronic back pain.

## Abstract

**Objective:** Chronic pain, particularly low back pain, is widespread. Although a great deal is known about the impact that this has upon quality of life and physical activity, relatively little has been established regarding the more cognitive effects of pain. This study aims to find out whether individuals with chronic pain experience memory deficits in prospective memory (PM), the process of remembering to do things at some future point in time. Examples of PM include remembering to keep an appointment, such as a visit to a clinic, or to perform a particular task, such as remembering to pay a bill on time. **Methods:** The PM of 50 participants with chronic pain was compared to 50 pain-free participants. Each participant completed the Prospective Memory Questionnaire which assesses three aspects of prospective memory (short-term habitual, long-term episodic and internally-cued), and records the use of strategies to aid remembering. **Results:** Compared to those not in pain, participants with chronic pain had significantly impaired short-term prospective memory, an effect which was evident even after co-varying use of analgesics and other drugs. **Conclusions:** These findings provide new insights into prospective memory dysfunction in people with chronic pain. Possible mechanisms for this dysfunction are discussed and suggestions for future research given. **Key words:** Chronic Back Pain, Prospective Memory, Analgesics.

## Short-term prospective memory deficits in chronic back pain.

## Introduction

Chronic pain is moderate to severe pain that has persisted for 12 weeks or longer (1). Chronic back pain is known to have a number of negative effects on quality of life such as anxiety, depression and social isolation (2-4). Such issues have been well documented in a range of studies, however relatively little is known about the cognitive difficulties experienced by patients with chronic pain.

Of the research that has examined cognitive problems in chronic pain patients, most has focused on memory for pain, rather than any memory-related difficulties related to pain (5,6). The need for research into pain-related memory problems is of therapeutic importance, because in the absence of objective measures of pain, subjective reports of a patient's own pain will be used as a foundation for treatment. However, this is based on the assumption that patients with chronic pain are able to recall information accurately. A difficulty with this is that high pain intensity is a stressor which is known to disrupt mental processes, particularly attention (7). Indeed Katz *et al.* (8) suggested that the cognitive and attentional vulnerabilities observed within their sample reflected adult attention deficit syndrome due to the memory and concentration problems reported by participants. Despite the absence of attentional impairment within their clinical sample, Apkarian *et al.* (9) proposed that chronic pain may be associated with a specific (yet undefined) cognitive deficit which impacts on everyday behaviour. Such attentional impairments may lead to problems with retention of information. Individuals with chronic pain appear to have poorer memory when tested under laboratory conditions on a variety of tasks, including remembering lists of words (10) and word-stem completion (11). Although research using laboratory-based cognitive tasks can be informative, it is important to establish whether chronic pain has an influence on memory function in an everyday context that is more relevant to the kind of tasks individuals perform in their daily lives.

Prospective memory (PM) is an important aspect of day-to-day memory function. PM is the process of remembering to do things at some future point in time (12). Examples of PM include remembering to attend an appointment at a clinic, or to carry out a task such as

remembering to pay a bill on time. PM has recently been subjected to systematic empirical research (12,13). Research in cognitive psychology has demonstrated that while retrospective memory can be facilitated by external prompts, PM relies more on internal prompts and cues (14). As such PM may be more prone to interference from chronic pain.

An important factor that must be considered as part of any investigation focusing on the PM of people with chronic pain is the age of participants. An extensive review of the impact of age on PM (15) has concluded that increasing age is associated with poorer performance on a variety of objective PM measures. Given that people with chronic pain tend to be older, any comparison of PM with people who have chronic pain and those who do not would need to control for age (although it is perhaps worth stating that Henry *et al.* concluded that retrospective memory is associated with greater age-related decline than PM). Although participants with chronic pain are likely to experience higher depression or anxiety than controls who do not have pain, research has found no relationship between these measures and deficits in memory, decision making or attention (9,16).

The Prospective Memory Questionnaire (PMQ), developed by Hannon *et al.* (17) is a self-rating scale that requires participants to record the number of times their PM has failed them within a period of time. The PMQ contains a number of subscales that measure various aspects of memory and has been shown to correlate with objective measures of PM. The PMQ has proved a useful tool in estimating the effectiveness of PM in a number of settings such as a neuropsychological instrument in the study of brain damaged patients (17.) and in the assessment of the impact of personality differences (18).

