UNIVERSITY OF SOUTHAMPTON

FACULTY OF MEDICINE, HEALTH & LIFE SCIENCES

School of Psychology

Treatment Adherence: The contribution of different mechanisms

by

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Thesis for the degree of Doctor of Philosophy

September 2006

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

FACULTY OF MEDICINE HEALTH AND LIFE SCIENCES
SCHOOL OF PSYCHOLOGY

Doctor of Philosophy

TREATMENT ADHERENCE: THE CONTRIBUTION OF DIFFERENT MECHANISMS

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The primary objective of the current programme of research was to determine the effects of cognitive variables (self-efficacy and outcome expectations) and other factors (affective state and aversive feedback) on adherence.

First, a laboratory based simulation study was used, as this enabled isolation of the influence that aversive feedback (simulating the effect of pain) had on adherence. Self-efficacy, outcome expectations and affective state were assessed at baseline and after early experience of the simulation. Adherence behaviour was recorded by the computer programme throughout the simulation. In a follow-up study, a longitudinal field study measured self-efficacy, outcome expectations, affective state and pain at baseline and after early experience of physiotherapy. Adherence was assessed 8 weeks after starting treatment. In both studies, self-efficacy, outcome expectations, affective state and aversive feedback served as the independent variables, and various aspects of adherence behaviour formed the dependent variables.

More positive cognitions predicted how long participants persisted with the simulated physiotherapy task and real world physiotherapy. Presence of aversive feedback in the laboratory study resulted in slower than instructed responding. Increased pain in the field study was also associated with poorer adherence during sessions. Simulated and perceived recovery, in the laboratory and field studies respectively, was related to both cognitions and aversive feedback.

The conclusions were that both cognitions and aversive feedback were important to adherence behaviour. In addition, it was evident that different factors were important to different aspects of adherence behaviour. It was recommended that future studies take account of cognitive and additional influences on behaviour. Assessing and distinguishing between the various different aspects of adherence behaviour and their predictors may help explain adherence behaviour more comprehensively.

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ACKNOWLEDGEMENTS

First, I would like to thank Lucy Yardley and Lewis Bizo for all their time, effort and expertise during their supervision of this PhD, it has been very much appreciated. In addition, the laboratory components of this research would not have possible without the help of Jin Zhang who tirelessly worked on version after version of the computer programme. Similarly, I would like to thank Lisa Roberts, Joanna Spencer, David Lampard and all the staff at Southampton General Hospital Physiotherapy department who enabled the field study to run. I also extend my thanks to Roger Ingham, Yori Gidron and Rona Moss-Morris for being my advisors at various points through the PhD. Last, but by no means least, I would like to thank all of the participants who took part in this research, without their involvement I would have no data! Without the support of all of these people, this research would not have been possible - Thank you.

ABBREVIATIONS

APETS	Anticipated Problematic Experiences of Therapy Scale
BPI	Brief Pain Inventory
CNS	Central Nervous System
dB	Decibels
HADS	Hospital Anxiety and Depression Scale
Hz	Hertz
PANAS	Positive and Negative Affect Schedule
PETS	Problematic Experiences of Therapy Scale
POMS	Profile of Mood States
SCT	Social Cognitive Theory
SEE	Self-Efficacy for Exercise Scale
SIRAS	Sports Injury Rehabilitation Adherence Scale
VI	Variable Interval

CHAPTER 1: INTRODUCTION AND THESIS OUTLINE

1.1 Rationale and aims

The overarching aim of this thesis was to assess the contribution of self-efficacy, outcome expectations, affective state and pain on adherence to physiotherapy. The explanation of behaviour has primarily considered the influence of cognitions such as attitudes and beliefs (e.g. Bandura, 1997; Conner & Norman, 1995; Horne & Weinman, 1998). Although such cognitions have been found to be effective at explaining significant proportions of variance in behaviour, these models based solely on these cognitions typically leave a large proportion of the variance in behaviour unexplained (e.g. Sutton, 1998). Researchers have begun to consider additional factors that may influence the performance of a behaviour (e.g. Bargh, 1997; Schneider & Shiffrin, 1977). The studies within this thesis consider both self-efficacy and outcome expectation cognitions, and affective state and pain as additional factors that may have an influence on behaviour. Learning principles dictate that an individual's behaviour can be influenced by the outcomes of performing that behaviour (e.g. Domjan, 2003). There has been some suggestion within the literature that where a therapy results in pain, the behaviour that results in pain will decrease (e.g. Waddell, Newton, Henderson, Somerville, & Main, 1993). In this case, pain may be acting as a punisher of the therapy behaviour. There is also some evidence that although affective state does not predict adherence (Alexandre, Nordin, Hiebert, & Campello, 2002; Belza, Topolski, Kinne, Patrick, & Ramsey, 2002; Rejeski, Brawley, Ettinger, Morgan, & Thompson, 1997), affective state can influence perception of bodily sensations including pain (Salovey & Birnbaum, 1989) which may have implications for adherence. The studies within this thesis aimed to clarify firstly, the importance of self-efficacy, outcome expectations, affective state and pain on adherence behaviour, and secondly, to offer possible ways in which these variables interact with each other to influence adherence behaviour.

1.2 Literature reviews

The literature reviews were broken down into three chapters. The first was a systematic review that addressed a number of questions relating to adherence to physiotherapy. The second took a primarily theoretical stance on the production of behaviour. The third

looked at how the theoretical considerations of behaviour production have been applied within the field of health behaviours and specifically, physiotherapy.

1.2.1 Systematic review

This systematic review was carried out primarily to ascertain an estimate of adherence to physiotherapy treatment. For the purposes of this review adherence behaviour was broken down into three main measures. The first was dropout from the studies; the second was attendance at clinic-based treatment sessions or number of attempts made to complete home-based treatment session versus those prescribed; the third was a measure of how well patients' managed to carry out the exercises they were prescribed (each statistic includes only those studies that reported usable information, weighted according to the same size). Forty-five studies met the inclusion criteria and it was found that the dropout rate was 14.82%. The percentage of appointments attended for treatments lasting less than six months varied between 64 and 77%. For treatments lasting more than six months, the percentage of attendance at appointments varied between 44 and 49%. Mean effort ratings as assessed by the sports injury rehabilitation adherence scale (Brewer et al., 2000) were 13.08 (maximum score of 15). The review also identified various factors that were found to be consistently associated with adherence to physiotherapy. These factors included higher athletic identity (in athlete patients) and increased social support and prior injury / therapy. In addition it was also found that increased adherence was consistently associated with improved physical outcome, improved pain and higher patient perceived rehabilitation.

1.2.2 Theoretical mechanisms of behavioural control

The next literature chapter considered the use of models to describe the various influences on performance of behaviour. As mentioned above, whilst these can explain significant amounts of variance in behaviour, there is still some way to go with regard to explaining behaviour. It has been found that whilst models are relatively good at explaining behavioural initiation, long-term maintenance of behaviour is explained more poorly, perhaps because this may use different resources to those used in initiation of behaviour (Rothman, 2000). The contribution that learning principles such as the influence that the outcome(s) of performing a behaviour, such as pain, have on subsequent performance of behaviour were also considered.

1.2.3 Theoretical mechanisms applied to health behaviour

The third literature chapter considered how the mechanisms described in the previous chapter might function specifically within the field of health behaviour. Research was considered that describes the influence of self-efficacy, outcome expectations, affective state and pain on health behaviours and in particular, physiotherapy.

1.3 Methodology

In order to consider the research questions set within this thesis, two methodologies were used. The first utilised a computer simulation of physiotherapy which enabled detailed data collection and experimental manipulation of the influence of aversive feedback on adherence to the simulated physiotherapy task. The second assessed how this group of variables influenced behaviour in physiotherapy patients.

1.3.1 Laboratory studies

The results of these studies showed that those participants who received aversive feedback did not adhere to the frequency with which they were asked to exercise. More positive self-efficacy and outcome expectations were found to be associated with persisting at the simulation task. In addition to this, the main laboratory study revealed that different factors were important to different aspects of adherence behaviour.

1.3.2 Field study

The results of the field study confirmed that self-efficacy, outcome expectations, and pain were important to how well patients adhered to their physiotherapy. Mirroring the findings of the laboratory study, different factors were important when considering different aspects of adherence behaviour.

1.4 General discussion

The overall findings of this programme of research suggested that both cognitive factors and aversive feedback / pain were important to adherence behaviour. Additional findings showed that cognitions that had developed after some experience at the therapy were generally better predictors of later adherence behaviour. The precise measurement of

adherence in the laboratory enabled a clearer picture to be determined about the predictors of different aspects of adherence behaviour. The factors that predicted different aspects of adherence in the field study were also found to differ. The theoretical and clinical implications of these findings were discussed.

CHAPTER 2: SYSTEMATIC REVIEW OF ADHERENCE TO PHYSIOTHERAPY

2.1 Rationale and Aims

The success of any treatment depends on both the efficacy of the treatment itself, and the extent that the patient adheres to the programme of treatment (e.g. Belza, Topolski, Kinne, Patrick, & Ramsey, 2002; Myers & Midence, 1998). In addition, where the adherence rates to a treatment plan of a population of patients are known, the effectiveness of the treatment itself can be deduced. Similarly, where adherence rates are known, the dose of treatment that is necessary and sufficient to produce clinically relevant improvement can be clarified. Determining those factors that can predict or are associated with adherence has potential advantages in that those who may be at risk of non-adherence can be identified early and interventions employed to encourage adherence. At present, although many studies have reported adherence rates, there are no reviews of the research that integrate these findings in physiotherapy for musculoskeletal problems. The primary aim of this systematic review was to establish adherence estimates for musculoskeletal physiotherapy. There were five further aims for this review, which are discussed below.

It has been recommended that systematic reviews need to take into account the quality of interventions they review (Herbert & Bo, 2005). Self-report measures often necessitate that participants rely on using memory, and together with the fact that the participant may respond in a biased way so as to present themselves more favourably (Conner & Waterman, 1996), the validity and reliability of self-report measures may suffer. Therefore, the first additional aim was to compare the adherence estimates from studies that used purely non self-report measures against those that used some or all self-report measures. The second additional aim was to assess whether there was any difference in reported adherence rates between supervised and non-supervised physiotherapy programmes. Physiotherapy treatment is primarily prescribed in one of two ways. The first form is that physiotherapy is clinic-based. This first option involves the patient being required to attend appointments during which time they will perform a set of therapy exercises. This clinic-based option may or may not be supervised by a physiotherapist. The second option is that patients are prescribed physiotherapy exercises to perform outside the clinic, usually within the patient's home. Although physiotherapists can visit patients in their own home and supervise performance of therapy exercises, this is not often done. The vast majority of home-

based physiotherapy programmes are therefore not supervised. The current systematic review therefore considers whether a programme is supervised or not and provides separate adherence estimates for programmes that are fully or partially and non-supervised.

It has been found that adherence to treatments declines as the length of treatment increases (e.g. Sluijs, Kerssens, van der Zee, & Myers, 1998). The third aim of this review was therefore to assess whether there was any difference in reported adherence to treatments lasting more and less than 6 months. These first three additional aims were achieved by comparing estimates of the percentage of sessions completed of those prescribed. Although other adherence estimates were calculated, due to the heterogeneity of the ways in which additional measures of adherence were made, comparisons between studies were not possible.

The fourth additional aim of this review was to qualitatively synthesise findings from studies in terms of what factors were associated with and have been used to predict adherence rates. A qualitative approach was taken to synthesise the findings due to the diversity of factors investigated, which meant that conducting a meta-analysis on these data was not possible. The last additional aim was to review the various methods of assessing adherence to physiotherapy that are currently used.

2.2 Method

The following section describes how the systematic review was conducted.

2.2.1 Selection of Papers for Review

The databases that were searched consisted of OVID (PsychINFO, EMBASE, MEDLINE, British Nursing Index, CINAHL) and Web of Knowledge (WoK). In order to find all articles relating to adherence to physiotherapy prescribed for a musculoskeletal problem, the following search terms were used in all databases: ((adheren$[1] OR complian$) AND (physiother$ OR physical therap$ OR exercis$)). It was decided that the search would begin at 1980 and end in June 2005.

[1] $ = truncation symbol

2.2.1.1 Inclusion and Exclusion Criteria

The inclusion criteria were designed so that the populations sampled in the studies used in this systematic review matched, as far as possible, the populations sampled in the field trial (see chapter 8). The primary inclusion criteria were that the studies were empirical and investigated patients undergoing physiotherapy treatment for a musculoskeletal problem. These inclusion criteria included rehabilitation for all acute injuries (such as sports injuries) and chronic conditions including chronic pain and osteoarthritis. Ideally, acute and chronic conditions would be considered separately as there is some evidence to suggest that these two patient groups may behave differently to the physiotherapy task. For example, chronic pain patients are more likely to over-predict expected pain than patients without chronic pain (Goubert, Francken, Crombez, Vansteenwegen & Lysens, 2002). Expectations can also be linked to adherence behaviour (Poulton, Trevena, Reeder & Richards, 2002), however these expectations can be altered with experience (Crombez, Vervaet, Baeyens, Lysens & Eelen, 1996). However, it was necessary to include patients with chronic conditions in the field study as the possible group of patients eligible to take part in the study would have been too few. Chronic conditions such as chronic pain and osteoarthritis were therefore included in this systematic review in order that the sample matched that of the field study. The studies also had to report at least one form of adherence statistic (for a definition of adherence statistic see section 2.3.1 below). Studies were excluded if the therapy was for cardiac rehabilitation, exercise to lose weight, falls prevention or for urinary incontinence. Studies that included patients with rheumatoid arthritis were also excluded (as rheumatoid arthritis is an autoimmune disease and is routinely examined separately to osteoarthritis; e.g. Baker et al., 2001; Ettinger et al., 1997; Seçkin, Gündüz, Borman, & Akyüz, 2000). These conditions were excluded to limit the heterogeneity of the samples used within the studies in terms of the factors that might influence performance of physiotherapy. For example, it is thought that many additional factors (over and above those of interest in the current study) influence performance of exercises to prevent falls, such as variables connected to the balance system (e.g. Myers, Young, & Langlois, 1996). To ensure that samples were homogeneous with regard to the possibility that therapies could cause pain, therapies that were unlikely to cause pain (such as those for urinary incontinence) were excluded.

2.2.1.2 Assessment of Papers Identified

The initial search identified 1,564 studies from OVID (consisting of PsychINFO, EMBASE, MEDLINE, British Nursing Index and CINAHL) and 2,452 from WoK (Science and Social Sciences Citation Index). The abstracts of 73 papers identified via OVID and 183 from WoK were reviewed. Of these, 146 full papers were ordered and read. Subsequently, 101 were excluded; leaving 45 studies that met the inclusion criteria.

2.2.2 Calculating Estimates of Adherence

Various types of adherence were reported by the studies included within this review. After reviewing the studies to be included in this systematic review, it became clear that the types of adherence estimates reported could be categorised into four primary categories. The first of these was *dropout* from the study. The second category was the *percentage of physiotherapy sessions carried out of those prescribed* (appointments attended for clinic-based programmes or percentage of home sessions attempted for home-based programmes). The third category was an indication of *effort/ accuracy* whilst carrying out the exercises. These first three adherence estimates from the different studies could be combined to give three overall estimates for each of the adherence categories.

Percentage of *dropout* was calculated from the total number of participants who took part in studies that reported dropout and the number of these participants who dropped out. Participants were included in the dropout statistics only if they were taking part in active treatment (therefore those in non-active control groups were not included).

Percentage of physiotherapy sessions carried out of those prescribed weighted for n within each study was calculated using those studies that gave appropriate data using two formulae. The first formula was used to factor in dropouts as 0% adherence to be conservative (where dropout was reported and was not already factored into estimates):

$$(\text{percentage adherence rate} \times n_a) / n_b = \text{adherence including dropouts at 0\%} \quad (1)$$

(where $_a$ represents the sample that completed the study and $_b$ represents the total sample, including dropouts)

The second formula was then used to generate the number of sessions carried out of those prescribed weighted for *n* within each study:

$$(\sum((n_a /100) \times \text{percentage adherence rate}_a) /\sum n_b) \times 100 = \text{adherence rate} \quad (2)$$

(where $_a$ represents an individual study, and $_b$ represents the sub sample of studies that report the particular adherence rate)

The percentage of physiotherapy sessions carried out was compared according to whether self-report or non self-report measures were used, the length of programmes (more or less than 6 months) and whether the programmes were fully supervised or not. In those studies that were clinic-based the majority of statistics for sessions carried out were based on objective patient records of number of sessions attended. In those studies that were home-based, these statistics were based on self-report (either diary returns or reports back to study co-ordinators).

Effort/ accuracy statistics for the Sports Injury Rehabilitation Adherence Scale (SIRAS; Brewer et al., 2000) weighted for *n* within each study were calculated using the same formula. The SIRAS is the most popular method for assessing how well participants followed advice within the sessions that they attended (the SIRAS is discussed further in section 2.3.3 below). A number of alternative ways of assessing effort/ accuracy have been reported within the literature. These include the percentage of exercises completed, the intensity with which exercises were performed, the percentage of exercises that were carried out correctly and the amount of time that exercises were carried out for of that prescribed.

The last category of adherence, *global/ categorical measure of adherence*, comprised all other adherence data that could not be compared across studies, for example, studies that categorised patients as adherent or non-adherent in a manner that was unique to that particular study.

Table 1

Details from studies on adherence estimates

Notes:

Coding column- Number denotes the numerical code for each study (see appendix A for code to reference translation).

Letters in capitols denote location of physiotherapy: H- Home; C- Clinic; LNS- Location of treatment not specified.

First set of lower case letters indicate the level of supervision: fs- full supervision; ps- partial supervision; ns- no supervision; nr- not reported.

Second set of lower case letters indicate who carried out the supervision (if supervised): pt- physiotherapist; at- athletic trainer; rp- rehabilitation practitioner; ti- trained instructor; t- therapist; ?- does not specify.

		Measures of adherence			
Coding	Sample size	Drop-out - (including lost to follow up to be conservative)	Percentage of physiotherapy sessions carried out of those prescribed	Effort/ accuracy	Global/ categorical measure of adherence
1 H ns; C fs-pt. (Alexandre, Nordin, Hiebert, et al., 2002)	120	3 lost to follow-up (not inc in sample size) 2.44% of total sample	No measures reported	No measures reported	Attendance at physiotherapy sessions- no compliance- 11 (9%- attended 0 appointments), low comp- 48 (40%- attended between 1 and 80%), high comp- 61 (51%- attended at least 80%). Home exercises- no comp- 27 (23%), low comp-51 (42%), high comp- 42 (35%)
2 C fs-pt (Annesi, 2001)	16 in standard treatment, 12 in standard treatment plus computer assisted.	None 0% of total sample	Standard treatment mean % 95.6, SD 4.8, n = 16; computer 96.4, SD 3.8, n = 12. Continue exercising after treatment- standard- 38% (n = 4) computer- 67% (n = 11).	No measures reported	No measures reported

3 H ps-? (Baker, Nelson, Felson, et al., 2001)	46 randomised, 23 in exercise intervention, 22 agreed nutrition allocation (non-active control)	4 of those in the exercise group dropped out before end of study 17.4% of active sample	Exercise intervention group- 84+/- 27% range of 24-100%; attention control group- 65 +/- 32% range of 27-100%. Defined as 100% adherent if 2 or fewer (of 48) exercise logs were missing, total no of logs returned were divided by 46 for the measure of adherence.	No measures reported	No measures reported
4 H ns (Bassett & Petrie, 1999)	74, only 66 in analyses	8 didn't complete course of physiotherapy 10.81% of total sample	The mean sample compliance % for number of sessions was 73.55 (SD 20.92).	70.15% (SD 21.8) for the repetitions	No measures reported
5 C fs-ti (Belza, Topolski, Kinne, et al., 2002)	125 treatment, 124 non-active control	21 of those in treatment group didn't complete study. 16.80% of total sample	None reported	No measures reported	Adherers defined as those who attended at least 2 sessions for 16 of the 20 weeks. 36 defined as adherent; 89 defined as non-adherent.
6 H ns; C fs-rp (Brewer, Cornelius, van Raalte, et al., 2003b)	85	None reported	Attendance index of sessions 0.81, SD 0.21	SIRAS (transformed) 0.74, SD 0.24. Home exercise 7.13, SD 2.38; self-reported degree of completion since last appointment- 1 (none) to 10 (all).	no measures reported
7 C fs-rp (Brewer, Cornelius, van Raalte, et al., 2000a)	80	None reported	81% (21%SD) of clinic sessions attended.	Average of 14.41(/15) (SD 0.7) for practitioner assessed SIRAS adherence during sessions.	No measures reported

8 H ns; C fs-pt/at (Brewer, van Raalte, Cornelius, et al., 2000b)	95 + 2 excluded due to extensive missing data.	26 dropped out of the study before the 6 month assessment. 28.9% of total sample	Attendance ratio (0-1) 0.86, SD=0.11.	SIRAS (transformed) 0.63; SD 0.21. Mean home exercise completion (1 none-10 all), 7.53 SD=1.93.	no measures reported
9 H ns; C fs-pt/at (Brewer, Cornelius, van Raalte, et al., 2003a)	61	none reported	ratio of appointments attended-mean 0.86, SD 0.11;	SIRAS mean score 14.23, SD 0.74. Home-based exercise completion 7.58, SD 1.95 (scale of 1-10, extent to which exercises completed, 0= none, 10 = all).	no measures reported
10 C fs-rp (Brewer, van Raalte, Petitpas, et al., 2000c)	Study 1- 145 general physiotherapy. Study2, 31 knee surgery rehabilitation. Study 3, 43 ACL reconstruction	none reported	none reported	Study 1- SIRAS mean (out of 15) 12.55, SD 2.3. Study 2- time 1 mean 11.68, SD 2.43, time 2 mean 11.81, SD 2.44. Study 3- primary provider- 14.22, SD 0.82, secondary provider- 13.59 SD 1.58.	no measures reported
11 C fs-at (Duda, Smart, & Tappe, 1989)	40	None reported	% of appointments attended-mean 83.3%, SD- 16.6%	% of exercises completed at rehabilitation sessions- mean- 79.8, SD- 18.6%. Intensity of exercise (assessed by athletic trainer on a scale of 1(min effort) to 5 (max effort)) mean- 3.2, SD 1.1.	No measures reported
12 H ps-ti; C fs-ti (Ettinger, Burns, Meisser, et al., 1997)	439 community dwelling adults; 290 of these were active	365 (83%) completed the trial (74 dropped out). 290 active; 53 dropped out of active treatment 81% completed in aerobic group, 84% in resistance group. 18.28% of total active sample	Compliance in the exercise prescription groups was 68% in aerobic training and was 70% in resistance training (based on clinic records and self-report for home-based portion).	no measures reported	no measures reported

13 H ns; C ps-pt (Evan & Hardy, 2002)	39 (all participants active; but does not report how many in each group)	none reported	Self-reported % of actual versus prescribed adherence in a diary. Total mean goal setting group- 78.83, social support control- 51.84, control- 49.09.	no measures reported	Physiotherapist assessed % of adherence based on knowledge of the patient, clinical symptoms, rehab progress & behavioural observations over the 5 week treatment period goal setting group- 79.62 SD 11.98; social support control- 69.23, SD 14.56; control 71.88, SD 16.98.
14 H ns; C fs-pt (Fisher, Tewes, Boyd, et al., 1998)	54-27 in home-based, 27 in clinic-based	1 patient in the clinic group was excluded due to further surgery. 1.9% of total sample	Home-based- prescribed 6 sessions- average 5 (83.3%). Clinic-based, prescribed 24 visits- mean 19.9 (83%).	no measures reported	no measures reported
15 C nr-? (Foley, Halbert, Hewitt, et al., 2005)	70- 35 in hydrotherapy; 35 in gym	6 in each group discontinued intervention. 1 hydro and 3 gym were lost to follow-up. 22.9% of total sample	Hydrotherapy- 84% attendance, gym group-75% attendance.	no measures reported	no measures reported
16 C fs-pt (Freidrich, Gittler, Halberstadt, et al., 1998)	93 - 49 standard exercise control, 44 exercise + motivation.	Data available for 93 at study entry, 74 and 1st follow-up, 84 and 4 month follow-up and 69 at 12 month follow-up. 1st (approx 3.5 weeks from start) = 20.4% 4m = 9.7% 12m = 26%	Adherence at 4 months- (treatment group; *control group).* No. of sessions attended: 9.6/10 (1.1) *8.6/10 (2.1).*	Treatment compliance after end of sessions: 4 month- 10.6 (2.7) *10.3 (2.9);* 12 month- 28.8 (18.5) *30.1 (20.5);* weekly training frequency (days), 4 month 3.6 (0.5) *2.9 (1.1);* 12 month 4 (1.9) *3.1 (2.2).* No. minutes per day 4 month- 17.9 (8.7) *16.1 (10.2),* 12 month- 15.5 (8.6) *16.4 (13);* total training time (minutes) 4 month- 917 (656) *748 (668),* 12 month- 2024 (2026), *1516 (1397).*	no measures reported

17 H ps-? (Häkkinen, Ylinen, Kautiainen, et al., 2005)	126, 65 in strength training group (stg) and 61 in stretching control.	At 2 month follow-up- 7 stg, 4 control group. At 6 month follow up- 5 from stg, 5 control group, at 12 month 7 stg, 5 control. 2m = 8.7 % 6m = 16.7% 12m = 26.2% of total sample	Mean strength training overall % of adherence to number of times exercised over 12m for strength= 40.83%; for stretching = 71.04%. In the control group overall % adherence to number of times stretched over 12m = 72.71% (all total %s calculated from intermediate data at 2, 6 & 12m).	no measures reported	no measures reported
18 C fs-pt (Helmhout, Harts, Staal, et al., 2004)	81 - 41 in HIT and 40 in LIT.	33/41 high intensity completed; 29/40 low intensity completed (9 month follow-up) 23.5% of total sample	none reported	no measures reported	29 (71%) of HIT compared to 19 (48%) attended all 14 sessions, 10 (24%) v s 13 (33%) missed one session, 2 (5%) v s 8 (20%) missed 2, 3 or 4 sessions.
19 H ns (Iverson, Fossel, & Katz, 2003)	26	18 completed 12 week protocol. 30.8% of total sample	Those who completed the trial exercised 2.2 x week (med2.5, range 1-3). 55% of prescribed	no measures reported	no measures reported
20 LNS nr-? (Jackson, 1994)	68	Response rate at initial data collection- 91% (62 of 68). Response rate for part 2 of study was 82% (56 of 68) 17.6% of total sample	group 3 (control- no booklet, n=19) mean 50.52 (% of exercises carried out), SD 46.37, group 2 (high credibility booklet, n=16) mean 92, SD 27.30, group 1 (low credibility booklet, n=16) mean 76.62 (no SD given)	no measures reported	no measures reported
21 H ns; C fs-pt (Kolt & McEvoy, 2003)	120	Of those invited only 2(/120) did not want to participate; only 105 included in the analyses- doesn't say whether those not included dropped out or supplied incomplete data. 12.5% of total sample	Average attendance %- 87.7 SD 13.7. Average home exercise compliance assessment % of 14 home exercise sessions prescribed 71.6 SD 23.4	Average SIRAS 11.6/15 SD 2.3.	no measures reported

22 H ns; C fs-pt (Koumantakis, Watson, & Oldham, 2005)	55 (stabilization enhanced group- 29, exercise only- 26)	17 dropped out in total - 8 in stabilization enhanced and 9 in exercise only 31% of total sample	Attendance at sessions- ex+ stabilization= (prescribed -16; 8 weeks 2x week) mean 12.21, SD 2.69 (76.3%), ex only mean 11.33, SD 2.67 (/16 sessions; 70.8%). Home adherence - ex+ stabilization- median 23.5, IQR 20-24 (97.92%); ex only group- median 22, IQR 15-24 (91.67%), (/ 24- 8 weeks 3x week).	no measures reported	no measures reported
23 C fs-pt (Lampton, Lambert, & Yost, 1993)	31	none reported	Missed appointments- mean 1.77, SD 3.8 (/12 scheduled). Attended a mean of 10.23- therefore missed average of 14.75% of appointments (attended 85.25%)	effort ratings compared to other patients- 6.9, SD 2.1 (/11, 11= high effort)- not used as does not give any info on performance effort	no measures reported
24 C fs-pt/at (Laubach, Brewer, van Raalte, et al., 1996)	34	none reported	Apps attended- mean 9.29, SD 4.83, appointments scheduled 10.24, 4.95. (90.72% attended)	SIRAS mean 14.10, SD 1.11	no measures reported
25 C fs-ti (Lin, Davey, & Cochrane, 2004)	106 - 66 in exercise group, 40 age matched non-exercising controls	Of the 66 in the exercise group, 59 returned follow-up health status questionnaires, 51 completed their post-test physical function measures. Only 42 completed the 12 m exercise programme. 21.21% of total sample	Of those who did complete- adherence (attendance) average 70 +/- 14%.	no measures reported	Split into tertiles of adherence- 0-40%- n=16-17; 41-70%- n=19; 71-100% n= 23)- 1 year study

26 H ns; C ps-pt (Ljunggren, Weber, Kogstad, et al., 2002)	126; 64 in conventional training, 62 in terapimaster.	27 patients dropped out before first follow-up at 4 weeks (not inc in the 126). 17.65% of total sample	no measures reported	no measures reported	Compliance was equally good in both groups- asked to exercise between 15- 30 minutes 3x week. Amount of exercise per week- during supervised time- conventional physiotherapy- 67.5min/week (SD 14.8), terapimaster- 69.3 (15.9); unsupervised practice- conventional physiotherapy- 47.7 (10.1) terapimaster - 51.2 (10.2) (asked to exercise 15-30 min 3xweek)
27 C fs-pt (Lowdermilk, Panus, & Kalbfleish, 1999)	54	none- used existing records	Compliance index- 76% +/- 41 of scheduled appointments attended.	no measures reported	no measures reported
28 H ns; C nr-t (Lyngcoln, Taylor, Pizzari, et al., 2002)	15	None reported	median attendance- 100% (25th -75th percentile- 100-100), home exercise (median)- 70% (53-94.2)	SIRAS median- 14.1 (13-14.7),	no measures reported
29 H ns; C nr-? (Messier, Loeser, Miller, et al., 2004)	316; 80 exercise; remainder non-active or combined programmes -78 healthy lifestyle; 82 diet, 76 diet & exercise	64/80 completed exercise only 20% of total active sample	Exercise only 60% (% of classes attended v s prescribed).	no measures reported	no measures reported
30 LNS nr-? (Milne, Hall,	270	none reported (one off data collection)	Frequency of exercises compared to those prescribed (mean 89.27% SD 27.32.	Quality of exercise (mean 80.3%, SD 13.46) (assessed using the question what % of	no measures reported

& Forwell, 2005)				the time do you believe that you perform your rehabilitation exercises correctly?) duration of exercise compared to that prescribed (mean 91.18%, SD 25.05)	
31 C nr-? (Oldfors Engstrom & Oberg, 2005)	353	94- Either didn't complete the programme or dropped out (20 of these dropped out because of errors with the programme rather than a decision by the participants. 20.10% of total sample who took part	none reported	no measures reported	defined as highly adherent if trained twice a week or more- 61 participants; more than once but less than twice a week - medium adherent- 170 participants; non-adherent- once a week or less- 28.
32 H ns; C fs-pt (Ostelo, de Vet, Berfelo, et al., 2003)	105, 53 active usual care, 52 intervention group	8 patients dropped out- 7 in intervention group- 1 in usual care. 7.61% of total sample	none reported	no measures reported	no measures reported
33 H ns; C fs-ti (Penninx, Messier, Rejeski, et al., 2001)	250 (170 active)- 80 inactive control, 82 resistance, 88 aerobic	9.8% resistance group (8 participants), 13.6% for aerobic group (12 participants) 11.76% of total sample	(Including people who dropped out as 0%) - resistance group- 61%, 56% aerobic. Compliance (% attendance at scheduled sessions) better in 1st 3 months- 85%, then 61% 4-9 months, and 54% for 10-18months (no significant diff between the exercise groups).	no measures reported	no measures reported
34 1st 20 sessions- C fs-pt, beyond 20 sessions LNS nr-? (Preisinger,	92; 61 active, 31 non-active control	none reported	none reported	no measures reported	44% (27) adhered- exercised at least 1 hr per week. (34 exercised less than this recommendation)

Alacamlioglu, Pils, et al., 1996)					
35 H ns (Ravaud, Giraudeau, Logeart, et al., 2005)	2957 patients, 221 in usual care, 220 standard tools- not definitely active; 2516 active (their physicians were randomised).	448 dropped out in total; 216 dropped out of active treatment 8.59% of total active sample	none reported	no measures reported	240 (32.6%) patients in exercise group and 196 (28.8%) in the tools +exercise group met criteria for adherence to recommended exercise sessions (at least 4x week for 6 months). A further 208 (28.3%) and 191 (28.1% of patients in these groups performed exercise during the 6 months but for less than 4x week, further 107 (14.6%) in exercise group and 131 (9.3%) in the tools + exercise stopped between 3 and 6 months.
36 H ns; C fs-ti (Rejeski, Brawley, Ettinger, et al., 1997)	439	3 months- aerobic- 25 dropout (doesn't define how assigned as a drop out), Resistance- 17 dropout, 9 months- aerobic- 45 dropout. Resistance- 43 dropouts, 16 months- aerobic, 74 dropout, Resistance- 71 dropouts, 3 month- 9.57% 9 month- 20.05% 16 month- 33.03%	3 months- aerobic-119 adherers, % attendance for adherers- 72.68%. Resistance- 128 adherers, % attendance- 76.4%. 9 months- aerobic- 99 adherers, % attendance- 64.21%. Resistance- 102 adherers, % attendance- 69.84%. 16 months- aerobic, 70 adherers, % attendance- 67.86%. Resistance- 74 adherers, % attendance- 64.9%.	3 months- aerobic- average min/session- 35.12 (target was 40 minutes). Resistance- average- 49.99. 9 months- aerobic- average, 37.01 minutes. Resistance- average- 43.99. 16 months- aerobic, average 37.35 minutes. Resistance- average 41.31 minutes.	no measures reported
37 LNS nr-? (Riley, Robinson, Wise, et al., 1999)	80, Only 51 physiotherapy	For compliance to physiotherapy measure- 51 were prescribed physiotherapy, only 31 gave info on adherence	61% (n=31) of physiotherapy treatments received.	no measures reported	no measures reported
38	180	None reported- participants were	no measures reported	mean compliance rating on	no measures reported

C nr-rp (Robinson, Bulcourf, Atchison, et al., 2004)		invited to take part 6m after assessment of adherence to their rehabilitation programme.		likert scale (0=no compliance; 100= did everything recommended)- patient- 89(sd17), HP- 58 (SD 29), significantly diff.	
39 H ns; C fs-pt (Røgind, Bibow-Nielsen, Jensen, et al., 1998)	25. 12 training group, 13 non-active control.	1 patient didn't complete the active study. 8.33% of total active sample	96/96 assessments attended. IG- 218 of 280 training sessions attended (77.9%), one person dropped out, of the remainder- they attended 85.2% of training sessions. No data on home-based therapies.	no measures reported	no measures reported
40 H ns; C fs-pt/at (Scherzer, Brewer, Cornelius, et al., 2001)	54	none reported	Attendance at sessions- 0.8, SD=0.23.	SIRAS (transformed) 0.76 SD= 0.24. Home exercises- 7.02(/10), SD= 2.35 (single items).	no measures reported
41 H ns (Schneiders, Zusman, & Singer, 1998)	96 (94 included in analysis as 2 were 'over-compliant').	none reported	Mean compliance in active control group n=49- 38.1% (39.96% accounting for the over-compliant participant), study group n=47- 77.4% (78.96% accounting for the over-compliant participant) (significant diff- t test 0.01).	no measures reported	no measures reported
42 H ns; (Seçkin, Gündüz, Borman, et al., 2000)	120	none reported	at end of 1st week-90 +/- 2.3%; 1st month- 86 +/- 2.7%, 2nd month 87+/- 1.9%, 3rd month- 85 +/- 3.1% (ns decline in adherence from beginning to end of study)	no measures reported	no measures reported

43 H ns Sluijs, Kok, & van der Zee, 1993)	1,681 patients completed questionnaire, only those who were non ad or ad were included (not partially ad) therefore, 695 participants in analysis.	none reported	none reported	no measures reported	1- not at all or 2 a little=270 (classed as non-adherent); 22%; 3- rather regularly (499; 41%, not used in analyses); 4- very regularly (425; 35%, classed as adherent)
44 C fs-pt (Taylor & May, 1996)	62	none reported	none reported	no measures reported	Physiotherapists' estimate-33 (55%) didn't comply; 27 (45%) fully complied. Patients' estimate- 34 % (60%) didn't comply; 23 (40%) fully complied. The physiotherapy assessed PMT variables were significantly greater for adherent participants, but not on the patient measured. (was a measure of perceived compliance- scale of 0- none - 5- all)
45 H ns; C fs-? (van Gool, Penninx, Kempen, 2005)	156	22 patients lost to follow-up 14.10% of total sample	Mean +/- SD; 65.5%+/- 27.1% in initiation phase (first 6 months), 53.7% +/- 29.4% overall (n=134).	no measures reported	69 in exercise only and 65 of ex+ diet were still exercising at 18 months.
Totals	5550	815; 14.82%			

2.3 Results

Table 1 presents all of the information relating to the four components of adherence for each of the studies within the review. The first column gives information on the location of the therapy (H- Home; C- Clinic; LNS- Location of treatment not specified), level of supervision (fs- full supervision; ps- partial supervision; ns- no supervision; nr- not reported) and who supervised it (if it was supervised; pt- physiotherapist; at- athletic trainer; rp- rehabilitation practitioner; ti- trained instructor; t- therapist; ?- does not specify).

2.3.1 Drop-out

Dropout was calculated as the percentage of participants who dropped out of the total sample (5,500 participants) in the 26 studies that reported drop out statistics. This resulted in an overall drop out rate of 14.82%.

2.3.2 Percentage of physiotherapy sessions carried out of those prescribed

2.3.2.1 Treatment period of less than 6 months

Objective (non self-report) records of attendance at clinic-based treatment sessions completed of those prescribed, weighted for *n* within the study (using formula 1 described in section 2.3.1 above), was 75.62%. This figure was based on *n* = 1,288 in 17 studies; if no length of treatment was specified it was assumed to be less than 6 months (study 6, 9 & 23). Without this assumption attendance was calculated as 74.38% based on *n* = 1,111.

Attendance at clinic-based treatment sessions completed of those prescribed based on some or all self-report measures, weighted for *n* within the study was 64.25%. This figure was based on *n* = 425 in 4 studies; if the article did not report whether the measures were self-report, it was assumed that they were to be conservative (study 14 & 15). Without this assumption attendance was calculated as 63.30% based on *n* = 328 (the remaining 2 studies derived their attendance statistics from both self-report and non self-report measures).

The number of home-based treatment sessions self-reportedly completed of those prescribed, weighted for *n* within the study, was 77.25% (based on *n* = 966 in 12 studies).

If the article did not report whether the measures were self-report, it was assumed that they were (study 14); if no location of the programme was reported it was assumed to be home-based (study 20 & 30); if no length of treatment was specified it was assumed to be less than 6 months (study 4 & 30). Without making these assumptions attendance was calculated as 72.02% based on n = 552). No home-based treatments used non self-report measures.

Adherence to fully supervised sessions, weighted for n within the study was 68.01% (based on n = 1,269 in 15 studies). This group of studies was clinic-based only; if no length of treatment was specified it was assumed to be less than 6 months (study 6 & 9). Without this assumption attendance was calculated as 66.04% based on n = 1,123.

Adherence to partially or non-supervised sessions, weighted for n within the study was 74.46% (based on n = 1,063 in 13 studies). This group of studies included both clinic and home-based sessions. Where studies did not specify whether they were supervised, it was assumed that they were not (study 15, 20, 28, 30 & 41). If no length of treatment was specified it was assumed to be less than 6 months (study 4 & 30). Without making these assumptions attendance was calculated as 71.57% based on n = 493.

2.3.2.2 Treatment period of more than 6 months

Objective records of attendance at clinic-based treatment sessions completed of those prescribed, weighted for n within the study was 43.50% (based on n = 681 in 4 studies).

Attendance at clinic-based treatment sessions completed of those prescribed based on some or all self-report measures, weighted for n within the study, was 47.59% (based on n = 985 in 5 studies; if the article did not report whether the measures were self-report, it was assumed that they were (study 12); without assumptions 43.91% n = 695; 3 studies derived their attendance statistics from both self-report and non self-report measures).

The number of home-based treatment sessions self-reportedly completed of those prescribed for programmes lasting more than 6 months, weighted for n within the study was 48.78% (based on n = 703 in 5 studies; if the article did not report whether the measures were self-report, it was assumed that they were (study 12). If no location of the programme was reported it was assumed to be home-based (study 37). Without making these assumptions attendance was calculated as 44.33% based on n = 362. No home-based treatments incorporated non-self-report measures.

Adherence to fully supervised sessions, weighted for *n* within the study was 45.00% (based on *n* = 801 in 4 studies; this group of studies were clinic-based only).

Adherence to partially or non-supervised sessions, weighted for *n* within the study was 47.80% (based on *n* = 583 in 5 studies). This group of studies included both clinic and home-based sessions. Where studies did not specify whether they were supervised, it was assumed that they were not (study 29 & 37). Without this assumption attendance was calculated as 48.97% based on *n* = 452.

2.3.2.3 Differences between Attendance / Completion as a Function of Length of Treatment, Method of Measurement and Level of Supervision

Table 2

Percentage of clinic-based attendance at appointments for self-report and non self-report measures for treatment periods of less and more than 6 months

	Self-report	Non self-report
Less than 6 months	64.25	75.62
More than 6 months	47.49	43.50

Chi square analyses were conducted comparing the percentage of attendance between the different lengths of treatment period, self-report versus non self-report and level of supervision. It was found that there was no significant difference between attendance at clinic-based sessions according to self-report and non self-report for treatment lasting less than 6 months ($\chi^2 = 0.92$, df = 1, *ns*) or more than 6 months ($\chi^2 = 0.17$, df = 1, *ns*). There was significantly better attendance at appointments for treatment periods of less than 6 months using non self-report measures ($\chi^2 = 8.66$, df = 1, $p < .01$) but not for self-report ($\chi^2 = 2.51$, df = 1, *ns*).

Table 3

Percentage of home-based completion of sessions for non self-report measures for treatment periods of less and more than 6 months

	Self-report
Less than 6 months	77.25
More than 6 months	48.78

The number of home-based sessions self-reportedly completed was significantly greater for treatment periods of less than 6 months compared to more than 6 months ($\chi^2 = 6.43$, df = 1, $p < .05$).

Table 4

Percentage of attendance at clinic-based appointments / completion of home-based sessions for fully supervised and non fully supervised sessions for treatment periods of less and more than 6 months

	Fully supervised	Non fully supervised
Less than 6 months	68.01	74.46
More than 6 months	45.00	47.80

Attendance at fully supervised sessions was not significantly different to attendance / completion of non fully supervised sessions for treatment periods of less than 6 months ($\chi^2 = 0.29$, df = 1, *ns*) or more than 6 months ($\chi^2 = 0.08$, df = 1, *ns*). Attendance at clinic-based / completion of home-based sessions over a less than 6 month period was significantly greater than for over a more than 6 month period for fully supervised ($\chi^2 = 4.69$, df = 1, $p < .05$) and non fully supervised sessions ($\chi^2 = 3.25$, df = 1, $p < .05$).

The overall findings of these analyses showed that attendance / completion of treatment was better for treatment periods of less than 6 months. They also reveal that there was no significant difference between objective and self-report estimates of attendance (based on clinic-based studies only). Lastly, they indicated that reported rates of attendance / completion of treatment were similar in fully supervised and non-fully supervised programmes.

2.3.3 Effort/ Accuracy

A number of studies included information on how well participants followed advice within the sessions that they attended (in clinic-based sessions only). The most popular method for assessing this measure was the Sports Injury Rehabilitation Adherence Scale (SIRAS; Brewer et al., 2000). This is a three item measure that is completed by the health professional and indicates how well the participant is following their treatment

regime. The mean SIRAS score weighted for *n* within the study was 13.01 (maximum score of 15), based on *n* = 545 in 6 studies.

The remaining methods employed by various studies were diverse, including assessing percentage of exercises completed, the intensity with which exercises were performed, the percentage of exercises that were carried out correctly and the amount of time for which exercises were carried out of that prescribed. The results from these assessments are discussed in the remainder of this section.

The mean self-reported percentage of exercises completed within treatment sessions was 63.57% of those prescribed (based on *n* = 162 in 2 studies). If the study did not report whether assessment was self-report or not, it was assumed it was (study 41). Without this assumption the percentage of exercises completed was 70.15% based on *n* = 66. One study reported the non-self-report percentage of exercises completed as 79.8% (based on *n* = 40). Five studies used the self-reported degree of exercise completion within sessions on a scale of 0 (none) – 10 (all); the mean, weighted for *n* within the study, was 7.50 (based on *n* = 363). One study reported health professionals' assessment of the degree of exercise completion within sessions on a scale of 0 (none) – 100 (all); the mean for the 66 participants in the study was 58. One study reported that 80.3% of exercises were self-reportedly completed correctly (based on *n* = 270). For rehabilitation from athletic injuries, one study reported that participants' mean intensity of carrying out exercises was 3.2, on a scale from 1 (minimum effort) to 5 (maximum effort), according to the health professionals' observations. It should be noted that this study does not specify whether this score is relative to the amount of effort prescribed.

The last method that was used to assess how well participants did at performing the exercises themselves was a measure of the total time spent exercising against that prescribed. However, each study that used these statistics reported different methodologies; combining the results from these different studies was therefore not possible. One study (code 30, *n* = 270) reported that 91.18% of the prescribed time spent exercising was completed (this study only collected data at one time point and treatments lasted for varying lengths of time). Another study (code 36, *n* = 439) reported that their control group (of those who gave data) completed between 87.80% and 93.38% of the time prescribed from 3-16 months. Their experimental group completed between 103.28% and 124.98% of the time prescribed from 3-16 months.

2.3.4 Factors Associated with Adherence

Table 2 illustrates the factors that have been used to predict adherence. A number of studies have also examined outcomes that are associated with adherence, which are also reported below. The measures of adherence that studies used for their analyses included all those discussed thus far; dropout, percentage of sessions attended, estimates of effort / accuracy and global / categorical adherence. As the results in some studies differed according to which measure of adherence was used, method of adherence measurement is also included in the table.

Table 5

Factors associated with and used to predict adherence

(Notes: numbers in cells represent the study codes. Letters represent which aspect of adherence: a- attendance at sessions/ training frequency, pr- practitioner ratings of adherence during sessions, ec- number of exercises completed, ex i- exercise intensity, g/c- global / categorical measure, h- number of home-based sessions completed, t- proportion of time prescribed spent exercising, ptr- patient rated adherence, ptq- patient rated quality of exercise, d- dropout from rehabilitation, + indicates the adherence measure was a combination of aspects of adherence, (...)-relationship not reported but has been assumed, [1] after study code represents how many measures of physical, psychological or mental outcomes were assessed within that study and fell into the given category)

	Prediction			Association		
Variables (increased/ more/ better)	Increased adherence	Decreased adherence	Does not predict	Increased adherence	Decreased adherence	No association
			Beliefs / knowledge about treatment / therapist			
Perceived barriers to perform therapy					43- g/c,	
Causal attributions (locus of causality, stability, personal control, and external control)	7- a		7- pr	24- pr (stability and personal control only)		24- a, pr (locus of causality, and external control)
Expected exercise as treatment				41- ec,		
No foreseeable problems	1- g/c,			1- g/c,		
Knowledge of treatment	11- a,ec,ex i, g/c					
Perceived dependency						43- g/c,
Perceived helplessness					43- g/c,	

Perceived physical ability	11- ex i,	11- a, g/c			
Perceived severity			44- pr,		6- a, pr, h, 44- ptr
Perceived susceptibility			6- pr, h, 44- pr,		6- a, 44- ptr
Positive attitude to exercising			16- a,		(16- t)
Positive expectations			31- g/c,		31- d
Positive feedback about physiotherapist			43- g/c,		
Self-efficacy			6- pr, h, 44- pr,		6- a, 44- ptr,
Coping self-efficacy			30- ptr, t		(30- ptq)
Task self-efficacy			30- ptq, t		(30- ptr)
Success dependent on environment / own will / physical status					31- g/c
Success dependent on treatment			31- g/c		
Task involvement	11- ex i,	11- ec			23- a, pr
Treatment efficacy	11- a, g/c,	11-ex i	6- pr, h, 44- pr,		6- a, 44- ptr
Valued treatment less				31- g/c,	
Personal incentives		11-a, ec, g/c			
		Psychological characteristics			
Athletic identity / Plans for future athletic activity / Perceived team role	9- h (younger participants), 11- ex i	8- h, pr, a, 9- a, pr, 11-a, ec, g/c			8- h, pr, a
Psychological distress		8- h, pr, a	16- t,		8- h, pr, a; (16- a)
Ego involvement					23- a, pr;

Internal Locus of Control	11- ec	11-a, ex i, g/c	16- t,	1- g/c; (16- a)
Positive self talk			40- h,	40- pr, a,
Self motivation	8- h, 9- h (older participants), 11- a, ex i, g/c,	8-pr, a; 9- a, pr	8-pr, h	8- a
Self-esteem			23- a,	23- pr
Self- handicapping				23- a, pr
Social support	9- h (older participants), 11- a, ec, ex i, g/c	8- h, pr, a; 9-a, pr; 36-a	8- h	8-a, pr, 36- a, t
Quality of Life				1- g/c,
Baseline well-being				5- g/c,
Baseline depression				1- g/c, 5- g/c, 36- a, t,
Mental health				45- a+h
Trait sport confidence	11-a, g/c	11- ec, ex i		
State sport confidence		11- a, ec, ex i, g/c		
Self reliance		11- a, ec, ex i, g/c		
Social functioning				45- a+h
		Demographic characteristics		
Employed / Socio-economic status				5- g/c, 42- a
White		36- a, t		5- g/c, 36- a, t

Being married		1- g/c,	1- g/c,	5- g/c
Competitive versus recreational athletes			30- ptq,	
Higher education				43- g/c,	1- g/c, 5- g/c, 42- a,
Male		1- g/c, 36- a, t,	1- g/c, 5- g/c, 31- g/c,		27- a, (30- ptr, t, ptq), 31- d, 36- a, t, 43- g/c
Younger age		36- a, t		31- g/c, 43- g/c,	27- a, 1- g/c, 5- g/c, (21- a, pr, ptr), 31- d, 34- g/c, 36- a, t
Living alone					1- g/c,
		Illness characteristics			
Co-morbidities	1- g/c,			1- g/c,	5- g/c,
Longer duration of disease			42- a,	43- g/c,	5- g/c,
More serious baseline illness			43- g/c,		5- g/c,
		Physical characteristics			
Discomfort					43- g/c
Lower baseline BMI		36- a, t	45- a+h,		36- a, t
Bone density					34- g/c,
Greater change in BMI			45- a+h,		
Increased disability / decreased functioning		36- a, t,	43- g/c,	31- d, g/c	1- g/c, 36- a, t
Poorer general health				31- d,	
Pain		36-a, t,	42- a, 43- g/c		5- g/c, 45- a+h

Pain duration / frequency / no. of pain locations					31[3]- d, g/c, 36- a, t
Pain intensity				31-d, g/c	1- g/c, 36- a, t
Increased difference in knee circumference			42- a,		
Increased range of knee flexion			42- a,		
More baseline symptoms / bilateral (rather than unilateral) knee OA			42- a,		34- g/c,
		Treatment variables			
Shorter duration of therapy		1- g/c,	1- g/c,		27- a, (30- ptr, t ptq)
Types of intervention	1				2- a, 20- a
	2		16- h, 20- a,		
	Collaborative goal setting		13- ptr,	4- h+ec,	13-pr
	Personal goal setting		40- h, pr,		40- a
Number of exercises per session					43- g/c
Number of questions asked by physiotherapist					43- g/c
		Other			
Perceived characteristics of athletic trainer			11- a, ec, ex i, g/c		
Duration of sick leave					31- d, g/c
Greater earlier adherence			17- h,		
Prior therapy / injury		36- a, t,	30- ptq, ptr, 36- a,		1- g/c,

t

Relationship between patient and therapist				43- g/c
Use of pain killers				31- d, g/c
Third party payer			27- a,	
	Outcome measures (adherence associated with / predicted)			
Improved physical outcome	8[1]- a, pr, 28[3]- h+pr+a	8[1]- h, 8[2]- h, pr, a, 28[1]- h+pr+a	19[2]- g/c, 12[2]- a+h, 25[2]- a, 5[1]- g/c, 33[1]- g/c, 45[2]- a+h	19[2]- g/c, 34[2]- g/c
Improved psychological / mental outcome			5[3]- g/c, 45[1]- a+h,	19[3]- g/c, 45[1]- a+h,
Improvement in pain / pain		28- h+pr+a	12- a+h, 25- a, 45- a+h,	5- g/c, 34- g/c
Patients' perceived rehabilitation	21- pr,		21- pr; 27- a	(21- a, ptr)
Physiotherapists' perceived rehabilitation			21- pr	(21- a, ptr)

Note. In the variable column, 1 denotes Computer assisted; Low versus high credibility booklet; Low credibility booklet versus no booklet control and 2 denotes High credibility booklet versus no booklet control; Motivation group intervention

2.3.4.1 Factors that predict adherence over time

Table 2 above displays those factors that have been found to be associated with or predict future adherence behaviour and outcomes of adherence. Eight studies used appropriate methodologies and statistics (longitudinal studies and regression analyses or repeated measure ANOVA) to be able to predict adherence. Of these studies, the majority found that while some aspects of adherence could be predicted, not all aspects of adherence were predicted by one particular factor. Due to the small number of studies that could predict adherence, there was a maximum of 3 studies that tested the predictive ability of the same factor. Of these factors that were investigated by more than 1 study, increased athletic identity and increased social support were predictive of some aspects of adherence in 2 studies each and were not predictive of some aspects of adherence in 2 studies each. Improved physical outcome was predicted from some aspects of adherence in 2 studies and was not predicted by some factors in 2 studies. Similarly, self motivation was predictive of some aspects of adherence in 3 studies, but not predictive of some aspects of adherence in 2 studies.

The remainder of findings relating to prediction of adherence are based on the findings of single studies. Prediction of increased adherence were made for no foreseeable problems, increased knowledge of treatment, shorter duration of physiotherapy, patient perceived rehabilitation and prior physiotherapy / injury experience. Only more co-morbidities was predictive of decreased adherence. The following factors did not predict adherence; personal incentive, psychological distress, state sport confidence, self reliance, being white, married, male or younger, having a lower baseline BMI, increased disability / decreased functioning, pain and perceived characteristics of the athletic trainer.

Of the outcome variables, adherence did not predict improvement in pain or pain levels. Of the studies that assessed multiple components of adherence, the following found that some aspects did predict increased adherence and some did not predict; causal attributions, perceived physical ability, task involvement, task efficacy, internal Locus of Control, and trait sport confidence.

2.3.4.2 Factors associated with adherence

In the studies that carried out analyses looking at the association with adherence, a large number of variables were examined; however, few were examined by more than one

study. This section discusses those variables that were used in more than one study. It was found that prior therapy / injury was more consistently associated with increased adherence (some studies found no relation between the variable and adherence). Of the outcome measures that were associated with adherence, there was more consistent evidence of improved physical outcome[2], improvement in pain[2] and patient perceived rehabilitation (some studies found no relation between these variables and adherence).