By utilising a reliable and valid measure in the PMQ we hope to determine whether anecdotal accounts of memory lapses by people with chronic pain can be substantiated by empirical data and comparisons with a sample drawn from the general population. In addition, this research will allow us to gain a valuable insight into the type of everyday memory problems faced by patients with chronic pain.

This research also seeks to examine whether a relationship exists between analgesic drugs and PM. If analgesics do impact on PM then there are important clinical implications, particularly if there is a link between long term use of pain medication and poor memory performance. From a clinical perspective, drug prescriptions would need to be addressed if it

can be shown that prescribing specific drugs is detrimental to cognitive function.

## Method

### Participants

In order to minimise any possible confounds due to source of pain, participants in the chronic pain group all had the same condition – chronic non-malignant lower back pain. All participants had been examined by clinic personnel and a subsequent diagnosis of mechanical low back pain been made. A sample of 50 individuals attending a spinal assessment clinic for the treatment of chronic back pain was recruited (23 males, 27 females; mean age = 52.14 years, S.D.: 13.25). The sample had been experiencing chronic back pain for anywhere between 3 months and 54 years, although the mean was 9 years. In addition to this sample, a control group of 50 pain-free participants was recruited from local social clubs (22 males, 28 females; mean age = 49 years, S.D.: 5.98). None of the control sample were taking medication for pain or had medical conditions that caused them pain and were matched as far as possible to the chronic pain group in terms of age, sex and socio-economic status on a case by case basis. Participants in the chronic pain group were tested between April and August 2004, control participants were tested between August and October 2004.

### Design

The study employs an independent groups design to compare the everyday memory problems experienced by participants with chronic low back pain with those experienced by a control group of pain-free participants.

### Questionnaires

Participants completed a series of brief questionnaires. Participants were asked to state the duration of their pain and their current pain level. Level of pain was assessed by participants placing a line on a visual analogue scale between 0 and 100, where 0 indicated no pain and 100 indicated the maximum possible amount of pain. A drug use questionnaire was also completed in which they listed any medication (including the dosage) they were taking for their pain, as well as their typical weekly consumption of alcohol, tobacco, and other drugs. Space was given for participants to add any other drugs they were taking.

As previous research has indicated that there may be an association between depression and cognitive failures (19), all participants completed the Zung Depression Scale

(20). Data from two participants who scored above 50 (one from the chronic pain group and one from the control group), which is indicative of some level of depression, were excluded from the analysis.

Prospective memory was assessed using the Prospective Memory Scale (PMQ) developed by Hannon *et al.* (1995). The scale shows high internal validity ( $r = 0.76$ ) and high test-retest reliability ( $r = 0.88$ ). The PMQ provides measures for three aspects of PM; questions 1-14 measure long-term habitual PM (e.g. 'I missed appointments I had scheduled'), questions 15-28 measure short-term episodic PM (e.g. 'I forgot to button or zip some part of my clothing as I was dressing', and questions 29-38 measure internally-cued PM (e.g. 'I forgot what I wanted to say in the middle of a sentence'). Additionally, questions 39-52, the 'techniques to remember' scale, provide a measure of the number of strategies used to aid such remembering (e.g. 'I make lists of things I need to do'). Each item consisted of a statement, for example, 'I forgot what I came into a room to get' - followed by a nine-point horizontal line with the left end-point, mid-point and right end-point labelled as 'never', '2 times/month' and '4 or more times/month' respectively. Participants were required to mark on each line the appropriate number of times they had made the error in the previous month.

Each PMQ scale ranges from 1 (where least forgetting is evident) to 9 (where there is a great deal of forgetting). Similarly the strategy use scale, referred to as the Techniques to Remember Scale, ranges from 1 (few techniques used) to 9 (a great deal of techniques used), and measures the number of strategies used to aid remembering. Thus on this latter scale the greater the score the more techniques have been used to aid remembering.