There were an equal number of studies that found evidence of a positive relationship between variables and adherence and no evidence of a relationship for: perceived susceptibility, self-efficacy, treatment efficacy, lower baseline BMI, and more baseline symptoms. Of the outcome measures, an equal number of studies found evidence for increased adherence being associated with and no evidence of a relationship for improvement psychological / mental outcome. No relationship was found more consistently between adherence and; increased perceived severity; psychological distress; internal Locus of Control; social support; baseline depression; employment status / socio-economic status; being white; male[2]; younger age[2]; increased disability / decreased functioning; pain duration / frequency / number of pain locations; pain intensity and shorter duration of therapy and adherence (some studies found evidence for an association with increased adherence).

There was mixed evidence for the direction of association, and whether there was an association, between longer duration of disease, and collaborative goal setting and adherence.

2.4 Discussion

2.4.1 Adherence Estimates

The results from this systematic review have revealed that dropout from physiotherapy studies was 14.82% (of those that report drop-out statistics). Adherence to physiotherapy ranged from 64.25% to 77.25% for treatment periods of less than 6 months and from 43.50% to 48.78% for treatment periods of more than 6 months for attendance at clinic-based sessions / completion of home-based sessions (of those that report attendance statistics). There was distinctly lower attendance at therapy sessions for those studies requiring treatment for longer than 6 months for both clinic and home-based treatment. There appeared to be little difference in attendance at sessions based on whether they were

[2] Indicates findings from more than five studies

fully supervised or not for both clinic and home-based treatment. There was very little difference in estimates based on self-report and non self-report measures, with self-report measures yielding slightly lower attendance estimates.

Estimates of adherence during physiotherapy sessions were less frequently measured. Estimates using the SIRAS indicated that participants scored a mean of 13.01 out of 15, which suggested that participants were carrying out physiotherapy well. Non self-report assessments of the percentage of exercises completed per session were used by a single study, and this measure showed that 79.8% of exercises were completed. Of the self-report measures, degree of completion estimates showed that participants assessed their completion of exercises as 7.50 on a scale from 0 (none) to 10 (all). Adherence to the length of time exercises were carried out for was also reported infrequently. Those studies that did report these statistics showed that between 87.80% and 124.98% of time prescribed was completed.

2.4.2 Factors Associated with Adherence

A wide variety of factors were investigated in relation to adherence, in terms of both precedents and results of adherent behaviour. However, few studies investigated the same factors, therefore the findings relating to a specific factor are based on relatively few studies. Of those factors that were investigated by more than one study, prior experience of physiotherapy / injury, stronger athletic identity, social support and self motivation were related to increased adherence. Higher adherence was also consistently found to be related to improved physical outcome, improvement in pain and patient perceived rehabilitation.

2.4.3 Measurement of Adherence

It is useful to break adherence to physiotherapy down into its constituent parts because adherence behaviour is complex. Attending an appointment and attempting to carry out sessions of physiotherapy is the first step toward adherent behaviour. In and of itself however, these measures do not fully capture adherence to physiotherapy and may not be sufficient for recovery. Additional measures that inform on how well the exercises are performed must also be utilised if a more comprehensive picture of adherence behaviour is to be established.

Of the methods of assessing adherence, the most commonly used was a percentage of sessions completed of those prescribed. As mentioned above, this is the first step toward adherence behaviour and is therefore an important statistic to report. For clinic-based treatments, an objective measure of how many appointments were attended was the most commonly used. Home-based treatments however, necessitate that self-report measures be employed. Twelve of the studies in this review did not report statistics (in a form that allowed combination with other studies) on this aspect of adherence.

Measurement of how well exercises were performed during each session of physiotherapy was less well reported. Only 13 of the 45 studies in this review reported such measures (in a form that could be integrated with findings from other studies). One of the most common ways of assessing adherence during sessions was the SIRAS. This measurement tool gives an indication of the physiotherapists' view of how well patients adhere during their physiotherapy sessions. It therefore has the advantage of not being a self-report measure. The reliability and validity have also been established and as it consists of only 3 questions, is simple and quick to complete (Brewer et al., 2000). The most common way of assessing adherence in a self-report format was degree of completion of exercises on a scale of 0 (none) – 10 (all). However, the reliability and validity of this measure has yet to be established. Studies have also reported the amount of time spent on exercising of that prescribed, however, there was no consistency or established measure for this aspect of adherence.

2.4.4 Theoretical Implications

The theoretical implications of the findings of this review are that adherence to physiotherapy was most commonly assessed by attendance at appointments only, which may not completely capture adherence behaviour. However, findings from those studies that do report adherence during each session revealed that adherence also varied within sessions. The laboratory and field studies (reported in chapters 7 and 8) suggest that different factors predict attendance at sessions and completion of exercise instructions during each bout of physiotherapy. Therefore, assessing only attendance at sessions may paint an incomplete picture of adherence and the various factors that predict it.

2.4.5 Clinical Implications

The clinical implications of the results of this systematic review suggest that attendance at sessions was no different for fully supervised and non fully supervised programmes. This means that fully supervising a programme is unlikely to increase attendance at sessions. However, it should be noted that the majority of studies reported at least partially non self-report assessments of attendance. Therefore, as participants have to rely on using memory and the fact the participant may respond in a biased way so as to present themselves more favourably (Conner et al., 1996), self-report measures may not reflect true adherence rates.

As physiotherapy is often a relatively complex form of treatment, it might be expected that the quality of performance of the exercises might be better where a physiotherapist supervises patients as they carry out their therapy exercises. Since few studies gave information on adherence during sessions, and the kind of measures that were used were not used in both fully supervised and non fully supervised programmes, this review could not assess the difference in adherence during sessions according to whether they were fully supervised or not. It would be important to answer this question as this could have implications for whether non fully supervised programmes have a detrimental effect on treatment. This may be important as it may not be possible to offer fully supervised programmes (e.g. the patient cannot get to the clinic or it may not be possible for the clinic to offer full supervision).

As with other treatments (Benner et al., 2002; Cherubini, Rumiati, Bigoni, Tursi, & Livi, 2003), this review confirms that adherence to physiotherapy programmes decreases as length of treatment increases. It is therefore important that physiotherapy health professionals implement interventions to increase long-term adherence for those patients who are expected to have a long programme of treatment.

The conclusions that can be drawn from those factors that are associated with adherence are limited due to the fact that few studies have investigated the same factors. However, based on those factors that were investigated by more than one study, it appeared that improving athletic identity (in athletes), social support and self motivation may increase adherence. Prior experience of physiotherapy / injury was also related to increased adherence. Encouraging adherence is likely to result in improved physical outcome, improvement in pain and patient perceived rehabilitation.

2.4.6 Recommendations and Future Research

To enable future systematic reviews and meta-analyses to be conducted on adherence to physiotherapy treatment the following recommendations are made based on the current review. To ensure that researchers are able to report adherence statistics that take into account all aspects of non-adherence, it is recommended that the following statistics are reported. Firstly, studies should report dropout from studies, secondly, attendance at therapy sessions or attempts at home-based exercise and thirdly, an indication of adherence during sessions. Statistics should also include information on how the adherence statistics were calculated and whether any adjustments were made for those participants that did not provide information or dropped out of the study and / or treatment. If researchers do not report or take account of dropout from their study, statistics generated may be artificially elevated. Reporting all these aspects of information on adherence statistics will enable researchers to be more confident that the statistics they are reporting are a more comprehensive reflection of adherence.

Development and validation of a self-report measure that can assess adherence during physiotherapy sessions at home would strengthen research. Few studies used methodologies that enabled predictions to be performed. Future research should aim to use both longitudinal designs and appropriate statistical techniques to enable the direction of relationship between adherence and other factors to be established. In addition to this, some studies that assess adherence do not report how adherence relates to the factors that are assessed in the study; reporting this information would increase the body of information available on adherence. Once such a measure has been designed and validated, research could then compare adherence during sessions for fully and non fully supervised programmes. The findings of such a study could have implications for the best use of physiotherapist time to maximise adherence.

2.4.7 Conclusions

The overall conclusions from this systematic review were that attendance at appointments was higher for those treatments lasting less than 6 months, but that there was no difference between attendance at fully supervised versus non fully supervised session. In addition to this, there appeared to be no difference in the attendance statistics generated by the use of self-report versus non self-report measures. As physiotherapy is a complex behaviour,

adherence statistics should ideally cover both attendance at / completion of treatment sessions and adherence during these sessions.

The conclusions that could be drawn concerning which factors were associated with adherence were limited by the fact that studies tended not to assess similar factors and / or report how other factors within a study related to adherence.

CHAPTER 3: REVIEW OF THE LITERATURE: THEORETICAL MECHANISMS OF BEHAVIOURAL CONTROL

3.1 Introduction

In the pursuit of explaining behaviour, health psychologists have tended to conceptualise the individual as a rational decision maker, and therefore the primary determinants of behaviour are intentions, beliefs and attitudes (e.g. Bandura, 1986; 1997; Brassington, Atienza, Perczek, DiLorenzo, & King, 2002; Conner & Norman, 1995; Horne & Weinman, 1998; Resnick, Palmer, Jenkins, & Spellbring, 2000; Sluijs, Kerssens, van der Zee, & Myers, 1998). The assessment of such cognitions has gone part of the way to explaining why behaviour occurs, as will be shown below (e.g. Sutton, 1998). However, there are additional processes, such as those that occur via learning, which are of importance to behavioural control. Consideration of these additional variables may add to the variance in behaviour that can be accounted for by cognitive variables.

The first main section of this chapter discusses how cognitive processes are thought to influence behaviour and some of the evidence that supports the ability of cognitive variables to explain behaviour. The disadvantages and problems associated with focussing solely on cognitive processes when explaining behaviour are then critically discussed. The components of Bandura's Social Cognitive Theory (1986; 1997) are then described, as this theory has been selected to examine the role that cognitive processes play in influencing behaviour in this programme of research. The next main section argues the case that additional processes may also play a key role in the performance of behaviour. Examples of variables that act in a potentially different way, such as pain (e.g. Waddell, Newton, Henderson, Somerville, & Main, 1993) and affective state (e.g. Suter & Marti, 1992), are discussed. The chapter concludes by considering how the two sets of processes, cognitive and additional processes, may interact to influence behaviour.

3.2 The influence of cognitive mechanisms on behaviour

A behaviour can be said to have arisen due to the action of a cognitive mechanism if the behaviour has been initiated as a result of cognitive decision making, and necessitates effortful attention to guide it from that point on (Schneider & Shiffrin, 1977). Cognitive processes themselves are characterised as being slow and effortful, but are flexible and well suited to learning new skills and problem solving (e.g. Bargh, 1997; Jansma,

Ramsey, Slagter, & Kahn, 2001). An example of 'cognitive' control of behaviour in health might be taking up a gym-based exercise regime. To initiate behaviour, a cognitive decision would be needed to decide to engage in the behaviour and subsequent to this, effortful attention would continue through deciding what to wear to and from the gym, perhaps how to get to the gym, and once at the gym the individual would need to learn the skills necessary to use all the equipment.

In the field of health psychology, many different behaviours that affect health, by either enhancing health or avoiding harm, in both the long and short-term, have been studied with the aim of trying to elucidate the role of different variables in these behaviours (Conner & Norman, 2005). The variables that influence health behaviour are numerous, and may focus on the individual and /or their environment. For example, demographic variables (e.g., age, gender, socio-economic status and ethnicity), social variables (e.g., peer influence and cultural variables), emotional variables (e.g., stress and self-esteem), perceived symptoms (which can also form cognitive variables if illness perceptions are considered), personality variables, and cognitive variables (e.g., knowledge, attitudes, perception of risk, efficacy of the behaviour being carried out and self-efficacy; Conner & Norman, 2005) may all contribute to the performance of a behaviour. This last set of variables, the cognitive variables, are often considered by health psychologists to be the most useful to study as they can potentially be altered (Conner & Norman, 2005). The popularity of using health-related cognitions to explain health-related behaviour in the literature is supported by the finding that 21% of articles published in four of the top health psychology journals (Health Psychology; British Journal of Health Psychology; Psychology and Health and Journal of Health Psychology) between 1997 and 2001 were concerned with health-related cognitions (Ogden, 2003). These cognitive variables are believed to form the 'substrates' for behaviours that occur in a social environment (Ogden, 2000) and social cognition models are the primary form of model used to conceptualise how these cognitive variables interact to influence behaviour.

The social cognition models share a number of similarities. Firstly, the majority include attitudes and beliefs such as intention, self-efficacy, and expectancy-value judgements and therefore they assume that these are central to the performance of behaviour (Conner & Norman, 2005; Horne & Weinman, 1998). Secondly, they help to identify variables that can be targeted with the goal of changing behaviour. Thirdly, they assume that the cognitions measured precede behaviour (Conner & Norman, 2005).

Models which assess cognitions with the aim of predicting behaviour and outcomes, have understandably received most research attention as they can suggest which cognitions, if changed, would be likely to alter behaviour (Conner & Norman, 2005). As well as these models being extremely useful for focussing research, the research results can also be used to test the efficacy of a given model to explain behaviour. For example, a meta-analysis that looked at the efficacy of the theory of reasoned action and theory of planned behaviour showed that these theories were able to explain between 19 and 38% of the variance in behaviour (Sutton, 1998). Another similar analysis revealed that the theory of planned behaviour, health belief model and protection motivation theory could explain between 1 and 65% of the variance in the behaviours they addressed and between 14 and 92% of variance in self reported intention (Ogden, 2003).

It is evident from these results that whilst these theories are predictive, there is still a large proportion of the variance in behaviour unexplained. Given that there may well be a bias towards the publication of significant results (as is evident in many fields including psychology; e.g. Evers, 2000; Petticrew, Bell, & Hunter, 2002; Scargle, 2000), statistical support for models within the published literature may be more prevalent than evidence to the contrary, which does not reach publication. It has also been noted that many published studies report that their findings support the specified model. Where the variance explained by these studies is low, often problems with a study's design are implicated rather than problems with the model it was designed to test (Ogden, 2003).

Some models have been criticised for trying to include too many variables to explain behaviour (Conner & Norman, 2005). Whilst an extensive model that includes tens of variables might not be of practical use, trying to distil the variables that influence behaviour to the other extreme may be equally unhelpful. Although it would be simpler and more convenient for researchers to find a small number of variables that have a large impact on behaviour, the difficulty that researchers have had in explaining behaviour suggests that the variables that influence behaviour are many and complex. Nonetheless, researchers strive to find the balance between the fewest variables possible and the largest variance explained, as this will be most helpful to interventions. However, as illustrated by the results of the meta-analyses reported above (Ogden, 2003; Sutton, 1998) that show between 35 and 99% of the variance in behaviour is left unexplained, by focussing attention on those variables specified by the model, the role of other potentially important variables might be overlooked (Conner & Norman, 2005).

There are further potential reasons as to why the explained variance in behaviour by the social cognition models is low, and further weaknesses of these models must be considered. Firstly, rationality is assumed in the processes that are carried out before a behaviour is performed, with some models even suggesting that complex cost-benefit analyses are conducted before a behaviour is performed (Conner & Norman, 2005; Horne & Weinman, 1998). One of the consequences of assuming judgements are based on rationality is that social cognition models have trouble explaining apparently irrational decisions such as not seeking medical care for a large and obvious tumour (Horne & Weinman, 1998). A further problem of assuming rational decision making is that this presumes an individual would need to make a decision each time a behaviour was performed, which is unlikely, particularly where the behaviour becomes habitual. As a result, social cognition models may have limited success in explaining habitual behaviour (Horne & Weinman, 1998).

Secondly, social cognition models, as used in health, focus mainly on the assumption that behaviour is primarily under the volitional control of the individual (e.g. Conner & Norman, 2005; Sutton, 1998). Whilst some models do acknowledge that factors beyond the control of the individual can influence the performance of a behaviour, none of the social cognition models used in health acknowledge the fact that performance of a behaviour might be influenced by processes outside of the awareness of the individual (e.g. Bargh, Chen & Burrows 1996). The influence of such variables that are beyond the awareness of an individual has been well established in many fields of psychology, but as yet has not been fully investigated in the field of health psychology.

Thirdly, although models can identify those variables that might be important to the performance of behaviour, they often do not suggest ways in which these variables might be changed (Conner & Norman, 2005). An exception to this criticism is Bandura's social cognitive theory (1986; 1997), although the evidence from experimental studies that show that changes to self-efficacy and outcome expectations lead to changes in behaviour is limited (e.g. Bandura, 1997). However, as the variance in behaviour that can be explained by models is far from perfect (e.g. Sutton, 1998), perhaps it is advisable to first elucidate which variables are particularly important to engagement in behaviour and then, at a later stage, research efforts could be effectively employed to discover ways in which these critical variables might be changed.

Lastly, a further problem to consider when using social cognition models is that it has been argued that these are best at explaining only short-term changes in behaviour or behavioural initiation (Rothman, 2000). Few studies within the field of physical activity have considered how maintenance of behaviour can be explained (Marcus et al., 2000). Thus the issue of longer-term maintenance of behaviour is not addressed (Horne & Weinman, 1998). It is suggested that the resources employed during maintenance of behaviour differ significantly from those used for behavioural initiation (Rothman, 2000). Therefore, clarification of the processes underlying long-term performance of behaviour is critically important to a better understanding of long-term adherence behaviour. With regard to the extended maintenance of behaviour, research has suggested that self-regulation is employed, which essentially involves guiding behaviour, and makes use both cognitive and additional mechanisms (Karoly, 1993). For example, it is thought that through the cognitive formation of implementation intentions that specify when, where and how a behaviour is to be performed, an 'automatic' mechanism is initiated that primes the desired behaviour to be activated without cognitive input in response to environmental cues (Gollwitzer, 1999; Kirsch & Lynn, 1999).

To summarise, action of a cognitive mechanism on health behaviour has been investigated primarily through the development of social cognition models. Although many different models have been proposed, most describe cognitions such as attitudes, beliefs and intentions. Whilst these models are effective at explaining some of the variance in behaviour, much of the variance is often left unexplained (e.g. Sutton, 1998). Social cognition models have also received criticism as research is often reported to support models, even when this support is modest at best (Ogden, 2003). Further criticisms of social cognition models include that rationality is assumed in the decision making process (e.g. Horne & Weinman, 1998). Individuals are also assumed to have volitional control over their health behaviour, therefore acknowledgment is not given that behaviour might be influenced without the individual's awareness (e.g. Sutton, 1998). Social cognition models may also be limited to the explanation of short-term changes in behaviour, and not to longer-term changes (e.g. Horne & Weinman, 1998).

Having taken these drawbacks into consideration, as mentioned above, many models have been proposed with the aim of clarifying the precedents of behaviour. For example, Leventhal, Brissette and Leventhal (2003) suggested the common sense model of self-regulation of health and illness. Leventhal and colleagues' (2003) model suggests that an individual interprets internal and external situational stimuli which lead to representations

of danger (based around the identity (such as symptoms), timeline (how long they believe the danger might last), consequences (expectations about effects of their situation), cause (their theories about how the danger was caused), and control (whether or not they have the ability to control the danger)) and of fear. Once the potential danger has been perceived, the individual will develop a coping procedure to deal with the danger and fear. After the coping strategy has been employed, an appraisal of its effectiveness will be carried out. If the perceived danger and fear have been eliminated, the individual is returned to the state at which they started and no more action will be taken. If however, danger and fear are still perceived, the individual will instigate further (possibly modified) coping procedures and subsequent appraisals. An additional model that has been frequently used in health psychology is that of the theory of planned behaviour (Ajzen, 1991). The proximal determinant of behaviour is the intention to behave. Behavioural intention is in turn influenced by attitudes toward the behaviour (comprised of beliefs about the outcome and an evaluation of these outcomes) subjective norm (the perception of what other important people felt about the behaviour and the individual's motivation to comply with these others) and perceived behavioural control (how much the individual believes they have the personal resources and the external opportunities to carry out the behaviour).

The present research used Bandura's social cognitive theory (1986; 1997) as a framework for exploring the contribution of cognitive mechanisms to behaviour. Bandura's social cognitive theory provides a suitable framework for appraising the contribution of the cognitive mechanisms in this study for a number of reasons. Firstly, it has been widely used and has successfully explained a wide range of health behaviours, such as treatment adherence (e.g. Brady et al., 1997), exercise adoption (e.g. Resnick, 2001) and adherence to exercise therapy (e.g. Rejeski et al., 1998; some of this literature is discussed further in Chapter 4). Secondly, the theory contains both cognitive variables (self-efficacy and outcome expectations; described below) that influence the expression of behaviour, and also acknowledges that physiological and affective variables are important, which might be of particular importance in explaining physiotherapy adherence behaviour. Thirdly, it has been suggested that self-efficacy is of particular importance to explaining health behaviours (Conner & Norman, 2005). Lastly, expectations have been suggested to be of importance to both initiation and maintenance of behaviour (Rothman, 2000; the role of expectations is discussed further in section 4.2). As physiotherapy behaviour requires performance of the required behaviour over extended periods of time, expectations may be particularly relevant. Bandura's theory is described and critiqued below.

3.2.1 Bandura's social cognitive theory

Bandura's social cognitive theory (1986; 1997) attempts to describe the variables that precede the performance of behaviour. According to this theory, self-efficacy and outcome expectations are of central importance to the production of behaviour. Self-efficacy has been defined as "beliefs in one's capabilities to organise and execute the courses of action required to produce given attainments" (Bandura, 1997, p.3) and outcome expectations as "... a judgement of the likely consequence ... performances [of a behaviour] will produce." (Bandura, 1997, p.21).

Self-efficacy, the first component of this model, can vary in level, strength and generality. *Level* refers to the difficulty of the task, for example, an individual might have high self-efficacy for running for one minute, medium self-efficacy for running for 10 minutes, but low self-efficacy for running for an hour. The basic task is the same, but the level of difficulty varies. *Strength* simply refers to how strongly an individual believes in their self-efficacy. Therefore, an individual's self-efficacy can vary from weak to strong. *Generality* of efficacy beliefs can vary from very specific, such as when an individual can believe themselves to be efficacious at only running, to general, such as when an individual believes themselves to be good at all sports (Bandura, 1997).

The second component of Bandura's social cognitive theory is outcome expectations. Outcome expectations similarly can vary according to physical, social and self-evaluative expectations. All of these components can have positive and negative aspects to them. The positive *physical* outcome expectations consist of, for example, an expectation of a pleasurable sensation, and on the negative side, could include pain. The positive *social* outcome expectations can include interest and approval from others and in the negative form could include disapproval and rejection. The last aspects of outcome expectations are *self-evaluative*. The positive side of these can include self-satisfaction and contentment, and on the negative side can include self-dissatisfaction or disappointment (Bandura, 1997).

Bandura (1997) also specifies the variables that can affect the development and change of self-efficacy. The four influences on self-efficacy are identified as enactive mastery experience, vicarious experience, verbal persuasion, and physiological and affective state. Through enactive mastery experience there is effectively a feedback loop on behaviour,

i.e. past experience can alter self-efficacy and may therefore affect subsequent performance of behaviour. Bandura states that as well as learning by personal experience, a second valuable way in which an individual can learn about their likely ability to perform a behaviour is to learn from the performances of similar others, i.e. vicarious experience. A third influence on self-efficacy that is stipulated is the effect of verbal persuasion; this is simply the effect that others have on persuading an individual regarding their efficacy at performing a behaviour. Lastly, Bandura believes that physiological and affective state can also influence self-efficacy judgements. Physiological state can have an influence in that an individual can interpret physiological feelings as being indicative of their efficacy at performing a behaviour. For example, if an individual experienced exhaustion from running up a flight of stairs, their self-efficacy for physical tasks might be low. Similarly, if an individual felt a racing heart before taking an exam, they may interpret this physical sign as arising from a worry that their preparation had not been sufficient. Affective state is believed to influence self-efficacy judgements because affective state can alter information processing (Armitage, Conner, & Norman, 1999) and different affective states can alter memory retrieval. For example, in a positive affective state, success is more likely to be remembered, and conversely in a negative affective state, failures are more likely to be recalled (Bower, 1981). The implication is that if in a positive affective state, participants' successes will be remembered which may increase self-efficacy.

There has been much research conducted that supports the idea that self-efficacy and outcome expectations are important to the performance of behaviour (Brady, Tucker, Alfino, Tarrant, & Finlayson, 1997; Brassington et al., 2002; Rejeski, Ettinger, Martin, & Morgan, 1998; Resnick, 2001; Yeung & Hemsley, 1997). There is also evidence that self-efficacy and outcome expectations are important in the performance of exercise behaviour (e.g. Rejeski et al., 1998; this literature will be reviewed in Chapter 4).

Bandura's theory would therefore suggest that where participants believe that they are capable of completing their physiotherapy even if they encounter problems they will be more likely to adhere to their physiotherapy. Similarly, where they believe the outcomes of completing physiotherapy are favourable, for example the physiotherapist will be pleased with them, they will be more likely to adhere to their treatment.

Research on processing that does not require cognitive input has become more prolific in recent years and definitions of what constitutes automatic processing have been put forward (Bargh, 1997; Schneider & Shiffrin, 1977). These definitions include three basic elements: firstly, that (once the effortful process of establishing the response is complete) the behaviour can be initiated by non-cognitive stimuli such as an environmental cue; secondly, that this initiation process needs no cognitive input or effort; and finally, that the behaviour does not require cognitive guidance once it has been initiated. An example of such a behaviour would be a habit, such as getting ready for work in the morning. The features of an automatic process include it being quicker, more accurate, less flexible (as consistent links must exist between the environment and the behaviour) and more difficult to change than cognitive processes (Bargh, 1997; Jansma et al., 2001).

For many years, research has investigated phenomena that occur without apparent cognitive input. Some of these, such as stereotype and habit activation, will be briefly discussed below. The idea of behaviour that occurs without cognitive guidance has been developed in terms of research and in terms of behaviours to which it has been applied. For example, in social psychology, automaticity has been implicated as being responsible for the activation of stereotypes, being involved in the learning of new skills (Bargh, 1997), and being of central importance to habitual behaviour (e.g. Aarts & Dijksterhuis, 2000). In other areas of psychology, acquisition of phobias is believed not to involve cognitive intent (Seligman, 1971) and non-volitional responses such as laughing or crying are thought to occur automatically (Kirsch & Lynn, 1999).

The main premise of an additional system that can guide behaviour is that such a system can reduce the load on the limited capacity of the cognitive mechanism (e.g. Bargh, 1997). When a behaviour is first performed, for example driving, each component of how to drive, such as how far feet must press on which pedal and when, remembering to use mirrors, how far to turn the steering wheel etc., are all extremely effortful. This is because the task is unfamiliar and therefore requires cognitive attention and careful consideration of how to execute each component. After practice however, aspects of the main task can become part of an automated response to the environment and hence demand less cognitive effort (Bargh, 1997).

A shift away from cognitive effortful processing towards other less cognitive processing has been noted in behavioural tasks. The shift from the former to the latter form of processing has been supported by the observation that responses become quicker, less erroneous and less variable (e.g. Jansma et al., 2001). Functional magnetic resonance imaging (fMRI) techniques backed up the distinction between the two processes by showing that although the majority of the brain regions used for novel tasks and for those that had been extensively practised were the same, the activity in the brain region associated with working memory was decreased in well practised tasks (Jansma et al., 2001).

Once a behaviour has become practised and has changed from using the cognitive mechanism to using a less cognitive mechanism, it is often called a 'habit'. It is believed that habits are best conceptualised as goal-directed patterns of responding that are brought about by an environmental cue (Aarts & Dijksterhuis, 2000). A recent study tested this theory and found that a goal (e.g. travel) must be present in order that behaviour (responding whether a bicycle was a viable means of travel) might be activated by an environmental cue (a specific place) (Aarts & Dijksterhuis, 2000). There is also evidence that behaviour outside the laboratory situation can also be cued by the environment. For example, the likelihood of drug relapse is greater where an addict encounters environmental cues associated with previous drug taking (Franken, 2003). Support can therefore be provided from different areas of psychology that environmental cues can activate behaviour.

The work concerning habits and environmental cues discussed above is consistent with what learning theory would predict. Bouton (2000; 2002) reports that learning theory can be usefully applied in health psychology to explain how an individual might behave if they are trying to change their behaviour. Bouton suggested that where a new behaviour is required to replace an older behaviour, such as quitting smoking, the old smoking behaviour is not unlearned, but new learning takes place which enables the individual to avoid smoking. Given particular circumstances, the originally learned behaviour can resurface. Lapse and relapse is likely to occur where the context (which can be internal or external to the individual) in which the new learning takes place changes. The old behaviour can then be re-activated via renewal[1], reinstatement[2] and spontaneous

[1] Renewal occurs where one context, such as a pub, is consistently paired with a behaviour such as smoking, the extinction of the smoking behaviour takes place in another context, such as at home, but smoking behaviour will still be cued on return to the pub.

recovery[3]. Franken's (2003) findings that drug addicts are more likely to relapse in surrounds previously associated with drug taking may therefore be explained by learning theory. Additional research using these learning theories has suggested ways in which adherence behaviour can be promoted. For example, Bouton (2002) suggests that performance of the new behaviour can be increased through the use of retrieval cues. These cues provide a reminder of the context in which the new behaviour was learned and cue the more recently learned (desired) behaviour. Learning theory has therefore been successfully applied within the context of health, through the replacement of previously acquired unhealthy behaviour with the learning of new healthier behaviours. However, as the need for musculoskeletal physiotherapy used in the current study primarily arises through acute injury or physical conditions such as osteoarthritis, learning of the new behaviour needed to carry out physiotherapy was not replacing an old 'non-physiotherapy' behaviour. Therefore, Bouton's work does not specifically apply to the acquisition of new physiotherapy behaviour.

Research suggests that previously learned behaviour can be changed (e.g. Bouton, 2000; 2002). Literature has been presented that suggests that once behaviour has become habitual and is therefore less under cognitive control, it is harder to change than behaviour under cognitive control (e.g. Bargh, 1997; Jansma et al., 2001). It is therefore important to consider whether the effect of these additional processes on behaviour can be changed, to either increase the occurrence of a desired behaviour or decrease an undesired behaviour. Evidence suggests that they can. The mechanism by which this is achieved is implementation intentions (Gollwitzer, 1999). Implementation intentions are effectively a set of instructions that specify when, where and how a particular action will be carried out (Gollwitzer, 1999). There is growing research that supports the idea that implementation intentions can successfully activate a desired behaviour by using appropriate environmental cues to prime behaviour. For example, through the formation of implementation intentions towards using a bicycle in non-habitual cyclists, the behaviour activated (speed of responding to whether using a bicycle was a feasible mode of transport for a given journey) mirrored that produced by participants who were habitual cyclists (Aarts & Dijksterhuis, 2000). Further support was found for the effectiveness of

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[2] Reinstatement of behaviour occurs where a context such as a pub is consistently paired with smoking, followed by extinction of smoking in the pub, but if an individual smokes outside of the pub, smoking in the pub will be subsequently reinstated.

[3] Spontaneous recovery may occur when a context such as a pub is paired with smoking, followed by extinction of smoking behaviour in the pub, but if sufficient time passes (temporal change in context) smoking behaviour may again be cued by the pub.

implementation intentions, in that through the construction of implementation intentions the behaviour (clicking a button as quickly as possible when a specific number was presented on a computer screen) could be activated by environmental cues (the presentation of the specific number; Brandstatter, Lengfelder, & Gollwitzer, 2001). The formation of implementation intentions may be extremely helpful in trying to encourage the performance of new behaviours.

Evidence that behaviour can be elicited and guided without the individual's cognitive input has implications reaching beyond social psychology. Some variables that are important in health settings, such as pain and affect, may have cognitive and additional effects. Whilst it is difficult to definitively say that the influence of a particular variable occurs without awareness (e.g. Field, 2000), an awareness of the possible influence of other non-cognitive processes on behaviour may have important implications for the explanation of behaviour. The next section describes and discusses the additional operating mechanisms related to aversive feedback and pain. This will be followed by examples of related variables that may be present in a physiotherapy setting and how these might influence adherence.

3.3.1 The effect of aversive feedback on behaviour

The situation facing a physiotherapy patient is best explained by instrumental learning principles. Instrumental conditioning effects are obtained when there is consistent, repeated pairing of the instrumental response (behaviour) with an outcome (Domjan, 2003). Whether the conditioning increases or decreases the occurrence of the behaviour depends on whether the outcome positively or negatively reinforces the instrumental response, or whether the instrumental response is punished. In the case of physiotherapy, pain is often concurrent with its performance. Carrying out the physiotherapy can be seen as the instrumental response which results in the occurrence of pain. Stopping physiotherapy may therefore be negatively reinforced (by the avoidance of the pain that results from physiotherapy). Therefore, it would be expected that performance of physiotherapy might be reduced when pain is felt.

The situation that faces an individual who needs to carry out a behaviour that results in aversive feedback is thus a contradictory one. For example, an individual who has been prescribed physiotherapy may have been asked to carry out behaviour that may result in pain. However, in order to improve the condition which has necessitated them to be

prescribed physiotherapy, they must persist with an activity which may be in learning terms, aversive, and potentially reducing the likelihood of attempts at physiotherapy. Despite potentially receiving aversive feedback, the individual is required to persist with treatment. Research in the field of chronic pain suggests that pain (and fear of pain, which will be discussed further in chapter 9) may decrease the occurrence of the behaviour that results in pain (Waddell et al., 1993). Further literature concerned with the influence of pain on adherence in physiotherapy is discussed in chapter 4.

3.3.2 The effect of affect on behaviour

The following section discusses the second of the two variables selected to represent the action of additional mechanisms on behaviour. It is important to note that although an individual can be aware of the affective state in which they are in, part of the influence that this affective state can have on their behaviour may still be non-cognitive; i.e. once an association has been made between a behaviour and subsequent affective state, the behaviour may be avoided or engaged in because of the affective consequences without a change in cognitive beliefs or interactions (Armitage et al., 1999). However, whether affective state has an effect on behaviour via a different mechanism to cognitions is not certain (van der Pligt, Zeelenberg, van Dijk, de Vries, & Richard, 1998).

The inter-relationships between affective states, behaviour (primarily adherence behaviour), and outcomes of the behaviour will now be discussed.

The effect of physical activity on affective states is of interest to this research because it has important implications for adherence. Adherence in a randomised controlled trial of sedentary men to an exercise programme found that adherence was related to affective state (Suter & Marti, 1992). At eight months adherence was not related to any physical (such as Body Mass Index, endurance capacity or subcutaneous fat) or psychological variables, apart from increases in 'vigour' and decreases in 'lack of energy' from baseline to four months. These two variables were components of an affective state assessment; however, the meaning of these is somewhat ambiguous as they can relate to physical state as well as affective state. Interestingly, none of the other components of positive or negative affective state that were unambiguously connected to affective state (enhanced affective state, calmness and contemplativeness for the positive component; depressiveness, excitement and anger for the negative component) were predictive of adherence. However, each of the four components of positive and negative affective state

consisted of five subcomponents. The subcomponents were not described and therefore the validity of the component names (e.g. vigour) cannot be ascertained; i.e. it cannot be conclusively be said that 'vigour' and 'lack of energy' did or did not relate to physical or affective state. It may be that what is being measured by these two components was a *perception* of physical change, and it was this perception that was driving the effect on adherence. Additional information from the study or additional research would be needed to ascertain whether it was in fact changes in affective state or perceptions of physical change that were important.

It should also be acknowledged that evidence has suggested that taking part in physical activity can influence affective state. For example, after increased vigorous exercise, there were significant increases in reported positive affective state in healthy women (Gauvin, Rejeski, & Norris, 1996). There were similar findings to this in a study that looked at the effect of 5 or 1.7 km runs on affective state (Kerr & Kuk, 2001). After a 5km run, there were significant increases in reported positive affect and significant decreases in reported negative affect, whilst after the 1.7 km run, participants experienced only a significant decrease in negative affective state. These studies reveal that physical activity can have a positive effect on affective states, however, both of these studies were carried out in healthy participants and as such they are unlikely to have experienced a very high level of discomfort whilst engaging in the exercise. Whilst these studies do show that physical activity can have an impact on affective state, the results of these studies might suggest exercise is rewarding behaviour, but the situation in physiotherapy is more complex and might be confused by the fact that pain may be experienced to a greater degree. Also, the methodology used in the studies reported above cannot reveal whether the effect of exercise on affective state was direct or was mediated by another variable.

The reasons why physical activity can have an effect on affective state are not certain (Yeung, 1996). It has been suggested that exercising increases levels of endorphins which are linked to affective state, however, there is little research evidence to support this claim (Yeung, 1996). Part of the reason for the lack of a conclusive link between exercise, endorphins and affective state may be that the most appropriate measure to take of endorphin levels would be central nervous system (CNS) levels; however, the method for measuring the CNS levels is invasive and would in itself cause changes in affective state (Yeung, 1996). Alternative explanations for the effect of exercise on affective state include a distraction effect ('escaping' the pressures of everyday life) and an expectancy

effect (due to demand characteristics (see section 5.1.1 for further discussion of demand characteristics) or their own expectations (Yeung, 1996).

This discussion now turns to focus on the literature surrounding what aspects of behaviour affective states can influence. The influence that affective states may have on behaviour may be direct and/or indirect. The indirect path has been investigated in a study that induced positive or negative affective state and then recorded the predictive validity of attitude and subjective norm (Armitage et al., 1999). When the participants were asked to make decisions about their intentions towards condom use or food choice, the decisions of those who had a negative affective state induced were best predicted by attitudes. The decisions of those participants who had a positive affective state induced were best predicted by subjective norm. These results were interpreted as an indication that positive and negative affective state resulted in different strategies of information processing. Whilst in a negative affective state, a more considered approach was taken and decisions were based on attitudes towards the behaviour(s). These decisions were considered to be more rational and less risky than those made in a positive affective state, which relied on subjective norm. Armitage and colleagues (1999) believed that these different ways of making a decision could be explained by a theory that suggested a negative affective state indicates that a potential problem has been encountered that needs a considered decision. A positive affective state, on the other hand, reflects no obvious problem and therefore decisions can be based on a less considered decision making processes. Whether the participants had any explicit knowledge that their affective state was affecting their decision making is not reported, therefore it is unclear whether this aspect of the effect of affective states is cognitive or not.

The effect of affective state on cognitions related to health has been looked at using a similar affective state induction procedure (Salovey & Birnbaum, 1989). When a sad affective state was induced in acutely ill participants, more aches, pains and discomfort were reported. Also, the participants were less confident that they would be able to carry out illness alleviating behaviours than those who had a happy affective state induced. This finding may be particularly important in physiotherapy, since if patients have high negative affective state they may focus more on the pain experienced and may be less confident that they can carry out their physiotherapy, and therefore may be less adherent. This effect may in part be due to memory biases as discussed above. Interventions to increase adherence may be particularly relevant for those patients with depression as they

may be more likely to recall past failures and may have less positive cognitions toward carrying out their physiotherapy.

Further experimental evidence shows that images that have different affective properties can influence pain intensity ratings without the participant's awareness (Wunsch, Philippot, & Plaghki, 2003). The procedure used in this experiment involved using an affective conditioning procedure in which slides of either pleasant, unpleasant or neutral scenes were presented to two groups of participants, whilst asking the participants to make intensity ratings of thermal stimuli that were applied to either their left or right arm (all participants were right handed). All participants acted as controls in that they all saw neutral pictures that were paired with thermal stimuli applied to their left arm. There were two temperatures of thermal stimuli; either at the participant's pre-measured pain threshold (painful stimuli), or at a fixed level below their pain threshold (non-painful stimuli). The initial results showed that none of the participants realised that neutral slides were always paired with a thermal stimulus being on their left arm and that the positive or negative slides were always associated with a thermal stimulus being on their right arm. It was therefore considered that the learning that took place did so without cognitive awareness. The results showed that the pain ratings of the painful and non-painful stimuli that were associated with the unpleasant slides were rated as significantly more intense than when the painful stimuli were paired with the neutral slides. Similarly, the painful and non-painful stimuli paired with the pleasant slides were rated as significantly less intense than those paired with the neutral slides (although that effect was not as strong as the effect of the unpleasant slides).

The importance of these findings is that pain intensity ratings can be affected by affective associative learning procedures that operate outside of the individual's awareness. This finding has important implications, since if negative affective state can increase pain intensity ratings, adherence might also be adversely affected, as would be suggested by studies that show that increased pain is associated with decreased adherence (e.g. Byerly, Worrell, Gahimer, & Domholdt, 1994; Rejeski et al., 1998; Waddell et al., 1993). This study also suggests a positive way of increasing adherence to painful treatment, by encouraging positive affective states, which may decrease pain intensity measurements.

The literature on the topic of how cognitive and additional mechanisms act in combination is extremely limited. Some of this literature will be outlined and related to how physiotherapy behaviour might be influenced by the workings of both these mechanisms.

Previous research has suggested that as well as the influence that experienced pain may have on adherence behaviour, a further complication for the physiotherapy patient is that although a certain amount of pain is to be expected whilst carrying out exercises, pain can also indicate that the body is sustaining further damage. The distinction between pain that is unavoidable and to be expected, and pain that may suggest further injury, is another issue for the physiotherapy patient to contend with. The difficulty of distinguishing pain that is consistent with recovery and pain that indicates further damage has been noted as being difficult for patients (Fisher & Hoisington, 1993). This research therefore also raises an important idea, that pain may have an indirect effect on behaviour via expectations about therapy. An individual's perception of whether the amount of pain they are experiencing is within the bounds of what they should be expecting, may therefore influence adherence behaviour. Similarly, it has been noted that affective state may influence recall of past successes or failures (Bower, 1981), which may then influence an individual's self-efficacy.

To begin this discussion of how the two mechanisms might act in combination, an early theory of avoidance learning will be considered. This theory (Seligman & Johnston, 1973) proposed a cognitive model of avoidance learning that attempted to account for the results of experiments conducted in avoidance learning (N.B this work was based on the findings from animal studies). This model was one of the first to consider that cognitive input and emotional input might be important to the production of behaviour. The model proposes that the cognitive component consists of judgements that consider the expectations of outcome and preference for these outcomes. For example, an animal is placed in an experimental chamber in which a light is followed after a number of seconds by a shock. The animal can avoid the shock by making the instrumental response of pressing a lever. In this situation, according to this model, the animal will develop an expectation that if they make no response after the presentation of the light, a shock will follow. Once they learn that pressing the lever will avoid the shock, they will develop a second expectation that if they make a response after the presentation of the light, they will avoid the shock. The animal will also develop a preference for one of these outcomes over the other (i.e. no

shock). Therefore, the animal will be more likely to make the response which it expects will result in avoidance of the shock.

The second part to this cognitive avoidance theory is an emotional component. This component specifies that fear will result from the experimental situation, by way of classical conditioning, because of the consistent pairing of the light and shock. Fear is noted by others as being important to behaviour in general (e.g. Mineka & Ohman, 2002), and in particular, pain-related fear is important where behaviour involves movement resulting in pain (Crombez, Vlaeyen, Heuts, & Lysens, 1999; Sieben, Vlaeyen, Tuerlinckx, & Portegijs, 2003). The learning of fear has been suggested to be biologically predisposed (e.g. Mineka & Ohman, 2002; Seligman, 1971). The primary idea behind this theory is that in evolutionary history, aspects of behaviour that convey an advantage to the animal will be more likely to be passed on to the next generation (Darwin, 1976). Seligman (1971) and others (e.g. Mineka & Ohman, 2002) have suggested that this is the mechanism by which learning of fear has become particularly important to the performance of behaviours. Learning that an event is associated with fear would be advantageous because fear should initially arise when there is a threat to the individual. This immediate fear response would then allow a speedier response to remove the individual from the threat because of the fight or flight response (Cannon, 1953). The result for humans today is that learning to be fearful of specific situations (e.g. heights) or animals (e.g. snakes and spiders) is biologically predisposed because avoiding these situations and animals has consistently produced benefits in terms of survival in the past (Mineka & Ohman, 2002; Seligman, 1971). However, through experience, the cognitive component will modify the contribution of the emotional component to a behaviour. For example, at the beginning of exposure to the experimental situation, the animal will react with classically conditioned fear to the presentation of the light when it has been paired with shock. With experience of lever pressing resulting in no shock, the classically conditioned fear to the light will diminish as the expectation alters from one of pending shock, to one of non-pending shock. Therefore, this theory suggests that the cognitive component can alter the activity in the emotional component.

Although this theory has gained support in the literature, Seligman and Johnston's (1973) dual component theory of avoidance learning has been superseded by the two factor theory of avoidance learning (e.g. Williams, 2001). The two-factor theory proposes that avoidance behaviour can result from classical conditioning and immediate negative reinforcement, however, this theory does not take into account the possible influence of

cognitive processes. Toates (1998) proposed a model that suggests that all behaviour is a result of both stimulus-response mechanisms and of a cognitive mechanism. The proposed stimulus-response and cognitive mechanisms of this theory are conceptually parallel to the cognitive and additional mechanisms suggested in the present research. Toates (1998) aimed to describe how stimulus-response mechanisms and cognitive mechanisms interact with each other and what factors determine the relative strength of contribution of each of these. The model was designed in response to an increasing suggestion in the literature (for example, in animal learning and addiction) that both of these processes were critical to the performance of behaviour. The cognitive mechanism is described as having a top down influence on the relationship between the stimulus and the response, as at the level of performance of behaviour some connection between the stimulus and response must be present. Which of these two mechanisms has most influence over behaviour is said to vary according to the circumstance, due at least in part to the nature of each of the mechanisms. The stimulus-response mechanisms can respond quickly to a predictable situation, but in order for this mechanism to become established, the links between stimulus and response must be consistent for an extended period of time. The cognitive mechanism, on the other hand, responds at a slower rate, but is flexible in that it can be employed in novel situations. The two mechanisms, therefore, are most usefully employed in different situations. The stimulus-response mechanism predominates, for example, in the case of a habitual response, and the cognitive mechanism will preside over novel behaviour such as taking up exercise. The two mechanisms will be in competition with each other in situations such as overcoming a habit.

The model asserts that the two mechanisms can interact and influence each other. It further states that feedback from the consequences of behaviour can influence the two mechanisms. This theory has intuitive appeal, and research was presented that is congruous with this theory from the fields of ethology, psychology and neuroscience. However, no studies have been carried out as yet to provide empirical evidence to support the paths within the model. This theory has face validity however, as it is a theory born of examination of the data that has resulted from research and attempts to explain these data.

There is therefore some theoretical support in the literature for interactions between cognitive and additional mechanisms acting on behaviour. However, empirical support for the relative strength of these paths and evidence of how these mechanisms might act is

lacking. The present research aims to provide data that tests the effects of both cognitive and additional processes on adherence behaviour.

3.5 Chapter summary

To briefly summarise the evidence presented in this chapter, the majority of the literature concerned with explaining health-related behaviour has tended to focus on how a behaviour is initiated. The variables assessed by social cognition models measure constructs such as attitudes, beliefs, and intentions, and these models are used frequently in health research. However, the success of social cognition models to explain even initiation is limited, as revealed by two recent meta-analyses of studies that applied three of the leading social cognition models to explaining a range of types of behaviours (Ogden, 2003; Sutton, 1998). This means that a substantial proportion of the variance in behaviour is not accounted for by these models.

If researchers wish to understand how self-care behaviour is maintained, they must look beyond behavioural initiation, which, it is argued, uses different resources to those employed in behavioural maintenance (Rothman, 2000). Social cognition models are thus likely to be of limited use when the aim is to further our understanding of behavioural maintenance. The literature concerning maintenance of behaviour suggests that for behaviour that persists beyond the short-term, i.e. is maintained, 'self-regulation' is utilised, which essentially involves guiding behaviour, and can use processes that operate with and without awareness (Karoly, 1993). For example, it is thought that through the considered formation of implementation intentions that specify when, where and how a behaviour is to be performed, a mechanism is initiated that primes the desired behaviour to be activated in response to environmental cues (Gollwitzer, 1999; Kirsch & Lynn, 1999). Given that simple methods of priming can influence behaviour, investigation into further variables that operate without cognitive input would be of theoretical and practical importance to understanding how behaviour arises and is maintained.

If the long-term maintenance of behaviour is to be understood, researchers must comprehend the processes that are important during initiation and those that are important to maintenance of behaviour. Therefore, the role of variables such as those suggested by social cognition models and those that might operate in a different way on behaviour is of central importance in the present research. It is hoped that by considering the contribution

of cognitive and additional mechanisms on behaviour, longer-term maintenance of behaviour might be better explained.

The proposed research will assess the relative contributions of cognitive (self-efficacy and outcome expectations) and additional (pain and affective state) mechanisms on adherence to a physiotherapy simulation and adherence in patients undergoing physiotherapy treatment. These studies will also examine the influence of pain and affect, which can have both cognitive and additional effects on behaviour.

CHAPTER 4: REVIEW OF THE LITERATURE: MECHANISMS OF BEHAVIOURAL CONTROL IN HEALTH CARE

4.1 Introduction

The previous chapter discussed theory and evidence in relation to behavioural control. The variables suggested by social cognition models are cognitive in that they assess judgements about the behaviour that are made using cognitive resources. Although the social cognition models that describe the cognitive variables that influence behaviour have been criticised, these cognitive variables, such as attitudes, beliefs and intentions, can explain significant proportions of the variance in behaviour. However, a large proportion of variance in behaviour is not explained using the cognitive mechanism. Further variables were then considered that might have an additional influence on behaviour that is not cognitive. The variables that were considered particularly relevant to the research of this thesis were pain and affective state. Lastly, the discussion focussed on how these two different mechanisms might interact in the production of behaviour.

This chapter will investigate variables that operate using the proposed cognitive and additional mechanisms with specific reference to health behaviours, and in particular to adherence to physiotherapy. As has been discussed previously in chapter two, adherence to physiotherapy is important to treatment outcome (Belza, Topolski, Kinne, Patrick, & Ramsey, 2002; Brewer et al., 2000; Ettinger et al., 1997; Iversen, Fossel, & Katz, 2003; Kolt & McEvoy, 2003; Lin, Davey, & Cochrane, 2004; Lyngcoln, Taylor, Pizzari, & Baskus, 2002; Lowdermilk, Panus, & Kalbfleish, 1999; Penninx et al., 2001; van Gool et al., 2005). Understanding the variables that may influence adherence to physiotherapy is important because this information can be used to encourage individuals to adhere.

Many illnesses and injuries demand that an individual carry out self-care behaviour over extended periods of time. In cases where it is necessary to carry out a behaviour in the long term, researchers are interested not only in how such behaviour is initiated, but also crucially, in how it is maintained. The present chapter considers variables that are believed to influence initiation and maintenance of health-related behaviour. A model will be presented that illustrates the potential relationships between these variables and how they might influence each other.

The proposed model below illustrates diagrammatically potential relationships between the cognitive variables (self-efficacy and outcome expectations) and those that may have an additional influence on adherence behaviour (pain and affective state). Each of the components and its possible effects on the other parts of this model will be discussed in the sections that follow below, linking how the present research and evidence from previous research may be used to explain adherence behaviour in relation to physiotherapy.

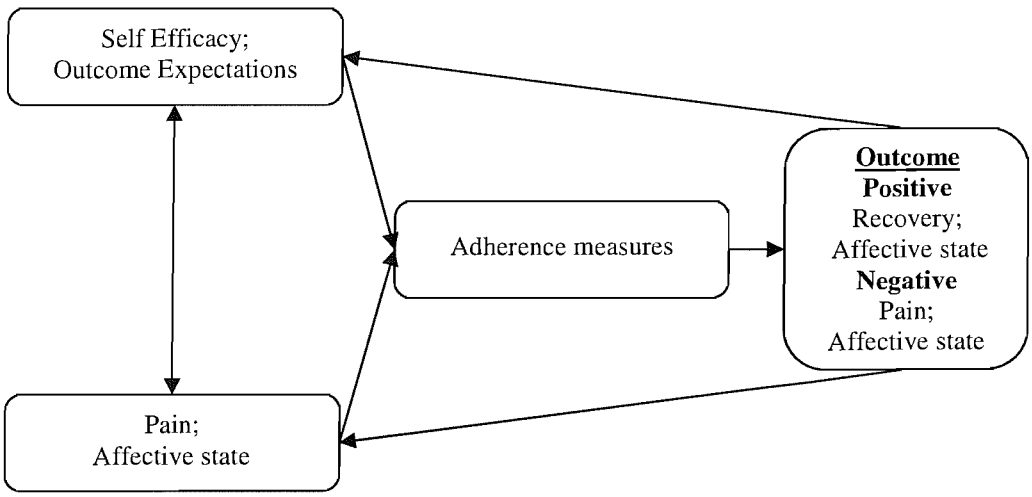


Figure 1

Proposed diagram to illustrate the theorised relationships between variables affecting adherence behaviour

4.2 The influence of self-efficacy and outcome expectations in health care

As discussed in chapter three, there are numerous social cognition models which have been used to focus research efforts that aim to explain behaviour. Social cognitive theory has been selected for use in the present study. In the previous chapter it was discussed that the reason Bandura's theory was chosen was that it acknowledged that physiological and affective states could influence cognitions.

Additional reasons for the selection of Bandura's (1986; 1997) social cognitive theory to represent the action of a cognitive mechanism are firstly, that it has frequently been used to explain health adherence behaviour (as will be discussed below). Secondly, social cognitive theory has been selected is because outcome expectations have been suggested to be important to both initiation and maintenance of behaviour (Rothman, 2000). However, the nature of the influence of outcome expectations on initiation and on maintenance of behaviour differs. Initiation of behaviour, on the one hand, will be considered by an individual after the potential benefits and drawbacks have been weighed

against each other; only if the expected outcome is favourable enough to justify performance of the behaviour will the behaviour be initiated. Maintenance of behaviour, on the other hand, will occur where the actual outcomes of the behaviour compare favourably to the expected outcomes. It is therefore conceivable that if outcome expectations are very high, behaviour may be initiated, but if the outcomes obtained do not match these high expectations, behaviour may not be maintained. Other researchers also suggest that response expectancies are important in non-cognitive responses, for example, the influence of placebos (e.g. Kirsch & Lynn, 1999). Both Rothman (2000) and Kirsch and Lynn (1999) therefore endorse the idea that expectancies are important to the performance of behaviour and to the outcome of a situation respectively. It must be acknowledged that these expectancies are conceptualised slightly differently by each author. Rothman does not offer a specific definition but does refer to a cost-benefit analysis of outcomes when considering a new behaviour and also states that later satisfaction with outcomes gained are also important. Kirsch and Lynn offer a more precise definition of response expectancies and state that these can have a non-cognitive effect on the response to a given situation. Therefore, expectancies as described by Kirsch and Lynn may influence effects of carrying out a behaviour (i.e. recovery in physiotherapy), and Bandura's expectations may influence the performance of a behaviour (i.e. adherence behaviour).

The following discussion considers evidence for the two main components of social cognitive theory (self-efficacy and outcome expectations) in relation to adherence in health care. In addition to examples drawn from physiotherapy research, examples will also be drawn from research into patients engaging in exercise behaviour, as literature in the field of physiotherapy is scarce.