#### Procedure

The research received local National Health Service (NHS) Trust research and ethical approval in line with the requirements of the Research Governance Framework for Health and Social Care (19). Participants were recruited on a voluntary basis from a local NHS spinal assessment clinic. They were asked to complete a questionnaire relating to how well they remember to do things and the strategies they might employ to help them to remember to do things. Details of gender, age and frequency of drug consumption were also collected. The PMQ was administered first, then the personal characteristics / drug-use questionnaire. After completing the study participants were thanked for their co-operation and fully debriefed.

Participants in the pain condition completed the questionnaire in the waiting room of the spinal assessment clinic; participants in the control group completed their questionnaires in their social club.

### Results

The effect of chronic pain on the three memory subscales of the PMQ was examined by means of multivariate analyses of covariance (MANCOVA). As there was a trend towards the ages of participants in the pain and control groups differing ( $t(98) = 1.736, p = .085$ ), age was included as a covariate in comparisons. The 'techniques to remember scale' of the PMQ was included (and developed by 17) as a covariate because differences in PM are associated with differences in strategy use (17), however the data is also presented with the strategies scale excluded to show the level of strategies employed by each of the groups.

Prior to analysis, the PMQ was checked for reliability. The instrument was found to be reliable for each of the subscales, with Cronbach's alpha = .89, .78, .93 and .92 for PMQ-ST, PMQ-LT and PMQ-IC subscales, respectively.

A MANCOVA examining the effect of chronic pain on the PMQ-ST, PMQ-LT and PMQ-IC scores, with age as a covariate, indicated that chronic pain had a significant effect on the short-term scale of the PMQ,  $F(1, 97) = 16.466, p < .001$ . Inspection of the means showed that participants with chronic pain reported more errors than those that did not have chronic pain (see Table 1). Chronic pain had no effect on the long-term scale,  $F(1, 97) = .028, p = .868$ , or on the internally-cued scale,  $F(1, 97) = 1.613, p = .207$ .

A second MANCOVA examining the effect of chronic pain on the memory subscales of the PMQ was conducted, using both age and strategy use (PMQ 'Techniques to remember' scale) as covariates, also indicated that chronic pain had a significant effect on the short-term scale of the PMQ,  $F(1, 97) = 23.189, p < .001$ . Inspection of the means showed that participants with chronic pain reported more errors than those that did not have chronic pain. Chronic pain also had an effect on the internally cued scale,  $F(1, 97) = 4.139, p = .045$ , with more errors reported by participants with chronic pain. There was no effect of chronic pain on the long-term scale,  $F(1, 97) = .017, p = .895$ .

[Table 1 about here](#)

Further analyses were conducted on the chronic pain group only. We found no correlation between current pain (as measured by a visual analogue scale) and score on any of the PMQ subscales (Pearson's  $r$ , all  $p > .05$ ). However this finding may have been mediated by the use of analgesic medication. Participants with chronic pain take a range of analgesics; only five of the 50 participants in the pain group did not use medication to control their pain. In order to examine the effects of analgesics on PM performance, we divided the pain group into three groups according to the analgesics they consumed each day (see 22). Participants were categorised as low users of analgesics if they consumed no analgesics at all, less than 6 compound analgesics, or one dose only of an opiate per day. Medium users took more than 6 compound analgesics, non-steroidal anti-inflammatory drugs, or more than 1 but less than 4 doses of opiate. Those categorised as high users took over 4 doses of opiates. Of the 50 participants in the pain group, 23 were categorised as low level users of analgesics (taking primarily paracetamol), 17 as medium (using primarily coproxamol and ibuprofen), and 10 as high (taking primarily meptazinol and tramadol). Analysis of variance indicated that analgesic use had a significant effect on the number of memory problems reported for the internally-cued subscale of the PMQ,  $F(2, 50) = 4.559$ ,  $p = .016$ . Inspection of the means indicated that participants in the low-use category experienced less impairment than those in either the medium- or high-use categories (see Table 2).