A number of studies have considered the association of self-efficacy with adherence to physiotherapy in athletes (Brewer et al., 2003; Milne, Hall, & Forwell, 2005; Taylor & May, 1996). Adherence to a home and clinic-based programme showed that increased self-efficacy was associated with increased practitioner rated adherence in the clinic-based component, and reported completion of home-based (Brewer et al., 2003). However, self-efficacy was not related to patient rated adherence. Similar findings were obtained in a study that utilised clinic-based physiotherapy in that increased self-efficacy was associated with increased practitioner rated adherence but was not associated with attendance at sessions (Taylor & May, 1996). A further study that did not report whether the physiotherapy was home or clinic-based found that increased self-efficacy was

associated with increased patient rated quality of adherence, but not with patient rated frequency of therapy (Milne et al., 2005). Perceived physical ability has been found to explain 22% of the variance in the intensity of rehabilitation exercise for athletic injury (Duda, Smart, & Tappe, 1989). However, this measure of physical self-efficacy did not add significantly to the variance explained in attendance or completion of prescribed exercises over the three weeks of rehabilitation exercises. Taken together, these findings show that increased self-efficacy is associated with some measures of adherence. However, it should be noted that this association did not hold for all measures within the same study. From these few studies and the fact that the same measures were not used in each study, it is not possible to ascertain whether adherence to physiotherapy was associated consistently with one aspect of adherence. However, where an association was found between self-efficacy and adherence, it was a positive one.

Research conducted into exercise behaviour using social cognitive theory has revealed mixed findings. The following studies illustrate some of the findings and their implications both for social cognitive theory and health behaviours. The first study to be looked at here examined the effect self-efficacy had on attendance at an 8 week exercise programme for sedentary women (Yeung & Hemsley, 1997). Exercise specific efficacy was a significant predictor of exercise adherence, but general self-efficacy did not predict adherence. Although this study had a small, female sample, the authors noted that the finding that only exercise-specific efficacy was predictive of adherence was consistent with Bandura's (1986) predictions that specific rather than general self-efficacy is a better predictor of behaviour. However, this study did not assess outcome expectations, which are also important in social cognitive theory (Bandura 1986; 1997).

Self-efficacy and outcome expectations have also been examined in exercise participation in older adults (Resnick, Palmer, Jenkins, & Spellbring, 2000). The study found that those with higher self-efficacy expectations and outcome expectations were more likely to report exercising over a three month period. The effect of self-efficacy was both direct and had an effect via outcome expectations. Outcome expectations were also a significant predictor of exercise participation even when self-efficacy was statistically controlled for. These findings offer empirical support for both self-efficacy and outcome expectations as components of social cognitive theory and suggest that both are important to exercise adherence behaviour. Another home-based exercise programme for sedentary older adults found that self-efficacy did not predict adherence over 6 months (Jette et al., 1998).

It has also been demonstrated that changes in cognitive variables can have an influence on reported exercise adherence behaviour in older adults (Brassington, Atienza, Perczek, DiLorenzo, & King, 2002). Self-efficacy and outcome expectations were recorded at baseline and at 6 months into the 12 month trial. Changes in self-efficacy from baseline to 6 months were related to increased exercise adherence at 7-12 months. A regression analysis showed that baseline measures of self-efficacy and changes in self-efficacy both independently added to the variance in adherence behaviour. Achievement of perceived fitness outcome expectations for improvement between 0 and 6 months (which were concerned with expectations about fitness, weight, appearance, energy and eating habits) correlated with improved self-efficacy for exercise at 7 to 12 months. These findings demonstrate that not only can self-efficacy and outcome expectations change as a result of participation in exercise, these changes are important to adherence behaviour. The results also suggested that achieving earlier expectations was important to later adherence levels, which is consistent with Rothman's (2000) suggestions that achieving expectations is important to maintain behaviour. This study also noted that only fitness specific outcome expectations (as opposed to more general outcome expectations concerned with for example, concentration, stress and confidence) were associated with increased adherence, similar to exercise specific efficacy being predictive of exercise adherence in previously sedentary women (Yeung & Hemsley, 1997; reported above). However, once self-efficacy was taken into account, the variance explained by outcome expectations was reduced, consistent with other research (e.g. Brady, Tucker, Alfino, Tarrant, & Finlayson, 1997). Brady and colleagues note that demonstrating to elderly people that they have achieved fitness outcomes (e.g. decreased weight) early on in the behaviour change programme will be important to later self-efficacy judgements.

Another study looked at the effects on exercise behaviour in older adults of an intervention that encouraged participants to walk. The participants were invited to consider any negative outcomes such as pain, fear, or fatigue and discuss these with the researcher, who would give advice on how to overcome any problems and encourage subsequent exercise (Resnick, 2002). Resnick found that the programme produced significant increases in both self-efficacy judgements and in reported exercise adherence rates six months on compared to the control group that received no intervention. This study also assessed outcome expectations in both groups, but although the intervention group did have more positive outcome expectations at 6 months these differences did not reach significance. Brassington (2002) and Resnick's (2002) studies point to the usefulness of discussing advances and problems encountered whilst taking up a new

behaviour. Such discussion appears to have a beneficial effect on self-efficacy and outcome expectations and adherence. Some caution is needed in interpreting the results from Resnick's (2002) study however; those in the control group only received routine care whereas those in the experimental group received a variety of extra contact and activities, some of which were in groups. It cannot definitively be said what the effect seen on self-efficacy and exercise adherence rates was due to. It may have been the content of the programmes (walking individually or in groups, addressing pain fear and fatigue, giving information about falling or the cues to remind participants to walk) or the simply the extra social contact that was the effective component. In addition to this, the sample size used in this study was only 17 participants, 10 in the experimental group and 7 in the control group. A power analysis for each analysis is reported in the article showed that 5/7 analyses had a power below .5. Therefore, these five analyses are at increased risk of type II error (Cohen, 1992). The analyses that had power over .8 consisted of those related to self-efficacy and exercise activity. These results may therefore be more reliable. This study therefore needs replication using a larger sample and with the addition of another control group who get similar amounts of social contact as those in the experimental condition before clear conclusions can be drawn.

Self-efficacy has also been found to be important to the outcome of treatment. The effect of exercise on outcomes in knee osteoarthritis was found to be mediated by self-efficacy. Adherence rates were not reported in this study however, so it is possible that self-efficacy influenced adherence rates to the exercise which then had an impact on the outcome of treatment (Rejeski, Ettinger, Martin, & Morgan, 1998).

4.2.1 Summary of the influence of self-efficacy and outcome expectations on adherence behaviour

Overall, it appears that Bandura's social cognitive theory is supported by research in health care. There is some evidence that where self-efficacy and outcome expectations are higher, adherence rates to self-care behaviour are also higher (e.g. Brassington et al., 2002; Brewer et al., 2003; Resnick et al., 2000; Taylor & May, 1996). The findings relating to the relative contributions of self-efficacy and outcome expectations are not conclusive. Some studies found that outcome expectations do not add to predictive power once self-efficacy judgements are taken into account (e.g. Brady et al., 1997; Brassington et al., 2002), whereas others demonstrate that outcome expectations do add to the predictive power once self-efficacy is controlled for (e.g. Resnick et al., 2000). Change in

self-efficacy and outcome expectations due to exercise participation (e.g. Brassington et al., 2002) also supports Bandura's theory, in that when self-efficacy and outcome expectations are increased, these correspond to an increase in adherence rates. The fact that outcome expectations and self-efficacy judgements can change and that these changes relate to improved adherence is advantageous in terms of potential interventions and the related benefits to health. However, health professionals have to consider that outcome expectations that are too high may result in unachievable goals which may in fact decrease adherence.

4.3 The effect of pain in health care

The next section of this chapter is concerned with the influence of pain on physiotherapy adherence. Literature will be considered that suggests that learning is of particular importance and that anxiety and expectancies are critical to understanding how pain might affect adherence behaviour. The discussion will consider that pain may have an effect on adherence that is both direct and indirect. The direct effect might be through learning to avoid the physiotherapy because of the pain that it causes i.e. there will be no change in cognitive variables. Alternatively, or additionally, there might be an indirect effect whereby the cognitive beliefs about the individual's self-efficacy might be affected by pain, or more negative outcome expectations may develop with repeated exposure to pain that is caused by carrying out physiotherapy.

To begin this discussion, some research is reviewed that suggests that learning principles may partly carry the effect of pain on adherence to behaviours that cause pain. Learning principles discovered in the laboratory have been applied to human health behaviour. One such example discusses the role that learning might play in the long term maintenance of behaviour (e.g. Bouton, 2000; as discussed in chapter 3). Bouton (2000) suggests that learning theory can offer explanations as to why a behaviour change might fall into lapse or relapse, and how the behaviour might be successfully maintained. However, as discussed in chapter 3, as new physiotherapy behaviour does not replace 'old physiotherapy behaviour', Bouton's work is not applicable in the case of taking up new physiotherapy behaviour.

A learning theory that is applicable to the learning of new physiotherapy be and may suggest a way in which pain might influence adherence to physiotherapy is that suggested by Seligman and Johnston (1973; as discussed in chapter 3). The theory of avoidance

learning posits that avoidance behaviour is a result of two processes. The first of these processes is cognitive in that it relies on expectancies to guide behaviour. The second process is 'emotional' in that behaviour is influenced by the fear that is evoked by a situation as a result of classical conditioning. It is this learned fear that may have an additional detrimental effect on adherence to physiotherapy. This theory has a number of similarities to the model suggested earlier in Figure 1, in that both acknowledge a potential influence of cognitive variables and a more direct route (possibly an additional one).

A third learning theory that might suggest how pain might have an influence of adherence is Seligman's (1971) preparedness theory (as discussed in chapter 3). Learning to avoid pain may be advantageous as it may prevent further harm and promote healing and so avoidance of pain might be considered to be a form of prepared learning or 'phobia'. However, this prepared learning has been distinguished from a phobia as researchers have investigated whether pain anxiety represents a specific phobia or a more general indication of anxiety sensitivity (Greenberg & Burns, 2003). It was found that pain anxiety was most likely to result from a more general anxiety sensitivity than specific phobia. Therefore, the effect that pain might have on behaviour is best conceptualised not as a phobia, but perhaps in more general learning theory terms and therefore learning theory perspectives on relapse such as those described by Seligman and Johnston (1973) are most appropriate.

In the field of physiotherapy, it has also been suggested that physiotherapy pain may have a direct influence on athletes' adherence rates to rehabilitation (Byerly, Worrell, Gahimer, & Domholdt, 1994). Of the variables measured (perceived exertion during training, self-motivation, being able to schedule the programme into their lives, the environmental conditions of the training room, social support and pain), only social support and pain had a significant association with adherence to the rehabilitation, in that those who were less adherent reported experiencing more pain. However, as methodology used was correlational, direction of causation could not be ascertained. In addition, neither questionnaire reliability nor validity was reported, therefore further research using validated questionnaires and a longitudinal design are needed to confirm whether physiotherapy pain does indeed impact on physiotherapy performance. Whilst acknowledging the draw-backs with this study (that causation cannot be implied and that the measures have not been adequately validated nor had reliability assessed) the finding that pain experienced was associated with adherence whereas none of the cognitive

variables measured were associated with adherence, suggests that pain might have an influence on adherence behaviour.

Further support for the idea that pain might be important to performance of physiotherapy was described in a study that found that pain moderated the effect of exercise treatment on outcome in knee osteoarthritis (Rejeski et al., 1998). However, adherence rates were not recorded. The findings of this study therefore suggest that pain might have an effect on treatment outcome, but it is unclear whether this is because of the influence pain might have on adherence rates, or whether this is a direct effect on treatment outcome.

Additional research that assessed the association between pain and adherence has found mixed results. Two studies conducted on participants with osteoarthritis undergoing physiotherapy found no association between pain and adherence (Belza et al., 2002; van Gool et al., 2005). However, one further study using patients with osteoarthritis and another study conducted on general physiotherapy patients found evidence for an association between increased pain and increased adherence (Seçkin, Gündüz, Borman, & Akyüz, 2000; Sluijs, Kok, & van der Zee, 1993). This finding that increased pain was associated with increased adherence contradicts the predictions that learning theory would make; i.e. that increased pain would result in less adherence. It should be noted that studies that have looked at the association of pain with adherence have tended to focus on patients with osteoarthritis. The finding that pain was not related to adherence may therefore not be generalisable beyond patients with osteoarthritis (as only one of the studies discussed above used general physiotherapy patients, which needs replication in similar populations). It may have been that participants with osteoarthritis were experiencing pain independent to that resulting from participation in physiotherapy, i.e. pain was not contingent on physiotherapy. Therefore, stopping physiotherapy would not have been negatively reinforced. As well as the findings of these studies being mixed, none of these studies used appropriate methodologies and statistics to examine the direction of causation between pain and adherence. However, an additional study found that pain was not predictive of adherence to exercise therapy in patients with osteoarthritis (using a longitudinal design and regression analyses; Rejeski, Brawley, Ettinger, Morgan, & Thompson, 1997).

Beyond the field of adherence to physiotherapy, the role of operant conditioning has been investigated in chronic pain patients (Flor, Knost, & Birbaumer, 2002). This study exposed healthy controls and those with chronic back pain to painful stimuli. Half the

participants received positive feedback in the form of a happy computer smiley (☺) and an addition to money earned during the experiment when their pain ratings increased compared to their previous trials, and negative feedback in the form a sad computer smiley and a deduction from the money earned during the experiment when their pain ratings were lower than they had been previously. The other half of the participants received the opposite, i.e. they were given negative feedback when their pain ratings were increased compared to previous ratings and positive feedback when their pain ratings were lower than they had been previously. The findings of this study are of interest because conditioning was successful; in both the chronic pain patients and in the healthy controls. Conditioning that should theoretically lead to increased pain ratings (the first condition described above) did in fact increase their reported pain, and vice versa for those that received conditioning to decrease their pain reports (the second condition described above). These findings suggest that chronic pain patients and healthy controls are, at least in this respect, similar. When the participants reached the extinction phase of the experiment, their pain reports were no longer given feedback. Those with chronic pain displayed less extinction than the healthy controls. The authors suggest that this result could be explained using learning principles, in that those who have previously been exposed to operant conditioning will show less extinction. Therefore, chronic pain patients are likely to have previously been exposed to operant conditioning (i.e. non-adherence behaviour has previously been negatively reinforced) and this previous operant conditioning might in fact play a role in the development of chronic pain. The importance of this study to the present research is that this shows that pain reports can be influenced by simple learning procedures. This suggests both that these learning principles may play a role in the expression of pain, and that these learning principles may be useful in reducing the perceived impact of pain on an individual and may therefore be beneficial to adherence.

Generalisation of expected pain to different movements has been investigated (Goubert, Francken, Crombez, Vansteenwegen, & Lysens, 2002). When asked to rate expected pain from one particular movement, chronic back pain patients would initially over-predict expected pain (similar to Crombez, Vlaeyen, Heuts, & Lysens, 1999). Also, as reported in Crombez (1999), on performing the movement, future expected pain ratings would be brought into line with experienced pain ratings. However, these adjusted pain ratings would not generalise to other dissimilar movements. The authors interpret these results in terms of learning theory and in particular conceptualise the non-generalisation across different movements as an indication there is an overall belief that pain will result from

any movement, and that each specific movement requires adjustment of expected pain to actual pain after performance. This may have implications where the types of movement that form a treatment may be changed; it may be advantageous for patients to be given extra support at times of change in treatment.

Further research using a sample of chronic pain patients supports the finding above that expected pain ratings can be changed by experience (Crombez, Vervaet, Baeyens, Lysens, & Eelen, 1996). Although initial expected pain ratings were higher than subsequent experienced pain ratings, expected pain ratings made after carrying out the activity in question were subsequently altered so as to be similar to the actual pain experienced. The findings also showed that when carrying out a novel exercise, as well as increased expected pain intensity and reported fears of causing further harm, effort put into carrying out the novel exercise was sub-maximal. The authors stated that these findings can be explained using learning theory, because the individuals were sensitive and reactive to experienced pain in that they adjusted later predictions of pain according to experience. The alternative explanation that was being tested was based on a top-down process where expectancies would result in experienced pain being similar to expected pain. This latter theory was not supported because expectancies of pain after experiencing pain were brought in line with the experienced pain. The authors noted that the clinical significance of this result is that pain expectations are readily adjusted by experience.

The importance for this research is that experience of carrying out physiotherapy can influence outcome expectations and particularly those concerned with pain. This might be of particular importance where outcome expectations do not favour carrying out the appropriate and necessary health behaviour. For example, if an individual expects that an outcome of engaging in physiotherapy will be an unacceptable increase in pain, then if the level of experienced pain was lower than expected after carrying out the physiotherapy, subsequent outcome expectations relating to pain may be reduced. This could then result in improved adherence behaviour. This also suggests that perhaps baseline measures of self-efficacy and outcome expectations may not be as good at predicting behaviour as later ratings after the behaviour has been engaged in.

Beliefs about the predicted discomfort that will be experienced due to physical activity have been shown to be connected to physical fitness, as assessed by cardio respiratory fitness, resting heart rate measures and body mass index calculations (Poulton, Trevena, Reeder, & Richards, 2002). The characteristics of those who correctly predicted and those

who under- and over-predicted discomfort from pending physical activity were examined. The findings showed that the 20% who over-predicted the discomfort they would feel were less fit and engaged in less physical activity than the remaining 80% (half of whom accurately predicted discomfort and half of whom under-predicted). The authors suggested that those who over-predicted discomfort from physical activity did so because they believe there was a high chance that the activity will be uncomfortable and would therefore avoid the chance to change this perception. This suggestion provides a parallel in health participants with the research reported above that found work-related fear avoidance beliefs accounted for some of the later disability (Fritz et al., 2001). The importance of this study to the present research is that it shows that even anticipation of discomfort can be enough to reduce the amount of exercise that an individual will engage in. Predicted discomfort and predicted pain may therefore serve as deterrents to physical activity. Although this study only assessed expectations prior to exercise, nonetheless these prior expectations were associated with decreased physical activity. This indicates that although it may be possible to alter subsequent expectations after engaging in the behaviour, some of those who over predict discomfort may avoid the behaviour, or may still be influenced by their first assessment. It may therefore be helpful to pay particular attention to outcome expectations of discomfort before and after initiation of a behaviour, as these can impact on adherence.

Research conducted in the field of chronic pain gives suggestions as to how pain might be dealt with in a physiotherapy context. Although chronic pain is arguably different from acute pain, techniques that are used with chronic pain patients to reduce the impact of pain on levels of activity might also be helpful for those with acute pain. These include cognitive-behavioural techniques such as goal setting and suggesting functioning as a focus during activity rather than focusing on pain (Liebenson, 2000). Liebenson suggests that through techniques that encourage the individual to think about the functional advantages of activity, the effect of pain can be diminished (i.e. cognitive route can alter the effect of an additional one).

4.3.1 Summary of the potential influence of pain on adherence behaviour

The research presented in this section provides evidence that pain can influence adherence to health behaviours. However, the direction of influence that increased pain had on adherence behaviour was not consistent; some studies found an association with decreased adherence (e.g. Byerly et al., 1994); whilst others found an association with increased

adherence (e.g. Seçkin et al., 2000). It should be noted that the majority of the studies that found an association between increased pain and increased adherence used patients with osteoarthritis and therefore may not be generalisable beyond this population.

The role of learning has been emphasised, and avoidance learning may be of particular importance (e.g. Crombez et al., 1999; Fritz, George, & Delitto, 2001; Seligman & Johnston, 1973). It has also been suggested that operant conditioning may be involved in the development of chronic pain (Flor et al., 2002), and this suggests that operant conditioning procedures might also be important to how individuals react to pain-inducing therapies, including physiotherapy. Expectancies of pain have also been shown to impact on adherence behaviour (Poulton et al., 2002), but these expectancies can alter as a result of experience of carrying out the behaviour in question (Crombez et al., 1996).

4.4 The effect of affect on adherence behaviour

The following section focuses on how affect might influence health behaviours. Bandura's (1986; 1997) view of the influence of affect in social cognitive theory and consequently behaviour, is that affect and self-efficacy can influence each other. Bandura believes that a negative affective state is more likely to result in lower self-efficacy judgements, and a positive affective state is likely to result in higher self-efficacy judgements; similarly self-efficacy can also influence affective state. The mechanism Bandura suggests is that efficacy beliefs exert an influence on how situations are interpreted, including whether they are interpreted as having a negative or positive influence on affective state (Bandura, 1997). The following section will consider research from a range of health behaviours, as specifically relevant literature is scarce. As in the section above concerning social cognitive theory, the implications of these studies in terms of the influence of affect on health behaviour and the possible implications these have for health interventions will be discussed.

Within the physiotherapy adherence literature, a few studies have examined the influence of depression on adherence to physiotherapy. The findings of these studies all showed that depression was unrelated to adherence levels (Alexandre, Nordin, Hiebert, & Campello, 2002; Belza et al., 2002; Rejeski et al., 1997). It would appear based on this limited literature that affective state has little (direct) influence on adherence behaviour. However, there still exists the possibility that affective state has an indirect effect on adherence behaviour which was simply not assessed in these studies.

There is some evidence in the literature that suggests that the influence of affect on health has an indirect as well as a direct path (Armitage, Conner, & Norman, 1999). The manner in which affect influenced the predictive power of different components of the theory of reasoned action and the theory of planned behaviour revealed that in a negative affective state, attitudes were most predictive of intentions to use condoms and intention towards and actual behaviour of eating more healthily (Armitage et al., 1999). In a positive affective state on the other hand, subjective norm was more predictive of intention to use condoms and intentions towards and actual behaviour of eating healthily. The authors suggested that the reason for this difference is that affect alters information processing. If an individual is in a negative affective state, this indicates a potential problem and the need for a problem focussed approach to information processing, whereas in a positive affective state the individual relies on less thorough information processing by relying on such variables as subjective norm (the individual's belief of what important others around them think about the behaviour in question).

If an individual's method of making decisions related to health changes according to their affective state, as Armitage and colleagues (1999) suggested, there may be important considerations to be made when considering any change in affective state after engaging in treatment. For example, if carrying out physiotherapy does not progress as they anticipated and the individual's affective state becomes negative as a result, not only might their attitudes about the physiotherapy become more negative (e.g. it does not work, or it is too hard), but their problem solving approach may also change.

Further support for the idea that affective state may have an indirect effect on adherence can also be found within memory literature. It has been suggested that affective state may influence what the participant recalls in the way of past successes or failures (Bower, 1981). In a positive affective state, successes are more likely to be recalled, but in a negative affective state, failures are more likely to be recalled. It may therefore be that affective state has an influence on adherence behaviour by making particular cognitions more available, and it is these cognitions that have an influence on adherence behaviour. Therefore, affective state may have little direct effect on adherence, but may have an indirect effect.

There is evidence to suggest affective state may become more positive with better adherence to physiotherapy. Higher adherence to an aquatic exercise programme for

osteoarthritis resulted in a decrease in negative affective state (Belza et al., 2002). If negative affective state decreased with performance of physiotherapy, it may be expected that longer-term maintenance of physiotherapy might be negatively reinforced. However, in breast cancer patients, higher levels of anxiety, depression and vigour were found to be associated with higher levels of adherence to chemotherapy (Ayres et al., 1994). This study illustrates the opposite side of the coin, that those in a negative affective state, as indicated here by higher levels of anxiety and depression, can be more likely to take a problem solving approach, and hence might make a pro-treatment decision. The important variable would therefore be the attitudes themselves, i.e. high self-efficacy and favourable outcome expectations or low self-efficacy and poor outcome expectations. However, further research would be needed to ascertain the mechanism by which affective state influenced adherence, i.e. changes in information processing or another process, and whether this differs in different situations.

Research into the effects of how affective state influences symptom perception and self-efficacy related to carrying out health behaviour have shown that a negative affective state might result in poorer adherence behaviour (Salovey & Birnbaum, 1989). Initially, affective state and symptoms were assessed in the participants, all of whom had a cold. Then positive, negative or neutral affective state were induced, after which the participant's affective state and symptom perception were reassessed, along with self-efficacy to carry out cold alleviating health behaviour. Affect manipulations were effective and those in the negative affect group reported more symptoms and had lower levels of self-efficacy than those in the positive affect group (those in the neutral affective state reported symptoms and self-efficacy in between those reported in the positive and negative groups). The authors of this study concluded that affective state might have an impact on adherence to health behaviours via self-efficacy. This would offer support for an indirect influence of affective state on adherence behaviour (see Figure 1).

Changes in affective state may also be important to longer-term adherence. Adoption and maintenance of an exercise regime by men who had previously exercised for less than one hour a week was studied (Suter & Marti, 1992). Whilst previous exercise behaviour carried most of the predictive power of exercise at four months, the most powerful predictor at eight months, rather than any of the physiological measures, was change in affective state during the first four months. More specifically, increases in measured 'vigour' and decreases in measured 'lack of energy' and 'depressiveness' were the critical variables. Again, decreases in depression have been associated with better adherence as

shown above (Belza et al., 2002). The authors acknowledged, however, that their study was based on only a small sample size of men, most of who were employed in similar organisations and came from the middle or upper middle class. Despite these limitations, this study is important for two main reasons. Firstly, it offers further support for the idea that the processes involved in adoption and maintenance of behaviour are different, as suggested by Rothman (2000). Secondly, it illustrates that changes in affective state as a result of carrying out a new behaviour can occur and are important to the continuation of the behaviour. The implication of this latter point when considering health interventions is that it may be helpful to assess changes in affective state during the early phases of a behaviour change, and perhaps to encourage thoughts about positive changes in affect and decreases in negative affect in those taking part in the behaviour change. This study did not assess cognitive variables such as self-efficacy, therefore the effect on affective state may or may not have been accompanied by cognitive changes.

The studies reported here have investigated an overall concept of 'positive' or 'negative' affective state, and in some cases have reported results concerned with specific affective states such as 'vigour'. It has been suggested that distinguishing between individual components of positive and negative affect might aid the elucidation of affect's role in the decision making process (van der Pligt, Zeelenberg, van Dijk, de Vries, & Richard, 1998), including decisions relating to health behaviour. The research reported above would support this idea, as not all components of positive or negative affect have been shown to be associated with adherence behaviour (e.g. Suter & Marti, 1992).

4.4.1 Summary of the influence of affect on adherence behaviour

Bandura (1986; 1997) suggests that affect and self-efficacy might influence each other. He suggests that where affective state is more positive, self-efficacy is likely to be higher. This idea would be supported by the work of Bower (1981). If affect can influence self-efficacy, and self-efficacy can influence behaviour, affect would therefore have an indirect influence on adherence behaviour. Armitage and colleagues (1999) also advocate an indirect effect of affect on behaviour but suggest that the influence of affect is carried by changes in information processing rather than self-efficacy.

The is some evidence within physiotherapy research that showed no association between affective state and later adherence (Alexandre et al., 2002; Belza et al., 2002; Rejeski et al., 1997). However, some research studies suggest that adherence to therapeutic exercise

and decreased negative affect may be associated (e.g. Suter & Marti, 1992). Precisely why adherence to exercise and affective state might be linked cannot be ascertained from these studies, however, research carried out by Salovey and Birnbaum (1989) showed that when in a negative affective state, participants' symptom perception was increased and their self-efficacy for carrying out behaviours to improve their health was lowered. Therefore, affective state and adherence may be linked via symptom perception, perhaps as a result of vigilance to bodily sensations. The effect of pain may therefore be increased where negative affective states are reported.

4.5 Chapter summary

Research examining self-efficacy, outcome expectations, pain and affective state in the field of adherence to physiotherapy is scarce. However, drawing on what research there is in physiotherapy and research from other fields of health care, there is some support for the idea that increased self-efficacy and outcome expectations are related to increased adherence behaviour (e.g. Brewer et al., 2003; Milne et al., 2005; Resnick et al., 2000; Taylor & May, 1996). The evidence relating to the relationship between pain and affective state and adherence behaviour is less clear. Some studies found that increased pain was related to increased adherence (e.g. Seçkin et al., 2000; Sluijs et al., 1993), whilst others report an association with decreased adherence (e.g. Byerly et al., 1994). Research in physiotherapy reported no relation between affective state and adherence (e.g. Alexandre et al., 2002; Belza et al., 2002; Rejeski et al., 1997). However, theories and research suggested that affective state may have an indirect influence on adherence behaviour. For example, negative affective state may make recall of past failures more accessible (Bower, 1981) or increased symptom perception which in turn may influence self-efficacy which may then influence adherence behaviour (e.g. Salovey & Birnbaum, 1989). In addition to this, adherence behaviour may reduce negative affective state (Belza et al., 2002), which may result in the negative reinforcement of adherence behaviour.