[Table 2 about here](#)

## Discussion

This research found significant impairment in one element of prospective memory – short term – in participants with chronic pain. This deficit was not observed in participants who were pain-free or in other areas of PM. This is an important finding: although previous research has indicated that there may be a tendency for people with chronic pain to perform more poorly in laboratory-based cognitive tasks, little prior research has examined the influence of chronic pain on everyday memory performance. The absence of differences between pain-free participants and those with chronic pain in other areas of PM has not only

theoretical implications for understanding of the action of pain on cognitive function, but also practical ones in terms of the support that people with chronic pain may be given to help manage their cognitive difficulties.

One explanation for the observation of short-term PM deficits may be related to the link between pain and stress and the impact of this relationship on cognitive function (7, 23). Patil *et al.* (24) demonstrated that a painful stressor impaired short-term memory function in healthy volunteers. They concluded that painful stimuli might affect cognitive functioning, although the relationship between the two is complex and dependent on the range of measurements and stressors used. In addition, Lupien *et al.* (25) measured cortisol levels and cognitive functioning in relation to a stressor and demonstrated that within stressful conditions declarative memory (memory for facts) was significantly impaired. They proposed that chronic exposure to high cortisol levels might be predictive of memory deficits. Empirical support for the link between stress-related cortisol levels and memory impairment has also been reported by Sauro *et al.* (26), although this was stronger in studies utilising experimental stressors than those examining chronic life stressors.

An alternative explanation may be related to glucocorticoid treatment to which our group of patients may have been exposed. As part of a prospective, longitudinal study with a clinical sample, Keenan *et al.* (27) examined glucocorticoid use and memory performance. They suggested that acute glucocorticoid treatment could adversely affect explicit memory and that such deficits were not secondary to inattention, affective disturbance, generalised global cognitive decline or severity of disease. Keenan *et al.* proposed that glucocorticoid treatment might be responsible for iatrogenic memory impairment. In the present study, there was no correlation between pain severity or duration of pain and PM, which supports some of the findings of Keenan *et al.*, although more information would need to be taken to determine patients' history of glucocorticoid treatment.

While the studies outlined above did not specifically focus on PM they do nevertheless point to the close association between stress and memory impairment and suggest one possible mechanism by which pain (and related stress) may impair short-term memory function. This can be seen in the data presented in Tables 1 and 2. It appears that high doses of analgesics normalized short-term scores on the PMQ with scores from the

control group participants (Table 1) obtaining the same mean score as high analgesia users in the experimental group (Table 2). This could suggest that where pain is not controlled (i.e., increased stress) there is greater likelihood of short-term memory problems and distinguishes pain-induced memory impairment as a state rather than a trait. This finding would also support Patil *et al.* (24) Lupien *et al.* (25) and Sauro *et al.* (26).

One of the difficulties with examining the influence of chronic pain on memory is the influence that pain has on other psychological factors. Although a range of research has reported links between psychological distress, such as depression, and back pain (27,29), there is no clear evidence to indicate that there will necessarily be subsequent memory problems due to these psychological factors, at least in terms of subjective reports. In a study examining reports of memory problems in patients with chronic pain, Schnurr and MacDonald (30) found that in a general measure of memory problems, differences between pain patients and controls could be attributed to the severity of patients' depression. However on a questionnaire designed to be more specific to memory complaints in chronic pain patients, differences in reports of memory problems between pain patients and controls were found even after the effects due to depression were statistically removed. This indicates that the relationships between pain, cognitive dysfunction and mood is a complex one, and that further research is essential to clarify the relative contributions of pain and frame of mind to cognitive performance. However we attempted to control the influence of one psychological variable by excluding all participants who reported a significant level of depression.

In addition to the link between pain and PM, the present study also showed an effect of analgesic use on memory performance. Participants in the present study who were taking moderate to high levels of analgesics were more likely to report problems with internally-cued aspects of PM, regardless of the pain they experienced, than those on lower doses. This supports previous research that has found a link between drug use and reported memory impairment (31). This result shows a clear association between higher levels of analgesic use and perceived memory dysfunction. This may reflect the class of analgesics consumed rather than the quantity – insofar as almost half of the pain group were taking opiate-based medication, and these were the participants who reported deficits. This raises cause for concern, as prolonged use of opiates is contra-indicated for chronic back pain (1) and

suggests that prescribing may not be following best practice guidelines. Nevertheless, while we believe this result to be a valid one, it is based on only a small sample of participants; further work with a larger sample is required.