The consideration of additional mechanisms as well as cognitive mechanisms to aid the explanation of behaviour will be of interest for a number of potential reasons. Firstly, consideration of these mechanisms may increase the variance in adherence behaviour explained, as suggested by Karoly (1993). Secondly, the influence of cognitive and additional mechanisms may change over time. For example, as suggested by different authors (e.g. Ogden, 2003; Rothman, 2000), cognitive variables may be of critical importance to initiate the behaviour, however, over time, the additional variables may

become more important. Whilst a number of theories have been proposed that suggest cognitive and additional mechanisms may both be important to the performance of behaviour (Seligman & Johnston, 1973; Toates, 1998), little research has tested these theories in adherence behaviour. Therefore, there is a need to study both cognitive and additional mechanisms and to test whether both cognitive and additional factors can influence adherence behaviour.

There is also some evidence within the research discussed in this chapter, that different aspects of adherence behaviour may not be associated with similar factors (e.g. Brewer et al., 2003; Milne et al., 2005; Taylor & May, 1996). An additional need is therefore present to elucidate the relationship between cognitive and additional factors and different aspects of adherence behaviour.

CHAPTER 5: METHODOLOGY AND RESEARCH QUESTIONS

5.1 Introduction to and Rationale for the Methodologies Employed

There were two components to the present study, one of which was conducted in the laboratory using a computer simulation of physiotherapy, and another component that was carried out in the field with patients undergoing physiotherapy.

Rothman (2000) states that we know little about the psychological experience that people undergo when they conduct a behaviour change. The aim of the laboratory study is therefore to try to isolate some of the individual factors (as outlined in Figure 1 in chapter 4) that have an influence on adherence behaviour. The laboratory study has a key advantage for studying 'physiotherapy' behaviour, as it will enable separation of the information content and the negative feedback component of pain on behaviour.

The laboratory component utilises a computer programme that simulates physiotherapy for a shoulder injury. The computer simulation programme began by using a vignette that asked the participant to imagine that they have been involved in a bicycle accident. As a result they needed to undergo physiotherapy to recover their normal level of functioning. Instructions then described how to carry out their exercises; one mouse click on the 'exercise shoulder' button on the screen would result in one shoulder 'exercise'. The participant was also told that they must exercise at a specific rate over an extended time period that was neither too fast nor too slow to enable recovery. To begin, each time a physiotherapy exercise was performed, feedback on the injury was given. Depending on which of the experimental conditions the participant was in, this feedback would either be auditory (an aversive loud 'scream'), visual (non-aversive red bar with 32 divisions) or combined visual and auditory (this third condition was used only in the main laboratory study reported in chapter 7 for reasons that will be discussed later). If the rate of exercising fell within the predetermined optimum range, the volume of the scream decreased and/or the visual bar indicated a step toward recovery had been made. The effect of cognitive variables (such as outcome expectations) and other processes (such as those evoked by the aversive component of the 'scream') on the performance of the participant were systematically assessed.

The field component of the study tested whether the variables that had been found to be influential in the laboratory were important in a physiotherapy setting. The field study recruited physiotherapy patients from Southampton General Hospital who had been

referred for treatment of musculoskeletal problems. If the patients agreed to take part, they completed baseline measures detailing information about their injury and the treatment they had been prescribed. They also completed measures of their self-efficacy, outcome expectations, anticipated problems with treatment, affective state and pain (which are discussed in more detail in chapter 8). Two weeks into treatment, they completed these measures of self-efficacy, outcome expectations, anticipated problems with treatment, affective state and pain again. Eight weeks after start of treatment the participants completed their involvement in the study by completing these measures again, along with measures of adherence (which will be discussed later in chapter 8).

This chapter covers the methodological issues that are relevant to the design and execution of the research described above. It begins by briefly considering ethical issues in research and their possible influence on the data gathered and then progresses to an examination of the issues that surround laboratory research, and in particular simulations. This will be followed by an exploration of the factors that are of relevance to the field component of research, and especially the difficulties that face researchers who wish to investigate treatment adherence. Finally, there will be a consideration of how the results from these two methodologies might be compared and the advantages of combining these two methodologies in the present study.

5.2 Laboratory Research Issues

5.2.1 General issues surrounding laboratory research

Laboratory research offers an excellent way of systematically investigating factors that can influence a topic of study. This is achieved by strictly controlling the environment in which the participant is present during their participation in the study. The experimental procedure is standardised so that when specific variables are independently manipulated, changes in the dependent variable can be linked to that particular change. Although this level of control can be extremely useful, it also has inherent disadvantages. One of the most common criticisms of laboratory experiments is that they have limited external validity. The argument is that the laboratory may differ so substantially from situations encountered in 'real life', that findings have little relevance to how individuals might act outside the laboratory (e.g. Coolican, 2004).

Various researchers have discussed this issue of external validity. One reply to this problem of low external validity in laboratory studies is that external validity might, justifiably, not be an aim of such work (Berkowitz & Donnerstein, 1982; Henshel, 1980; Mook, 1983). It is argued that low external validity is justifiable where the aim of an investigation is to explore a more theoretical question, for example, does *x* affect *y*, but would not be appropriate to ascertain answers to questions that result in, for example, prevalence estimates.

The overall aim of the present study is to examine specific variables with respect to their influence on adherence behaviour. The laboratory component of the study is therefore asking a theoretical question: can *x* affect *y*? However, whilst the laboratory component of the study cannot and does not hope to faithfully replicate the 'real world' in a laboratory setting, consideration is given to the design of the laboratory component so that it resembles the 'real world' sufficiently that the results might be reflected in the subsequent field study. In this attempt to keep external validity as high as possible, the laboratory study mirrors key features of the physiotherapy setting. These features include a slow and non-uniform pattern of recovery (using a variable interval reinforcement schedule which will be described further in chapter 5) when the 'correct' rate of exercising is carried out, and performance feedback that is aversive (in those conditions that contained auditory feedback). This aversive feedback was intended to simulate the pain experienced in physiotherapy.

However, despite employing these techniques to increase external validity, certain aspects of the simulation cannot be removed. For example, the participants were in the laboratory environment. It cannot be avoided that the participants were instantly and acutely aware of the fact that they are in a laboratory and that this awareness might have a number of influences on how a participant behaves in an experiment (e.g. Berkowitz & Donnerstein, 1982; Bowling, 2002). Firstly, this awareness might result in changes in the observed behaviour due to demand characteristics (Orne, 2002). The laboratory environment, including the often assumed authority of the experimenter, is said to elicit a desire in the individual to be a 'good' participant and to behave in a way that they believe the experimenter wants them to. Despite some researchers reporting the effect of demand characteristics (e.g. Orne, 2002; Spence, 2002), some argue that there is little evidence demonstrating their effect (Berkowitz & Donnerstein, 1982; Mook, 1983). In addition, the ability of the participants to correctly deduce the aim of an experiment has also been questioned, as has the desire to go along with and support this aim (Berkowitz &

Donnerstein, 1982). However, it is possible that a guess might be made about the purpose of the experiment and that, whether it is right or wrong, this might affect the participant's behaviour. Similarly, it has been noted that the experimenter themselves can influence the results obtained (e.g. Rosenthal, 2002). For example, the age, gender and ethnicity of the experimenter and the expectancies of the experimenter have been found to influence the results obtained in controlled experiments. To reduce the effect that experimenter expectations could have on the results, the procedure used for all conditions in the laboratory study was standardised and differed only where necessary in relation to the types of feedback given.

Secondly, this awareness of being in the laboratory and therefore of being observed, may lead to 'evaluation apprehension' (Berkowitz & Donnerstein, 1982; Bowling, 2002). Evaluation apprehension can result in the participants biasing their behaviour so as to portray a 'good/ socially acceptable' view of themselves. In order to reduce the potential influence of this effect, it has been suggested that the experimenter emphasise that the study is not judgmental in nature, and is concerned with any behaviour that arises (Berkowitz & Donnerstein 1982).

A further potential influence on the external validity of the study is the sample available to participate in the research. Ideally, the sample would be a representative sample which mirrored the characteristics of the population who attend physiotherapy. However, due to practical constraints, this laboratory study relied on a pool of undergraduates to volunteer their participation. The sampling used in the current study is therefore likely to lead to a biased sample that should be acknowledged (Bowling, 2002). For example, students represent a relatively well educated section of the population. This may be important as it has been found that those with higher education have been found to adhere less (Sluijs, Kok, & van der Zee, 1993), although other studies have found no effect of education level on adherence (Alexandre, Nordin, Hiebert, & Campello, 2002; Belza et al., 2002; Seçkin, Gündüz, Borman, & Akyüz, 2000). Student populations are also largely comprised of younger people. It has been found in some studies relating to adherence to physiotherapy that younger age was related to decreased adherence (Oldfors Engstrom & Oberg, 2005; Sluijs et al., 1993), however research has also found no relation between age and adherence in physiotherapy (Alexandre et al., 2002; Belza et al., 2002; Kolt & McEvoy, 2003; Lowdermilk, Panus, & Kalbfleish, 1999; Oldfors Engstrom & Oberg, 2005; Preisinger et al., 1996; Rejeski et al., 1997).

Although laboratory studies enable the control of various variables, choosing which variables to examine is difficult and needs careful consideration (Bowling, 2002). Factors that affect adherence research are no exception. As has been discussed in chapter 2, many variables have been investigated in relation to physiotherapy adherence, including beliefs / knowledge about treatment or therapist, psychological, demographic, illness and physical characteristics, and treatment variables. Some of the variables thought to influence adherence behaviour include self-efficacy, initial adherence, intention, physical and cognitive ability (Dunbar-Jacob & Mortimer-Stephens, 2001) and depression and anxiety (Matute, 1994). Theory and previous research will be used to determine which variables are controlled for. In the laboratory study, to control for the effect of the difference in ease of distinguishing when a step of recovery had been made in the auditory condition (1.5 dB reduction in volume of auditory feedback) and visual condition (permanent onscreen record of when a step of recovery had been made), a third condition was introduced with combined auditory and visual feedback. This third condition therefore contained aversive feedback but also easily discriminable informational content.

A problem that may arise from simulation studies is the possibility that the participant may be responding in a way that is different to how they would if they were actually experiencing the event. If the participant finds it hard to identify with their computer-simulated self, they may respond differently to how they would given the same situation in 'real life'. If the participants can be effectively encouraged to identify with the simulation, they may react similarly to how they would if they themselves were going through physiotherapy. This has been supported by researchers who have found that where the meaning assigned to two objectively different situations is the same, participants will respond in the same way (Berkowitz & Donnerstein, 1982). Vignettes are often used in research to describe a theoretical situation which participants are subsequently asked questions on (e.g. Finch, 1987; Hughes & Huby, 2002). Describing the instance leading up to the injury and the consequences of the injury for the participant should therefore make the simulated situation more comparable across participants (e.g. Solomon, Tandon, & Murray, 2004) and may encourage identification with the simulated character.

5.3 Field Research Issues

5.3.1 General issues surrounding fieldwork

Fieldwork avoids some of the problems that are associated with laboratory study (namely the issues of external validity discussed above) and enables examination of variables in more realistic situations. Fieldwork can therefore better reflect behaviour as it happens in a real world context, can benefit from participants feeling less evaluation apprehension and occurs in a less artificial environment than laboratory studies (Coolican, 2004). However, fieldwork has its own problems and also needs careful design and execution.

Firstly, it should be noted that fieldwork can also suffer from the effects of demand characteristics. Researchers have found that participants who volunteer to take part in studies may be more likely to exhibit altered behaviour due to demand characteristics (e.g. Rosnow & Rosenthal, 1997).

To begin, the sample from which data is to be collected needs to be considered. Where the participants are to be recruited from, how many are needed and who they are, are key questions. As recruitment of participants can be problematic, suggestions have been made to encourage the design of feasible studies. Pilot testing and exploratory studies are recommended to locate and assess the willingness to participate of those in the particular group of interest. It is also suggested that exploration of the design of the study be carried out so those features that may discourage participation can be tempered to make them more acceptable (Shadish, 2002). Randomisation in fieldwork can also be difficult due to practical constraints (Shadish, 2002). However, the present field study will not require randomisation as the field component of this study involves observation rather than experimentation.

As discussed in chapter 2, dropout from studies including physiotherapy studies, is prevalent. In those studies reviewed in chapter 2, 14.82% of participants dropped out. Although dropout from studies can mean reduced sample size and decreased representativeness of the remaining data, as this study is concerned with adherence, dropout in itself is important to acknowledge. However, it was planned that objective records of attendance would be collected from the hospital to monitor the effect of dropout from the study. As previously mentioned, the study can be designed so that the procedure is as acceptable as it can be (bearing in mind the needs of the study) to the participants, such as using short, simple questionnaires and freepost envelopes. Another technique to reduce attrition is to make it as easy as possible for the participants to take part. This would involve the researcher visiting the participant, rather than requiring the

participant to visit the researcher (Shadish, 2002). Although this may be particularly relevant to this study as those participating will be undergoing physiotherapy and therefore may have mobility problems, the field study was a postal questionnaire study so participants could complete the questionnaires in a place that suits them. Another concern for this study was that as adherence was being measured, participation at more than one time point may increase the risk of attrition. Recommendations have been made that notes be kept detailing who drops out, when and for what reason (Bowling, 2002). This information can be useful during analysis of data.

Although avoidance of attrition is preferable, if attrition cannot be avoided, there are statistical methods that can be used to attempt to compensate. Firstly, statistical packages such as SPSS can allow data to be entered as 'missing', which enables the rest of the data to be analysed. Also statistical methodologies such as structural equation modelling can be used to assess whether attrition rates themselves vary across groups (Shadish, 2002).

Conducting fieldwork can require the co-operation of more than just the person participating (Wilkinson, 2000). During this research the physiotherapists and additional physiotherapy staff were needed to co-operate. Visits were made to the physiotherapy department during the process of applying for ethical approval for the study to check details of how the study could be conducted and check the feasibility. Throughout the study contact was maintained with the staff involved with the study to check whether they had encountered any problems.

One major drawback of fieldwork is that control of variables that might also affect how the dependent variable changes can be extremely difficult. Instead of using techniques that can remove variables that are not of interest from the experimental environment, as in a laboratory study, control of variables is achieved through measurement of them and statistical control for them. However, as there are many different variables that can affect adherence behaviour, adequate control for all these variables is unlikely as this would necessitate an unfeasibly large number of participants. Detailed inclusion and exclusion criteria can help to reduce the impact of too many variables.

5.3.2 The specific problem of measuring treatment adherence in field work

As discussed in chapter 4, the issue of treatment adherence in healthcare is an important one. The term adherence refers to the extent then an individual follows the instructions

given to them by health professionals and can have a profound influence on their state of health (Myers & Midence, 1998). Adherence to treatment regimes has been demonstrated to be of importance to the outcome of numerous medical conditions, including conditions treated using physiotherapy (e.g. Belza et al., 2002; Brewer et al., 2000; Ettinger et al., 1997; Iversen, Fossel, & Katz, 2003; Kolt & McEvoy, 2003; Lin, Davey, & Cochrane, 2004; Lowdermilk et al., 1999; Lyngcoln, Taylor, Pizzari, & Baskus, 2002; Penninx et al., 2001; Sluijs, Kerssens, van der Zee, & Myers, 1998; van Gool et al., 2005). Research into adherence is difficult because of a number of inherent problems. This section will briefly discuss some of these problems in terms of two broad categories; those of measurement, and delineation of adherent and non-adherent behaviour.

Due to the array of different forms of therapies that are available for different conditions in healthcare, there cannot be a single tool to measure adherence, that would apply to examples such as medication adherence and physiotherapy adherence, as the behaviours involved can be so different. This necessitates that specific tools be developed according to the attributes of the behaviour being assessed and renders the possibility of a single 'gold standard' unlikely. There are additional problems with measuring adherence to physiotherapy; as the treatment regime involves an individual carrying out exercises, unless they are observed, self-report must be relied upon. Although self-report measures are frequently used in adherence research, there have been many investigations that question their validity (e.g. Farmer, 1999; Hanita, 2000; Vitolins et al., 2000). As with any measurement tool, adherence measures must demonstrate validity and reliability. Whilst the laboratory study will produce detailed information on the rate and timing of adherence, assessment tools to fit the physiotherapy situation needed to be developed. To ensure face validity was addressed, the 8 week questionnaire measure was concerned with how often participants skipped physiotherapy and asked participants to report the length of time for which they continued exercising (which was compared to baseline reports of how long they had been prescribed physiotherapy for). The internal reliability of the Problematic Experiences of Therapy Scale (Yardley & Kirby, 2006; described later in chapter 8) was also checked once data collection had been completed. As the completion of self-report adherence measures relied on participants' memory, and together with the fact that the participant may respond in a biased way so as to present themselves more favourably (Conner & Waterman, 1996), the validity and reliability of the adherence measures may have suffered. Ideally, a reliability check would have been carried out on the adherence data provided by the participants, by comparing participant rated and

physiotherapist rated adherence. Unfortunately, due to the imposition this would have required on physiotherapist's time and resources, this was not deemed possible.

The next consideration for adherence research relates to what level of adherence is both necessary and sufficient to result in improved outcomes. Treatment regimes often require that a behaviour be carried out a certain number of times and that the timing of the adherence behaviour can also be imperative. In many treatments health practitioners do not know precisely how much treatment and over what time scale will be necessary for recovery because of the diversity of factors that can influence recovery independent of adherence. Chapter 2 reviewed some of the ways in which adherence has been measured in physiotherapy. Whilst some studies simply report adherence as a continuous variable, others set boundaries that separate out levels of adherence. The setting of boundaries that distinguish adherence and non-adherence has been criticised for being defined poorly, with the effect that comparison of adherence across studies is difficult (Cleemput, Kesteloot, & DeGeest, 2002). The setting of boundaries should, ideally, be based on the level of adherence necessary but sufficient to produce the desired therapeutic benefit. However, as mentioned above, this is unfortunately a question that remains unanswered in medication taking. Some researchers set boundaries based on at least 80% of the adherence behaviours carried out according to the instruction of the health professional (e.g. Dunbar-Jacob & Mortimer-Stephens, 2001; Lee et al., 1996). In physiotherapy adherence, attendance at 80% of appointments (Alexandre et al., 2002), tertiles of adherence to attendance at appointment (Lin et al., 2004) and completing at least a given number of sessions per week for a set number of weeks has also been utilised (e.g. Belza et al., 2002; Ravaud et al., 2005). Others have suggested the use of different categories of adherence (e.g. Farmer, 1999). The major problem that arises from using categorical classification of adherence is that comparisons across studies that use different methods of classification is not possible. Also, unless the mean adherence rate is also reported, overall estimates of adherence to a particular treatment cannot be ascertained. A further problem regarding adherence is whether over-adherence should be considered as non-adherence. Treatments where the effect of over-adherence may result in harm to the participant may well be usefully considered as non-adherent. The problem arises where the level of adherence sufficient for recovery is unclear. If over-adherent behaviour is to be considered non-adherent, a number of assumptions need to be met; firstly, that the specific amount of physiotherapy needed to reach recovery is known and has been prescribed, and secondly, that over-adherence is detrimental to recovery. For these reasons it may be preferable to use a continuous measure of adherence and to check

whether trends in recovery according to adherence were linear or not. Whether over-adherence is detrimental to recovery can then be assessed.

Previous research in physiotherapy adherence indicated may be influence by the participants' age (Oldfors Engstrom & Oberg, 2005; Sluijs et al., 1993), gender (Alexandre et al., 2002; Belza et al., 2002; Oldfors Engstrom & Oberg, 2005) and whether the participant had had the injury or physiotherapy before (Milne, Hall, & Forwell, 2005; Rejeski et al., 1997). These variables were therefore controlled for in the field study.

5.4 Comparability of Results Obtained in the Laboratory and Field

The same underlying principle was to be examined in both contexts, i.e. the effect of cognitive and other processes on adherence behaviour. However, there were a number of differences between the two groups of participants. There were two main issues here, one of the differences between the participants, and one of the uses of different measurement techniques. As briefly discussed above, attempts to encourage those in the laboratory study to behave as they might if they themselves were going through physiotherapy were made by promoting identification with the simulated person. As well as this issue of identification, the two participant groups differed in terms of what type of aversive feedback they will received; participants in the laboratory component of the study received the aversive 'scream' (in the auditory and combined conditions) and those in the field study may have experienced pain. However, as it is unethical to cause pain to participants in the laboratory, the difference in the exact form of aversive feedback between the studies cannot be the same; but this difference must be acknowledged. However, the aversive stimulus used in the laboratory should have similar properties with regard to the reinforcement of behaviour.

Whilst the measurement of the cognitive variables can use the same questionnaire format in both laboratory and field, assessment of the effect of other processes differed between the groups. The laboratory participants received feedback with or without an aversive component (a loud 'scream') that was controlled through the experimental design. Those in the field study needed the aversiveness level of pain they experience measured. The laboratory study yielded rich data that could reveal the precise timing of 'exercising' and precise overall measure of adherence. By contrast, the field study produced an approximate timing of exercising and a cruder adherence measure because the data

collected came from self-report and as such may not have been as reliable or as detailed. Direct comparison of results were therefore tentative. However, if instead of there being one cut-off point between adherent and non adherent behaviour in the laboratory and field, a continuum of adherent behaviour was used, examination of those cognitive and other processes that were important to higher levels of adherence behaviour could be achieved. As mentioned above, the different methodological components of this study were designed to investigate the same problem; that of whether cognitive and other processes could affect physiotherapy adherence behaviour. The advantage of using both laboratory and field studies in this research was that the weakness of one (i.e. external validity in the laboratory and the difficulty of controlling confounding variables in the field) are a strength of the other. Therefore, if the results obtained from these different methodologies are complimentary, taking the study as a whole, there will be strong support for the findings.

5.5 Conclusions

This discussion has examined some of the methodological issues that need consideration during both the planning and execution of this study. Both methodologies have inherent advantages and disadvantages that were somewhat offset by the use of both of these methods.

5.6 Research Questions

There were two main research questions to be addressed by the present study. The literature discussed in chapters 3 and 4 suggested that the cognitive variables of self-efficacy and outcome expectations were important to physiotherapy adherence behaviour. The first research question aimed to confirm whether self-efficacy and outcome expectations influence physiotherapy adherence behaviour in both the laboratory and field studies.

In addition, more anticipated problems have been found to be associated with decreased adherence (Poulton, Trevena, Reeder, & Richards, 2002). Therefore, an additional aim in the field study was to assess whether anticipated problems would influence adherence.

The second research question was concerned with the potential impact of another route between aversive feedback (the loud 'scream' in the laboratory study or pain in the field study) and affective state on adherence behaviour. The literature discussed in chapters 3 and 4 suggested that pain may have an influence on behaviour (Byerly, Worrell, Gahimer, & Domholdt, 1994; Seçkin et al., 2000; Sluijs et al., 1993; Waddell et al., 1993; Seligman & Johnston, 1973). The literature indicates that positive affective state might be associated with increased adherence and negative affective state might be associated with lower adherence rates (Salovey & Birnbaum, 1989). The second research question was therefore concerned with determining whether affective state and aversive feedback influenced physiotherapy adherence behaviour.

CHAPTER 6: PILOT TESTING

6.1 Rationale and Aims

Studying the contribution of self-efficacy and outcome expectations (which represent the action of the cognitive mechanism) and pain and affective state (which act using another mechanism) in the laboratory context enables the separation of the influence of the aversive component of pain from the information that pain conveys to the patient about their injury. The separation of these two facets of pain means that the effect of the aversiveness of pain (which may have a direct influence on behaviour) can be disentangled from the effect of the information about recovery and clarifies the role of self-efficacy, outcome expectations and affective state in each case.

The particular aim of this pilot test was to develop and test the simulation programme and to determine the programme parameters to be used in later experiments to ensure a range of responses on the various possible dependent variables within the programme (i.e. to ensure that floor and ceiling effects of responding would be avoided) whilst ensuring that the task was neither too easy nor too hard. A further aim of this exploratory pilot study was to calculate effect sizes to examine the relationships of the different variables on behaviour. It was initially planned that the results of these effect size calculations would subsequently be used during hypothesis generation for the first full scale laboratory study (NB: - due to the small sample size obtained for this pilot study, no probability testing has been carried out).

6.2 Introduction to the Programme

The task that the participant faced was to help their computer-simulated self to recover from a shoulder injury using physiotherapy arm exercises. To encourage identification with the simulated person, information was given to the participant that explained how the injury occurred and described how their life was affected as a result. Instruction screens were presented alongside the image of a person, as illustrated below.

Figure 2

Introductory screen layout of the simulation programme

The instructions explained to the participant that in order to recover they had to click the mouse button over the 'exercise shoulder' onscreen button to make their simulated self raise and lower their arms. If they 'exercised' too fast or too slow, they would not recover. If they were exercising at the right rate either the volume of the scream or the red bar would reduce (this is described more fully below). The participants were informed that they should respond at a steady rate throughout the simulation, i.e. to avoid responding in bursts with rest periods in between. They were not told the exact rate to exercise at so that an appropriate tolerance boundary around the tolerance rate could be found. An appropriate tolerance boundary was needed to be found in this way to establish that participant's responding behaviour could successfully be brought within the tolerance boundaries that governed recovery. This boundary needed to be sufficiently small that responses had to fall within a narrow band of response rates in order to be reinforced, but also not so small that participant's were not sensitive to tolerance boundaries, i.e. the task was not too easy or too hard. They were told that at various points through the simulation they would receive questionnaires that assessed their beliefs about their recover and their affective state. These questionnaires were administered at baseline before exercising commenced, at the end of days 2, 4, 8, 12, and 16; the affective state questionnaire was also completed once the participant had finished. Once the participant had read all the instructions and been given the opportunity to ask questions, they completed baseline measures of self-efficacy, outcome expectations and their current affective state.

The task then began and the participant could press the onscreen 'exercise' button at any time they chose. Each press of the 'exercise' button resulted in their simulated self raising their arms to shoulder height and lowering them once. In order to completely recover, the participant had to achieve 32 steps of recovery. The participant received feedback on their recovery in one of two forms- either auditory or visual. The auditory feedback consisted of a loud scream (start value of 90 dB) that decreased in volume in 1.5 dB steps as the participant recovered. The scream was delivered by headphones every time the participant clicked on the 'exercise' button. The auditory feedback therefore contained informational value on their recovery, by the volume of the scream, and an aversive component in that the scream was unpleasant.

Figure 3

Screen display for those in the auditory condition, arms in mid 'exercise'

Feedback in the visual condition was given using a vertical bar with 32 horizontal divisions. At the start of the simulation this bar was solid red, and one division would turn black as the participant recovered by one step. The visual feedback therefore only contained information on the recovery with no aversive component.

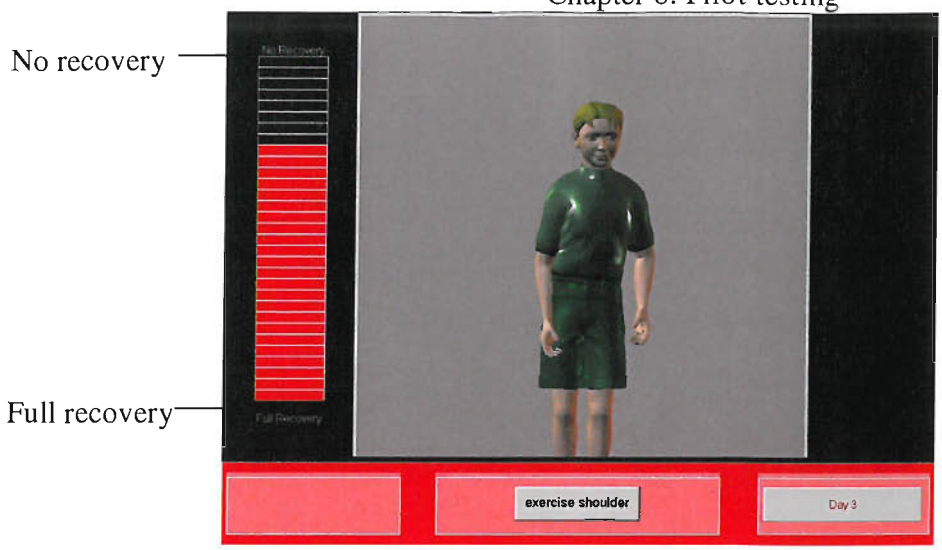


Figure 4

Screen display for those in the visual condition (8 steps of recovery have been made)

Recovery was governed by the participant's response rate and by a variable interval (VI) schedule that enabled recovery to occur (provided the response rates were within predetermined boundaries) on average every 45 seconds. A VI schedule was used because the unpredictable gap between possible reinforcements (in the form of a step of recovery) simulates the unpredictable nature of recovery from a physical injury using physiotherapy. A VI 45 second which had 20 iterations was chosen so that within each 'day' (which lasted 3 minutes) a least one VI schedule would time out and therefore there would be a chance for recovery to occur. Therefore, when the variable interval schedule had timed out, if the participant was responding within the predetermined correct response rate boundaries, the participant would recover by one step. The participant then needed to continue exercising at the correct rate until the next VI schedule timed out, when recovery would again become possible. As the animation and sound files lasted approximately 550 milliseconds, the target response rate therefore needed to exceed this value. A target response rate of 3 seconds was initially selected which could be modified if necessary.

The computer programme recorded the time between each response that the participant made and calculated a moving average based on the last three responses. This moving average was used to determine whether the participant was responding within the target response times.

The simulation was divided into 20 3-minute epochs that represented 'days'. The participant was required to stay for the first four 'days', at the end of which they were informed that they could then stop at any point by pressing the button labelled 'finish' that would appear alongside the 'exercise' button. It was made clear to the participant at this point that they may finish at any time they wished as in physiotherapy, patients often attend the first few sessions and subsequently drop out. Participants in the psychology department from which the sample was drawn were used to being required to complete the entirety of experiments. To reduce the likelihood that participants would be more adherent because of the experience of completing other experiments within the department, it was explained that they could choose to finish the programme from the end of day 4 onwards. The purpose of this was to better simulate adherence rates in physiotherapy patients. If they finished at this point, they would be given one psychology participation credit (the standard 'payment' for completing the 15 minutes they had taken part in the study for). However, full recovery was not achievable within this four-day period. To simulate motivation to recover and promote engagement with the task, the participant was informed that should they choose to stay on, and they recovered completely, they would also be entered into a draw to win £20. They were informed they would have a one in four chance of winning this prize if they were entered into the draw.

The primary outcome variables were the number of steps of recovery that the participant achieved and the length of time that they stayed in the programme.

6.3 Development of the simulation programme

6.3.1 Aims of the Programme

The simulation programme specifically aimed to simulate a number of characteristics of physiotherapy. Firstly and critically, it aimed to simulate having an injury. The effects that this injury had on the participant's life were described to encourage identification with the simulated person. Secondly, in the auditory condition, the aversive feedback that a physiotherapy patient would receive on exercising was simulated using the loud scream. Thirdly, feedback on recovery from the injury was simulated by the decrease in volume in the auditory condition and reducing the number of red bars displayed in the visual condition. Fourthly, a potential reward for adhering to the exercises was simulated by offering a chance

of £20 if the participant recovered. Only the chance of winning was offered to simulate the fact that with real physiotherapy, adherence does not perfectly correlate with recovery.

6.3.2 Preliminary Problems with the Simulation Programme

A precursory aim whilst carrying out this pilot study was to ensure the programme functioned as required. During development of the simulation programme and pre-piloting stage rigorous checks on the functioning of the programme were carried out. A number of problems were encountered during testing of participants. Whilst the data from these participants could not be analysed, their participation was crucial in identifying problems that were concerned with the VI schedule, auditory feedback, animation and data recording.

The first category of problems were concerned with the VI schedule. Initially, the number of VI schedules registered in the programme was too few. The VI tape therefore could run out before the programme had been completed. This had the effect that the participant's recovery was artificially stopped as once the VI tape had ended; the programme was subsequently unable to reach a point at which recovery was possible. To overcome this problem, the length of the VI tape was extended so that the schedules on the tape could not run out before the participant reached the end of the programme. A further problem that was encountered with the VI schedule was that the schedules re-started at the beginning of a day- thus the length on the VI schedules were being artificially altered. The final version of the programme recalculated what was left of the current VI schedule at the end of each day and this value was then carried over to the next day.

The second category of problems were concerned with the auditory feedback. Initially the decrease in volume was in 3 dB steps from a start value of 90 dB. The average frequency of the scream was 866.82 Hz (1^{st} 100ms = 1273.20, 2^{nd} 100ms = 942.15, 3^{rd} 100ms = 336.02, 4^{th} 100ms = 891.87, 5^{th} 100ms = 890.87), therefore the threshold for hearing this sound should be approximately between 5 and 10 dB (Fletcher & Munson, 1933). This meant that the volume of at least the last 5 steps of recovery would fall below the audible range (step 28 = 6dB). To overcome this problem, the steps were reduced to 1.5dB. The end point was then 42 dB which is above the normal hearing threshold for the frequencies of the scream. Checks were made on the actual dB change per step and from the start value to the finish value. These tests revealed that the start value was 90.3 dB and the end value was 52.3 dB. This

equates to an average 1.2dB drop in volume per step. The frequency of noise generated by the computer (1 metre from the computer at head height when sat down) as assessed for 1 second at 3 successive 10 second intervals, revealed an average background noise frequency of 1220.17 Hz the dB level of which was assessed for one minute and the maximum level recorded as 50 dB. Therefore, the scream would have been a similar level of loudness to the background noise (Fletcher et al., 1933). The fact that the scream was delivered by headphones would have meant, firstly, that some of the background noise would be filtered by the headphones and secondly that the 'scream' was delivered directly to the ear. Participants are therefore likely to have been able to hear all 'screams'. It was also identified that the scream did not always sound. This was due to a difference in the length of the sound and animation files, such that if the 'exercise' button was clicked before the sound file had finished, the animation file could run without the sound file. The length of the sound file was shortened so that this problem was avoided.

The third category related to a problem with the animation. If the participant did not make any responses during the course of one day, the animation file ran on one frame. This was resolved by ensuring that the animation file began from the first frame at the beginning of each day.

The fourth category of problems were related to data recording. The first version of the programme began recording data with the second response that was made by the participant. This was changed so that the first response made in each day was recorded so that every response could potentially result in recovery. It was also found that in the auditory condition, the signal from the mouse could be stored that resulted that an impossibly fast set of responses were recorded (as fast as one response every 0.036 seconds) that did not reflect the actual responding of the participant. This problem was eradicated by only allowing a click of the 'exercise' button to be registered by the computer once the animation and sound file had finished and another exercise was possible.

6.4 Method

6.4.1 Design

A between participants design was used to examine the effect of different parameters used in the programme, specifically tolerance rates, on the performance at the physiotherapy simulation. The aim was to find a tolerance rate around the target response rate that resulted in the task being of moderate difficulty, i.e. it was not too easy so that too many people recovered or too hard that no-one recovered. Four different tolerance rates around the target response rate were used. For this first part of the pilot study the independent variable was the tolerance boundaries around the target response rate. The dependent variable was the number of steps of recovery achieved and the length of time the participants persisted at the task.

The secondary aim of this study was to assess the effect of different variables on adherence to a physiotherapy simulation. The second independent variable was the type of feedback received by the participants about their simulated injury. Feedback on their performance was given either in an auditory form (a 90 dB 'scream' whenever a physiotherapy 'exercise' was performed, that decreased 1.5 dB steps as they recovered) or visually (a vertical bar with 32 horizontal divisions that begins solid red and as each step of recovery was achieved one division changes to black- see figure 3). The dependent variable was how many steps of recovery were made. Recovery was chosen as the adherence measure as recovery requires extended responding within the tolerance boundaries around the target response rate. For example, if the tolerance boundaries are set so that the correct response rate lies between 0.18 and 0.48 seconds, the participant would have needed to be responding within these boundaries when a VI schedule times out in order that recovery would occur. As the VI schedule was set to 45 seconds, recovery was possible at unpredictable and after potentially extended periods of time. To maximize the chance of recovery, the participant must therefore respond within the tolerance boundaries for extended periods of time. It is worth noting that simply continuing with the programme (i.e. not dropping out) was not sufficient for recovery. The participant must also be responding within the tolerance boundaries to recover. To simulate the motivation to recover, the participants were informed that if they successfully recovered, they would be entered into a draw to win £20 (and that once entered there was a 1 in 4 chance of winning).

6.4.2 Participants

The sample consisted of 13 participants, 9 females and 4 males, with an age range of 19-52 (mean = 26.92, SD = 8.73). The participants were recruited via the psychology participant

pool. A separate 13 participants took part in the simulation but due to various reasons (problems with the VI schedule, auditory feedback, animation and data recording, as detailed in section 5.3.2) their data was not included in the following analyses.

6.4.3 Materials

6.4.3.1 Computer programme

The physiotherapy simulation programme was written in C++ using Borland Builder C++ (see appendix B for details of the functioning of the programme). The programme set up page enabled the programme settings to be altered. All of these settings constituted potential variables in the study. The first of these variables was the type of feedback given, with the choice of either visual or auditory. Other variables include total epoch length (total time available to spend on 'exercising' in minutes), number of epochs (divides the total epoch length into X number of 'days'), target response rate (rate of responding deemed correct, 1/ response time in seconds), tolerance rates (margin around target response rate considered by the programme to be 'correct' responding), tolerance calculation (either as a percentage of the target response rate, or an absolute value above and below the target response rate), length of variable interval schedule (the average time in seconds at which recovery becomes possible if responding was within tolerance boundaries) and moving window (how many responses were used in calculation of the response rate).

The simulation programme calculated and recorded data on the participant's performance into a Microsoft Excel file organized by one variable per column. The first of these columns was a record of how long it had been since the participant had pressed the 'exercise' button in milliseconds. The second recorded when the 'exercise' button was pressed since the start of that 'day'. The third showed the length of the VI schedule (in milliseconds) that was running at that time. The fourth recorded the number of each 'exercise'. The fifth noted how many VI schedules had finished to that point. The sixth recorded the day number. The seventh showed on a binary measure (0 = no; 1 = yes), whether reinforcement was due (i.e. the VI schedule had timed out). The eighth recorded in binary form (0 = no; 1 = yes), whether the participant's response rate met the target response rate criteria. The ninth recorded whether a step of recovery was achieved using 'yes' and 'no' (i.e. the seventh and eighth column both recorded '1'). The tenth column displayed the response rate calculated using the last X

number of responses (as specified in the programme set up). Extensive checks were made to ensure that the data that was recorded was a true representation of actual behaviour. For example, the number and frequency of 'exercises' were noted and compared to the data file. By the time the pilot study was carried out, irregularities had been identified and removed.

6.4.3.2 Questionnaires

6.4.3.2.1 Self-efficacy

The literature was searched for a suitable measure that assessed self-efficacy for completing a computer/ simulation task. No measures were found, therefore a new measure was designed. Using guidelines specified by Bandura (1997) a measure was designed that was specific to the simulation task. The level of self-efficacy belief was assessed by using questions that presented potential barriers to completing the task, such as it was harder than the participant thought, they were tired or found it unpleasant. The participant was asked to rate on a 7 point likert scale (0 = "definitely will not be able"; 6 = "definitely will be able") how strongly they believed that they would be able to complete the simulation even if they encountered the barriers (this constituted the strength aspect of self-efficacy). Therefore a high score on this questionnaire indicated strong self-efficacy. Five potential barriers to completing the task were identified. These included "if it was boring" and "if you found it unpleasant". This initial questionnaire was briefly piloted by 15 participants (a different sample to those who took part in the pilot simulation study) were given a brief description of the simulation task and asked to complete the questionnaire (see appendix C). The Cronbach's alpha obtained for this questionnaire was 0.92. No items were removed from the scale as the alpha value was acceptable and Bandura (1997) recommended multiple potential barriers to avoid ceiling effects (see appendix D for final questionnaire).

The obtained Cronbach's alpha for those in the pilot study as assessed at baseline was 0.91. Therefore, no alterations were made to the measures before using the data generated by this questionnaire.

6.4.3.2.2 Outcome expectations

A search of the literature was conducted that looked for an existing outcome expectations measure for simulation studies. This search of the literature yielded no measures. As no existing measures were found and due to the recommendation that outcome expectations measures be designed specifically to suit the particular situation they would be applied to (Bandura, 1997), a new measure was designed. An initial set of 20 questions (8 physical, 6 social and 7 self-evaluative; see appendix E) were written for the study using Bandura's (1997; 1986) definitions of outcome expectations as a guideline. Participants were required to answer how much they agreed / disagreed with each question on a seven point likert scale (0 = strongly disagree; 6 = strongly agree). Items were scored such that a high score indicated more positive outcome expectations. An example of a social outcome expectation was concerned with how the participant believed the experimenter would feel about their performance:

"I expect the experimenter will be unconcerned if I complete the simulation".

The questions referring to the self-evaluative aspect of outcome expectations consisted of, for example:

"I expect I will be impressed with myself if I complete the simulation".

As there would be no actual physical sensations in both the auditory and visual conditions (such as pleasurable sensations suggested by Bandura (1997)), the items that related to physical outcomes to taking part in the study were concerned with the experience of completing the simulation. A sample item relating to physical aspects of outcome expectations was:

"I expect that the simulation will be boring to complete".

15 participants (a different sample to those who took part in the pilot simulation study) were given a brief description of the simulation task and asked to complete the 20 item questionnaire. The questionnaires were scored so that a higher score represented more positive outcome expectations. The resulting data was entered into SPSS and Cronbach's alpha values were computed for each of the three components (social, self-evaluative and physical). Questions were deleted from the scale until three questions remained for each of the subscales. The questions were deleted so that the Cronbach's alpha value increased (or decreased least; see appendix F for the final version of this questionnaire). On completion of this process, the scale as a whole had a Cronbach's alpha value of 0.79, and the social, self-evaluative and physical subscales alpha values were 0.93, 0.82 and 0.89 respectively.

Initial analyses on the data collected during the simulation study revealed unacceptable Cronbach's alpha values for the scale as a whole and one of the sub-scales. One item was removed from the social subscale (question 1) to result in acceptable alpha values (whole scale = 0.65; social sub-scale = 0.44; self-evaluative sub-scale = 0.62; physical sub-scale = 0.76).

6.4.3.2.3 Affective state

Selection of the affective state measure was based on the following criterion; the scale should contain no items relating to physical symptoms. As the participants were asked to imagine they were the simulated person on-screen, questions on physical symptoms would have been inappropriate. The Profile of Mood States (POMS; McNair Lorr & Droppleman 1971) and the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith 1983) were rejected for this reason. The POMS asks participants to describe how they have felt within the last week including today on 30 (short form) or 65 adjectives on a five point likert scale (0 = not at all; 4 = extremely). Adjectives that would have been inappropriate for the current study include "vigorous", "sluggish" and "weary". The HADS consists of 14 questions relating to anxiety or depression. Participants are required to answer on a four point likert scale with anchor points appropriate to each question. For example, a question that was inappropriate for this study was: "I feel as if I am slowed down" with responses of "nearly all the time", "very often", "quite often" and "not at all". The second criterion was that the questionnaire needed to be quick to complete as it would be administered at multiple points throughout the simulation. Two questionnaires met these two criteria; the Positive and Negative Affect Schedule (PANAS; Watson Clark & Tellegen, 1988) and a nine-item questionnaire that assessed positive and negative affective state (Diener, Larsen, Levine & Emmons; 1985). Diener and colleagues' (1985; see appendix G) scale was selected for use in the study as it was designed using factor analytic techniques to select the individual items, it has been successfully used in research (e.g. Gauvin Rejeski & Norris 1997) and is quicker to complete than the PANAS. Diener and colleagues (1985) reported acceptable internal consistency of the scale (Cronbach's alpha = 0.85) as have others (e.g. Gauvin et al. 1996; 0.76). Cronbach's alpha for the positive and negative affective state scales in the present study was 0.93 and 0.75 respectively. The scale consists of four items that relate to positive affective state and five that relate to negative affective state. Participants are required to indicate how much they currently feel related to each item on a 7 point likert scale (0 = not at all; 6 =

extremely). Positive items consist of: "Happy", "Pleased", "Joyful" and "Enjoyment/ fun". Negative items consist of: "Depressed/ blue", "Worried/ anxious", "Frustrated", "Unhappy" and "Angry/ Hostile". A high score on the positive subscale indicated higher positive affective state and a high score on the negative subscale indicated higher negative affective state.

6.4.3.2.4 Demographic information

Information on the age, sex and whether the participant had ever had physiotherapy were recorded (see appendix H).

6.4.3.2.5 Post participation

This questionnaire measure used open-ended questions to ask the participants to describe what they did to try to recover from their shoulder injury, whether they thought they were successfully recovering and what aspect(s) of their exercising they thought controlled changes in their recovery (see appendix I).

6.4.4 Procedure

Participants read the information sheet and signed the consent form prior to taking part in the study (see appendices J and K). Instruction screens displayed on the computer described the task the participant would be carrying out (for a copy of the auditory and visual instructions see appendix L and M respectively). The participant was instructed to imagine they had been injured and in order to recover, they needed to complete physiotherapy 'exercises'. Participants in both conditions were given the opportunity to practice one 'exercise'. Each 'exercise' consisted of the participants clicking an on-screen button marked 'exercise'. Every click on this button resulted in the on-screen animated person raising both arms to shoulder height then returning them to their sides. In both conditions, this first practice exercise was accompanied by a loud (90dB) 'scream' delivered by headphones. Once all the instruction screens had been read, the experimenter explained to the participant that they should aim to respond at a steady rate rather than opting for bursts of activity interspersed with rest periods and that they would be able to tell when they had found the correct rate when they began to recover. The opportunity to ask questions was given. Following the completion of two

questionnaires (first questionnaire collected information on age and gender - see appendix H, second questionnaire assessed outcome expectations, self-efficacy and affective state- see appendices D, F and G) the experiment began.

To ensure the experimental procedure was being followed the door to the cubicle was left ajar to enable checks to be made on the participant (for example, that the participant had the headphones on if they were in the auditory condition and that they were not using a watch to time their exercise). At the end of days 2, 4, 8, 12, 16 and 20, instruction screens were displayed on the computer informing the participants to call the experimenter for another questionnaire. If questions were asked of the experimenter concerning progress in the simulation or what they should be doing, it was explained that no further information could be supplied beyond that on the instructions. On completing the questionnaires, exercising was resumed. At the end of day four, after approximately 15 minutes, a screen was displayed on the computer that stated that the compulsory part of the experiment had finished and they had earned their participation credit and they could now finish the simulation any time they chose. From the beginning of day five onwards, the option to finish the experiment at any time was made explicit (a 'finish' button was now shown next to the 'exercise' button). If the 'finish' option was chosen, confirmation was sought by an onscreen question asking the participant if they were sure they wanted to finish. If confirmation was received, the programme ended and the participant was informed they had finished the experiment. An email address was requested to enable later contact to be made. Two final questionnaires were then completed that assessed affective state and post participation beliefs (see appendices G and I), and then the participant was debriefed (see appendix N for copy of the debrief sheet) and offered the opportunity to ask questions relating to the study.

If exercising was continued, the experiment would resume were it was left, i.e. all data recording was paused if the participant pressed 'finish' and restarted if the participant clicked 'no' they did not want to finish.

If the end of day 20 was reached and recovery had not been achieved, the final questionnaires and debrief were given (see appendices G, I and N). If complete recovery was achieved (i.e. all 32 steps, at any point through the programme), the participant was informed that they had been successful and their name would be entered into the draw to win £20. Their email

address was requested to enable contact to be made should the participant win the £20 prize, and the debrief was given as above.

6.5 Results

Due to the small sample size, no analyses were conducted on the questionnaire measures. The following results section therefore reports only information related to the influence of the simulation programme parameters on behaviour.

6.5.1 Individual response rate and recovery data

6.5.1.1 Case study 1

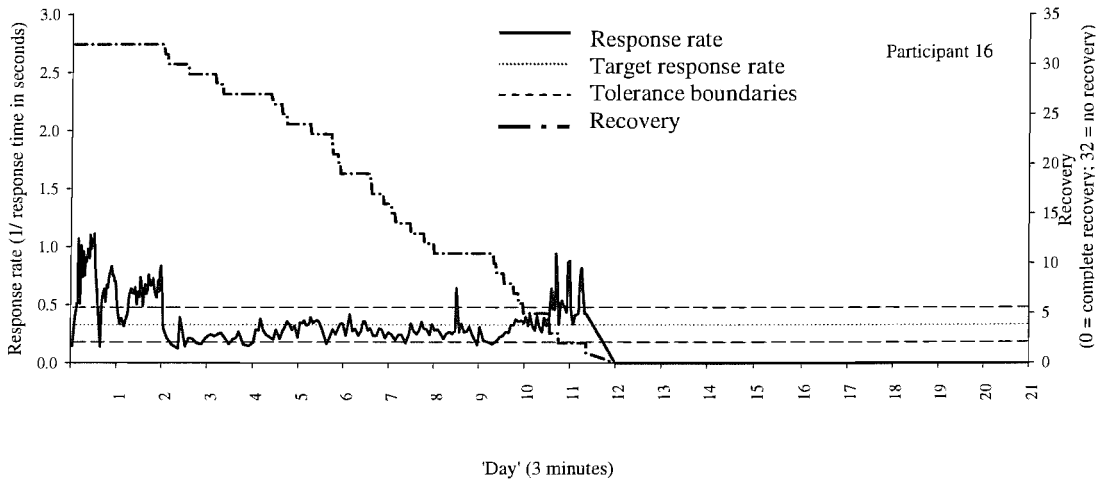


Figure 5

Sample graph of rate of 'exercising' and accompanying recovery in the visual condition

Figure 5 illustrates one of the participants who completed the visual feedback version of the task. This particular participant's responses are illustrated as the responses that are made are consistent with good adherence behaviour and the participant was successful at the task comparatively quickly. This graph also describes pictorially the functioning of the programme in relation to the participant's responses. Initially the participant's response rate was quite high during the first part of day 1 and did not fall with in the tolerance rates around the target response rate. During this first day, when the response rate was not consistently within the tolerance boundaries, no recovery takes place. During day 2 the participant began the day within the tolerance boundaries but soon started responding too fast, again, no

recovery was achieved. From the beginning of day 3 however, the participant began responding within the tolerance boundaries and a number of steps of recovery were achieved. The participant continued responding within the tolerance boundaries with only a few exceptions until they reached complete recovery part way through day 12.

This participant displayed learning as their responding was brought within the tolerance boundaries from approximately the beginning of day 3 and remained within the boundaries until they were very close to full recovery. At the point at which they were nearing full recovery, their responding increased, perhaps because the visual bar would have shown that they were near to full recovery and would therefore be entered into the draw to win £20. Interestingly, this participant's positive affective state decreased and negative affective state increased with participation in the study, even though they were clearly recovering. The participant's beliefs about the potent parts of their responding show that they did not think they were recovering successfully to begin with, but that "half way through recovery looked quite successful." As with participant 21 (discussed below), participant 16 seemed vague about how they achieved recovery, saying that "The speed at which recovery took place. Time between exercises" was important; no reference to what this 'correct' speed of responding was made.

6.5.1.2 Case study 2

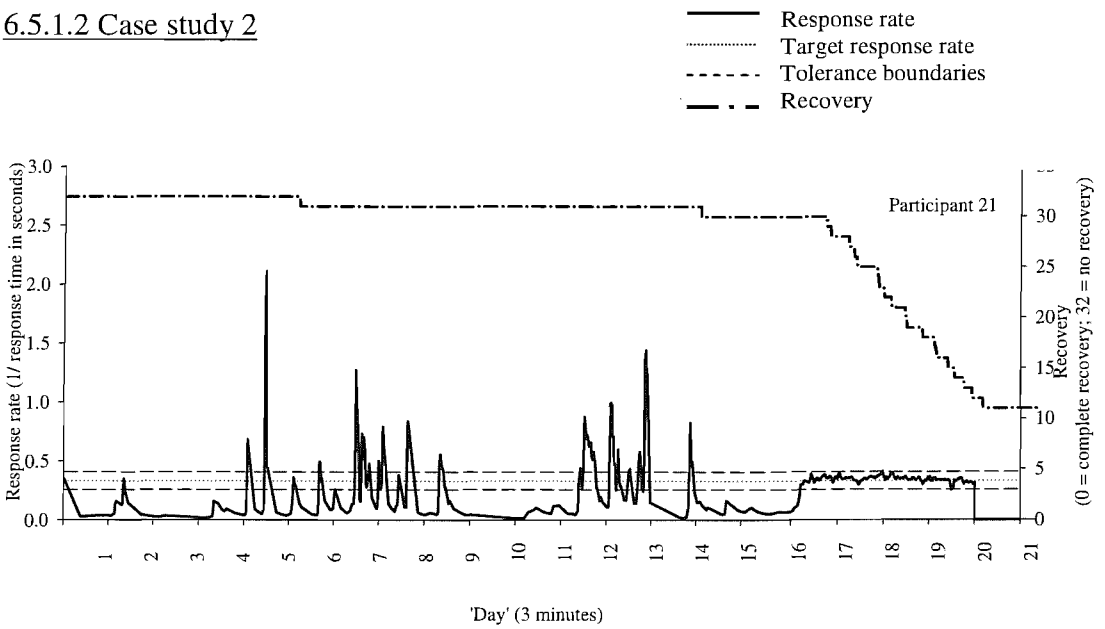
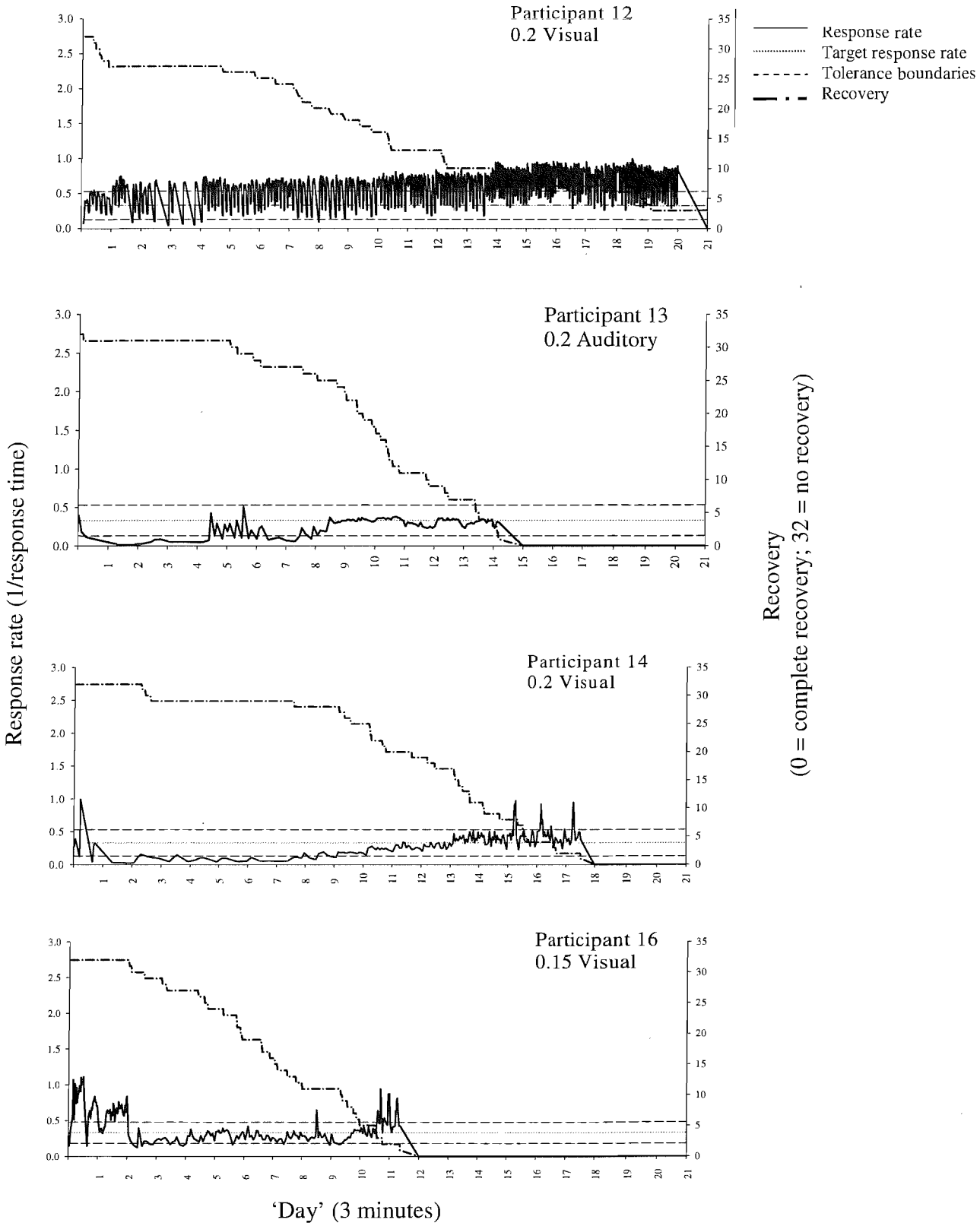