Although data relating to specific steroid use was not collected as part of this study, given the findings of Keenan *et al.* (27), future studies that aim to explore prospective memory in chronic low back pain samples should consider asking participants about previous prescribed medication or steroid use in order to ascertain whether there is any relationship between glucocorticoids and memory impairment.

The current study used a self-report measure, Hannon *et al.*'s (17) PMQ, to assess perceived difficulties with PM. As indicated above, the PMQ has been used in a variety of contexts to examine subjective PM function. However there is a need to replicate our findings for two reasons. First, the cognitive PM literature makes a distinction between time- and event-based PM (32). In time-based PM, people are required to perform a behaviour at a particular time (e.g. attend an appointment at 10am). In event-based PM, people are required to carry out an activity after being prompted by an external cue (e.g. take a pill when the alarm goes off). Although related, this distinction is an important one for research into PM difficulties in people with pain, as research indicates that time-based PM is more dependent on internal cues and therefore may be more likely to be disrupted by chronic pain. The PMQ does not make a distinction between these two types of PM and so it was not possible to test this prediction. Second, this study examined subjective reports of PM rather than assessing actual PM difficulties. Thus without further research it is difficult to determine whether participants were accurate in their responses, especially if they were unaware of, or did not wish to admit to memory difficulties. Nonetheless, there were consistent differences in the difficulties reported between the pain and control groups, and given that these groups were matched as far as possible, the results of the present study form an important foundation for future research using objective measures (33).

The reliance on self reports of memory lapses in a group who may already have memory problems raises the possibility of a 'memory paradox', in which participants with faulty memories may be more likely to forget recall failures, causing an underestimation of their cognitive problems. However, it is unlikely that patients would seek to exaggerate the

size of their memory problems; several studies have shown that participants with a range of pathologies are in fact more likely to underestimate their memory deficits (34, 35). Given the direction and strength of our findings we believe that this, if anything, adds strength to our conclusions.

The current research was, of course, correlational in nature as participants were not randomly allocated to groups, however on the basis of the data it is possible to draw some inferences about the relationship between chronic pain and PM. On the basis of the present data we cannot say whether those individuals with chronic pain were functioning within the normal range in terms of memory ability prior to the onset of their pain. As this research is the first to examine the impact of chronic pain on PM, and also conducted a number of tests in the absence of statistical control the findings of this study should be treated with caution and require replication. Further investigations, including the use of objective measures of prospective memory and longitudinal studies, are also needed. However, it is worth noting that the individuals with chronic pain who participated in this study were recruited from a clinic at a local hospital. One feature of this clinic was the number of patients who failed to attend appointments. Non-compliance with appointments is a complicated problem, with a number of determinants however it would be interesting to discover whether such absences were due to memory lapses related to chronic pain.

In conclusion, we hope that participants' responses have improved knowledge about the wider effects of chronic pain and that the results obtained will help inform future support given to patients with chronic pain and guide the development of skills aimed at ameliorating such memory problems.

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Table 1

*Mean scores on the memory subscales of the PMQ*

	Subscale		
	Short-term	Long-term	Internally-cued
Pain	1.63 (0.94)	2.04 (1.16)	2.72 (1.90)
Control	1.19 (0.29)	2.18 (0.95)	2.43 (1.17)
Overall mean	1.41 (0.73)	2.11 (1.06)	2.57 (1.58)

*Note.* Standard deviations are given in brackets

Table 2

*Mean scores on the memory subscales of the PMQ, by analgesic use*

Analgesic use	Subscale		
	Short-term	Long-term	Internally-cued
Low	1.64 (.85)	1.80 (.97)	2.26 (1.86)
Medium	1.88 (1.22)	2.42 (1.55)	3.11 (1.92)
High	1.19 (.25)	1.93 (.63)	3.12 (1.89)
Total	1.61 (.94)	2.04 (1.17)	2.72 (1.90)

*Note.* Standard deviations are given in brackets