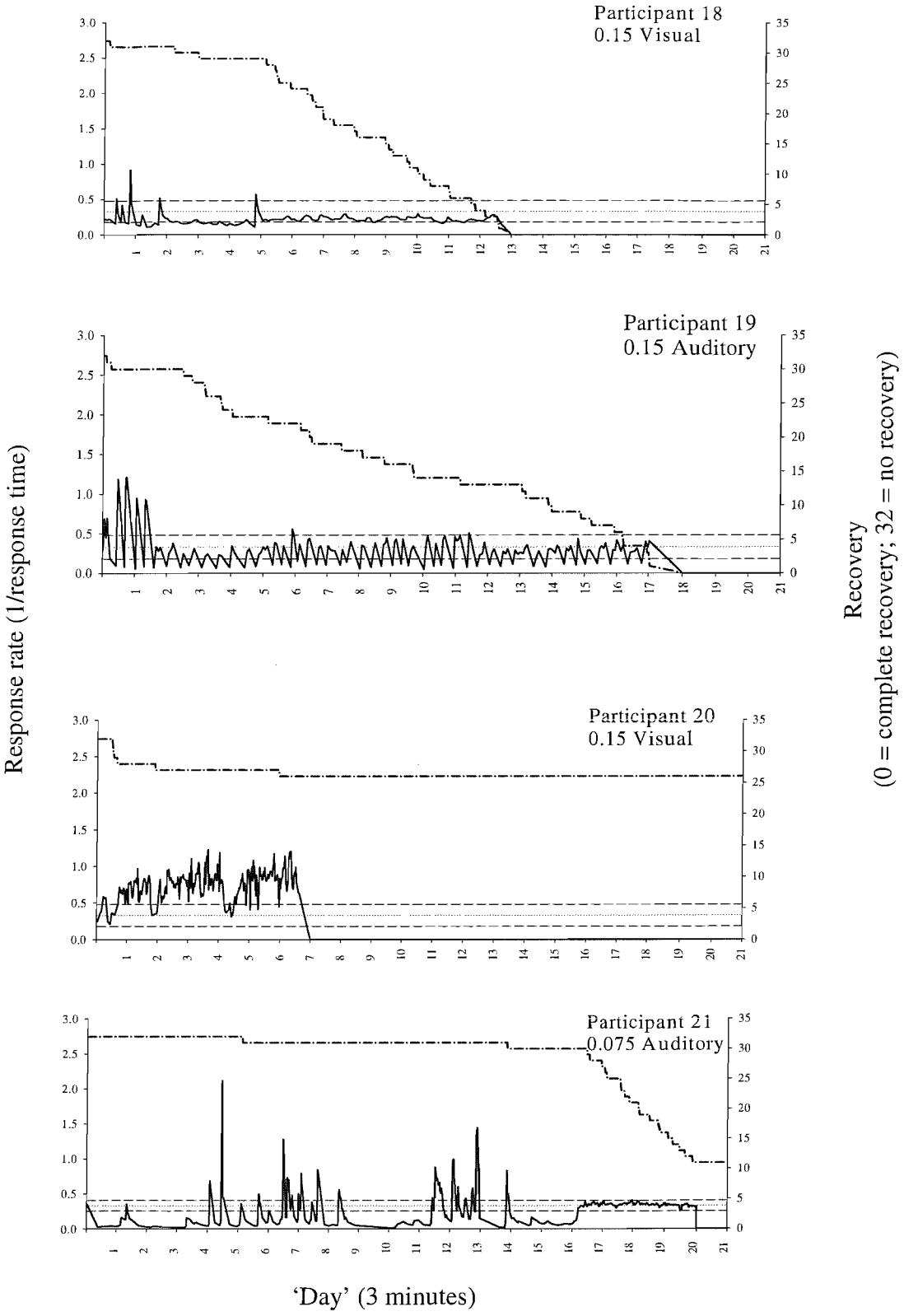
Figure 6

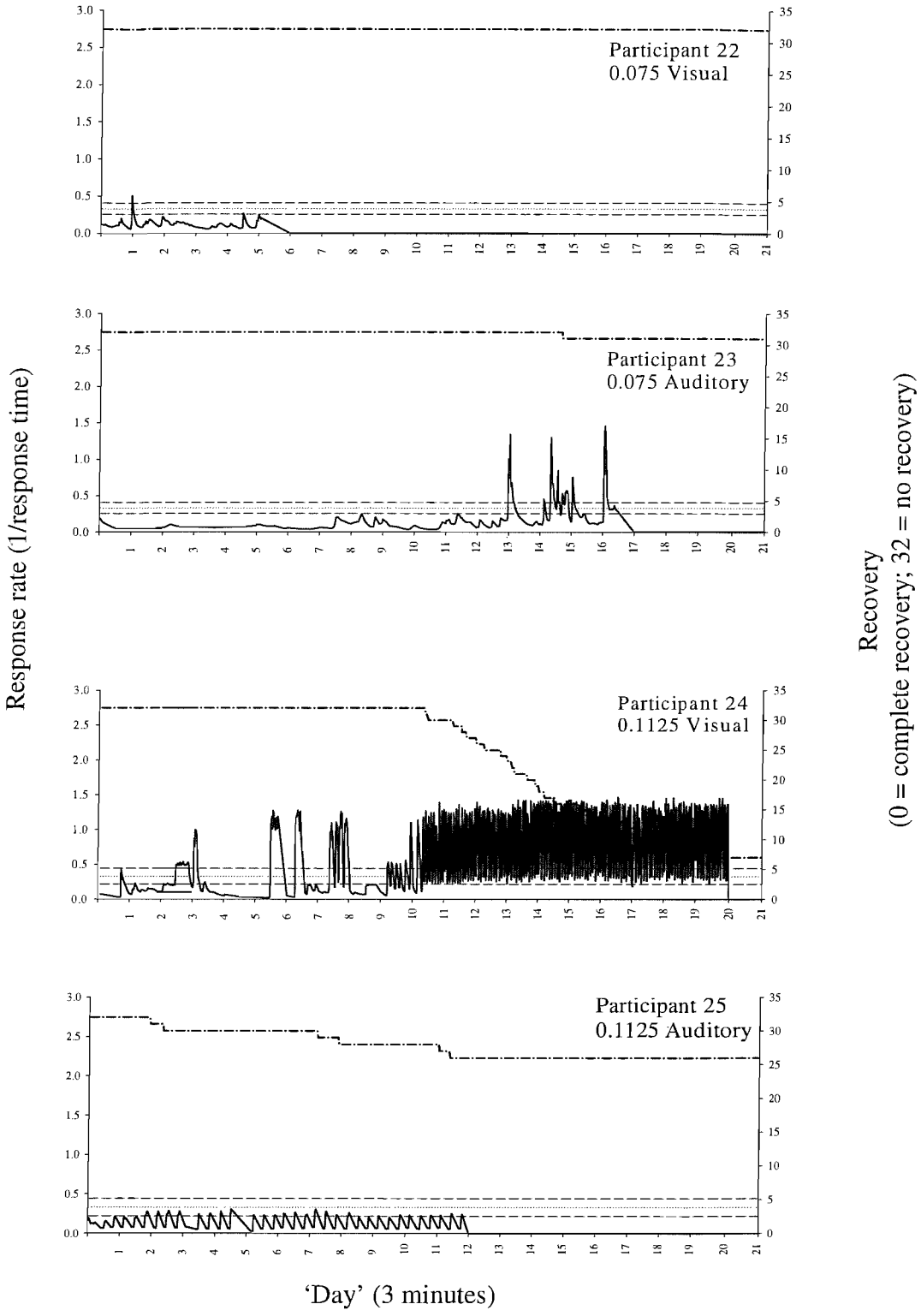
Sample graph of rate of 'exercising' and accompanying recovery in the auditory condition

The data from participant 21 is graphically illustrated in Figure 6 and shows great variability in responding as the participant tries to recover. This participant received auditory feedback on their recovery. This participant's data was illustrated as it shows the participant generally responded slower than participant 16 (illustrated in figure 5). Slower response rate was typical of those in the auditory condition (see below). Figure 6 also shows the effect of the narrower tolerance boundaries on performance at the task, in that it has taken the participant longer to begin responding correctly, i.e. the task appears harder. The participant appears to be sensitive to the tolerance boundary used here (0.0750), although it has taken the vast majority of the time available to them for recovery (16 'days' = 48 minutes of responding). It appeared that the participant did not display learning from the feedback they received about their recovery until the end of day 16. From the end of day 16 however, the participant responded consistently within the tolerance boundaries and as a result, achieved multiple steps of recovery. This participant displayed persistence at the task despite little progress until the end of day 16. Evidence from this participant and the data displayed in table 6 (below) suggest that this small tolerance boundary resulted in the task being difficult. The data from the affective state questionnaires for this participant showed that on each subsequent assessment whilst still exercising, positive affective state decreases by one or two points (of a total possible 28 points) and from assessment at the end of day 2, total negative affective state increases from one to five (possible 35 points). The post participation questionnaires for this participant revealed that whilst they did realise that they were recovering, what they believed to be controlling their recovery was vague, reporting that they thought "performing the exercises at routine times" controlled their recovery.

6.5.1.3 Response rate and recovery for each participant


Participant 12
0.2 Visual
Participant 13
0.2 Auditory
Participant 14
0.2 Visual
Participant 16
0.15 Visual
Response rate
Target response rate
Tolerance boundaries
Recovery
Response rate (1/response time)
Recovery
(0 = complete recovery; 32 = no recovery)
'Day' (3 minutes)


Participant 18
0.15 Visual
Participant 19
0.15 Auditory
Participant 20
0.15 Visual
Participant 21
0.075 Auditory
Response rate (1/response time)
Recovery
(0 = complete recovery; 32 = no recovery)
'Day' (3 minutes)


Participant 22
0.075 Visual
Participant 23
0.075 Auditory
Participant 24
0.1125 Visual
Participant 25
0.1125 Auditory
Response rate (1/response time)
Recovery
(0 = complete recovery; 32 = no recovery)
'Day' (3 minutes)

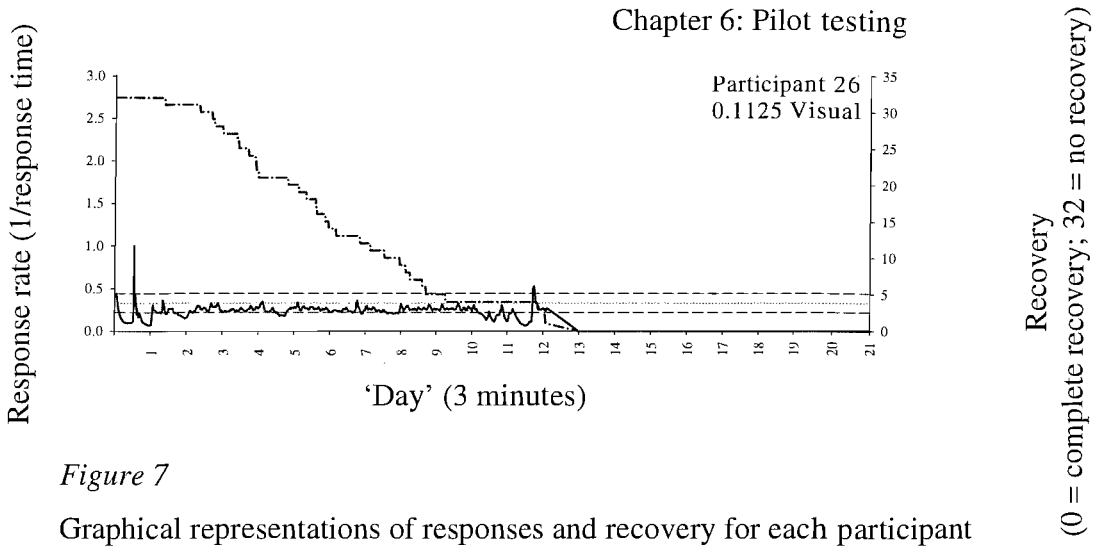


Figure 7

Graphical representations of responses and recovery for each participant

Note. Participant number, tolerance boundary and condition are displayed on each graph

Figure 7 shows that the patterns of responding vary between and even within most participants. Whilst some participants were quick to begin responding within the tolerance boundaries, others required more prolonged periods of time before they began responding correctly. The following analyses explore the data using effect size calculations.

6.5.2 Between group comparisons

Due to the small sample size for this pilot test, all the results are reported as effect sizes. Effect sizes for correlations were determined using the method detailed in Cohen (1992). Cohen's *d* values for all independent means assessments were calculated using the formula specified by Thalheimer and Cook (1992), as this formula accounts for group size. Effect sizes based on ANOVA results were assessed using partial Eta squared.

6.5.2.1 Tolerance rates

The effect of the size of tolerance boundary on the difficulty of the task (as measured by recovery) was assessed. Table 6 displays the means and standard deviations in total number of steps of recovery (32 possible steps) for each tolerance boundary.

Table 6

Means and standard deviations of number of steps of recovery for different tolerance boundaries

	Tolerance boundaries			
	0.0750 (2.47- 3.92 seconds)	0.1125 (2.26- 4.60 seconds)	0.1500 (2.08- 5.56 seconds)	0.2000 (1.89- 7.69 seconds)
Mean recovery	7.33	21.00	25.50	31.00
SD	11.85	13.45	13.00	1.73
N	3	3	4	3

Note. The tolerance boundaries are given as a response rate (i.e. 1 ÷ response time) around the target response rate of 0.33. The figures in brackets are the corresponding response times in seconds. For example, target response rate = 0.33; upper tolerance boundary = 0.33 – 0.0750 = 0.255; 1 ÷ 0.255 = 3.92 seconds.

An ANOVA was carried out that revealed a medium effect size ($F_{(3,12)} = 2.43$, $p = 0.13$; partial eta squared = 0.45). Post hoc tests using Cohen's d for independent means revealed a very large effect size for the difference between the 0.0750 and 0.1125 groups ($d = 1.32$), a medium effect size between the 0.1125 and 0.1500 groups ($d = 0.40$) and a medium effect size between the 0.1500 and 0.2000 groups ($d = 0.64$). Therefore, the participants in the 0.0750 tolerance boundary recovered least and the number of steps of recovery achieved increased as the tolerance boundaries widened.

6.5.2.2 Aversive feedback between group comparisons

Comparisons of number of steps of recovery achieved and the response rate in each of the feedback conditions were made using Cohen's d for independent means. The means and standard deviations are shown below.

Table 7

Means and standard deviations of response rate and number of steps of recovery achieved in those in each condition

		Assessment	
	n	Response rate	Recovery
Auditory	5		
Mean		0.15	18.40
Standard deviation		0.05	14.43
Visual	8		
Mean		0.34	23.50
Standard deviation		0.18	12.98
Cohen's *d*		1.31	0.37
Relative size of effect		very large	small

Those in the auditory condition responded slower than those in the visual condition. This suggests that the aversive feedback on recovery had a direct influence on behaviour. Those in the visual condition achieved more steps of recovery than those in the auditory condition.

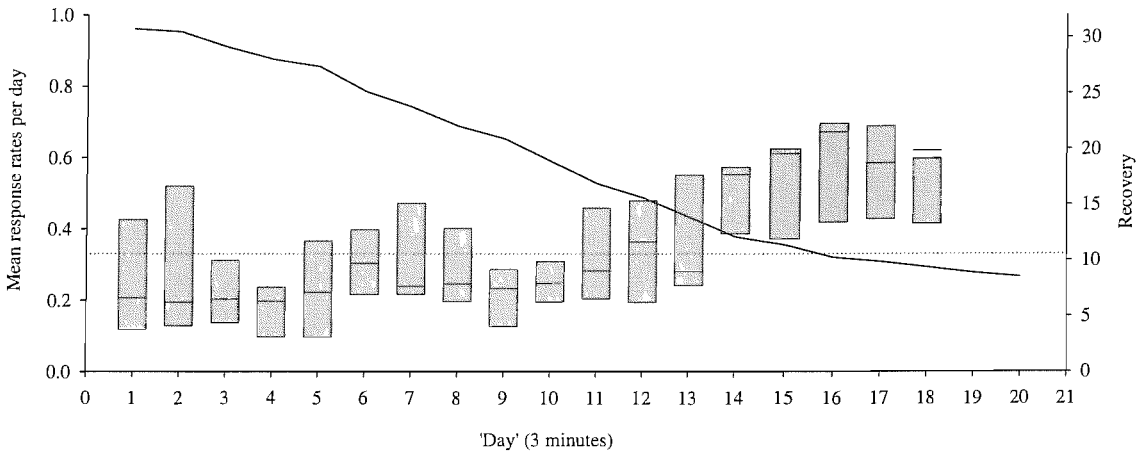


Figure 8

Mean response rates per day for those in the visual condition and the associated mean rates of recovery achieved

Note. Only the target response rate was displayed as the data include cases from all four different tolerance boundaries. Data was not displayed for days 19 and 20 as there were insufficient data points.

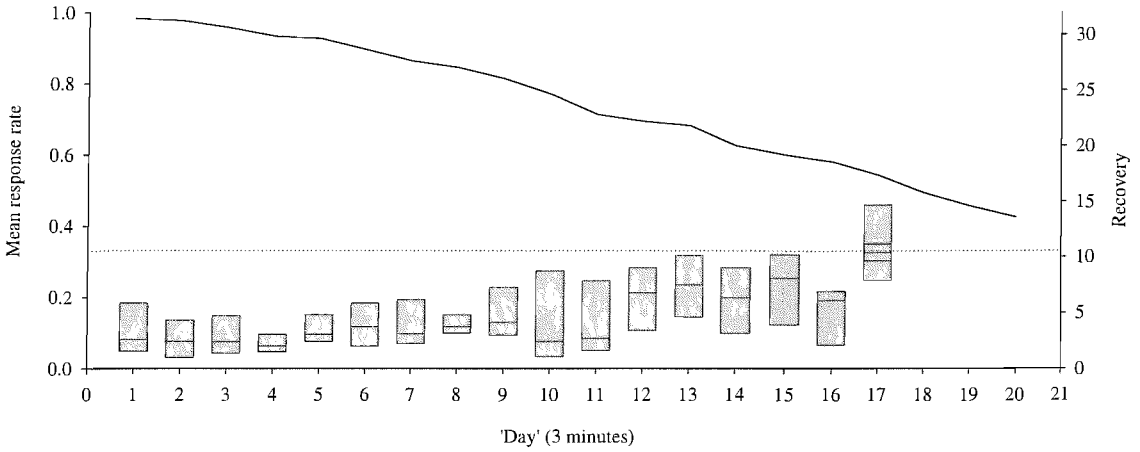


Figure 9

Mean response rates per day for those in the auditory condition and the associated mean rates of recovery achieved

Note. Only the target response rate was displayed as the data include cases from all four different tolerance boundaries. Data was not displayed for days 18 to 20 as there were insufficient data points.

Figures 8 and 9 illustrate that the responding of those in the auditory condition was slower and less variable that those in the visual condition.

The mean recovery achieved in both conditions reveals a shallower angle in the auditory condition which shows that recovery was slower in the auditory condition.

6.5.3 Summary of Results

A variety of aspects of the functioning of the simulation were investigated for their effect on the participants' behaviour. From the case studies and graphical representations of each participants' data (figure 7), it could be seen that the task was achievable. There was clear indication that the size of tolerance boundary influenced the amount of recovery achieved, in that the wider the tolerance, the more recovery was achieved. The effect of feedback condition was also evident in the fact that participants responded faster in the visual condition as compared to the auditory condition. There was a small influence of the feedback condition on the amount of recovery that was achieved.

The following discussion considers the parameters that have been found to be suitable for the simulation, primarily focussing on tolerance boundaries. The results are then discussed with reference to the effect of feedback condition on behaviour.

6.6.1 Programme parameters for future studies

The data for each individual revealed that although there was variability in the ways participants responded, the task was possible. Based on the findings that the size of tolerance boundary had a strong effect of the number of steps of recovery that were achieved the tolerance boundaries to be used in future studies was set at 0.095 (2.34 seconds- 4.20 seconds). This figure was the mid point between the two smallest tolerance boundaries and therefore would result in a task that was not too easy (in that responses need to be within a relatively small speed boundary) and yet participants should not find the task too hard (as indicated by the steep increase in mean steps of recovery made between the 0.075 and 0.1125 tolerance boundaries).

6.6.2 Research questions

6.6.2.1 Aversive feedback

The effect of aversive feedback shows that those in the auditory condition responded more slowly and recovered less than those in the visual condition. The slower response rate was believed to be due to the negative direct influence of the aversive feedback on behaviour. Activities with inherent aversive feedback may pose an unseen threat to performance of the required behaviour. Further study of the impact of aversive feedback in the next laboratory study will aid the quantification of this problem with respect to following specific instructions for completing 'exercises'. Later studies may also be able to suggest ways in which this effect could be lessened.

6.6.3 Limitations of the pilot study

There may have been a confounding variable in that the level of difficulty of task might have been different between the two conditions. Recovery in the visual condition was easily distinguishable and has a permanent record on the screen, whereas distinguishing level of recovery in the auditory condition relied on the ability to distinguish between the steps and lacks any definite way of comparing present volume with past volume. In experiment one (reported in chapter 7), a third condition was added that gave both forms of feedback (visual and auditory) to ensure that the ease of the tasks could be accounted for. It was expected that those in the combined condition would adhere less than those in the visual condition because while both the visual and combined condition will receive easily distinguishable information on recovery, those in the combined condition would also receive aversive feedback.

There was a potential difference in the reinforcing value of each step of recovery in the auditory condition. A drop in dB when the starting level was louder and potentially more aversive might be more reinforcing than a drop in dB when the loudness was not so aversive. This problem cannot be solved, but must be acknowledged.

Whilst simulation studies can aim to simulate their 'real life' counterparts, they are unlikely to succeed in every aspect. One aspect in which this simulation did not simulate physiotherapy was that if the participant chooses to end the simulation, they did not leave with any persisting problems, nor was there any fear of causing further harm from carrying out the exercises. Whilst the participant would not be entered into the draw to win £20, a physiotherapy patient would be left with an injury that had not fully recovered. The simulation also lacked a relationship with the physiotherapist. However, contact with the experimenter may have mirrored some part of the relationship a physiotherapy patient has with their physiotherapist. The duration of the simulation was also markedly different to the periods of time needed for treatment in physiotherapy. The participant was also restricted to only the one form of treatment (although they could choose how much they carried it out), whereas a patient with a shoulder injury has other options such as chiropractic treatment. If the participant responded within the tolerance boundaries in the simulation, recovery was achieved (albeit in a non-uniform pattern); whereas recovery in physiotherapy patients does not necessarily follow from adhering to the physiotherapists instructions.

Physiotherapy patients are given specific exercises with instructions to repeat them an advised number of times, however, the participants in the simulation study were given vague instructions to follow (to respond at a steady rate rather than responding in bursts and they would know if they had found the correct rate as they would begin to recover). The reason for this was that a primary aim of this pilot study was to find a tolerance boundary that resulted in the task being neither too easy nor too hard. The participants in the next laboratory study were informed that the correct response rate was one 'exercise' every 2-4 seconds. A tolerance boundary of 0.095, which will be used in the next laboratory study, meant that recovery would only be achieved when the participant responded within a narrow response rate window (2.34 seconds- 4.20 seconds). This pilot study indicated that it would be possible for participants' behaviour to be brought within the tolerance boundaries (even if they cannot explicitly report what they were doing to achieve recovery). However, this size of tolerance boundary is sufficiently small that the participants will need to adhere closely the instructions given to them in order to recover.

The sample size calculations for the laboratory study were based on the effect size of condition on response rate (Cohen's $d = 1.31$; very large) in the pilot study. Therefore a minimum of 21 participants were needed in each condition (Cohen, 1992).

Due to the small sample size, no analyses were conducted on the relationships between the questionnaire measures and behaviour. The full laboratory study reported in Chapter 7 investigates these relationships.

6.6.4 Amendments made to the programme for experiment one

It was unclear from the design of the pilot study whether the differences found in level of recovery achieved in the two conditions was attributable to the aversive component of the auditory condition or the difference in discriminability of the two forms of feedback. Those in the visual condition had a permanent comparable record of their recovery as the bar that was displayed throughout the experiment tracked their recovery. Those in the auditory condition however, were only given feedback on their recovery when the 'exercise' button was pressed. This meant that direct comparison to the previous level of recovery was impossible. The participant may therefore have been uncertain when a step of recovery had been made.

To overcome this problem of the discriminability of the stimuli, a third condition was added to the programme that provided both auditory and visual feedback. This third condition therefore had a permanent record of recovery and the aversive feedback (see appendix O for a copy of the functioning of the programme).

6.6.5 Conclusions

Overall, the findings of this pilot study suggested that the speed at which participants responded was slower in those who received aversive feedback in this simulation. These findings suggest that variables that act via additional mechanisms are important to adherence behaviour to this physiotherapy simulation.

CHAPTER 7: LABORATORY STUDY

7.1 Rationale and Aims

The primary aim of this laboratory study was to examine the influence of self-efficacy, outcome expectations, affective state and aversive feedback on adherence to the physiotherapy simulation. The principal advantage to this simulation was that the aversive and informational components of pain that are inextricable in real physiotherapy could be abstracted. The work in this chapter follows on from that conducted for the pilot study which has been presented in chapter 6.

7.2 Introduction to the Study

The task for the participants in this study was essentially the same as for those in the pilot study; their goal was to aid their simulated self to recover from a shoulder injury by carrying out exercises. Feedback on recovery was given in an aversive or non-aversive form. There were two main differences between the pilot study and this study. The first of these was that there was a third feedback condition introduced in which participants received both auditory and visual feedback on their injury. This condition was added as it was noted in chapter 6 that it could not be ruled out that any difference in responding between those in the auditory and visual condition may have been due to a difference in discriminability of the two forms of feedback. This third condition which gave auditory (aversive) and visual feedback (easily discriminable information) would ensure that those in the visual and combined feedback group would receive exactly the same information content to their feedback. Any differences between these two conditions would therefore be attributable to the auditory (aversive) feedback. The auditory condition was still used to allow comparison of simple aversive feedback (as in the auditory condition) and aversive feedback plus more detailed information on recovery rate (as in the combined condition). Comparison between these two conditions would be interesting and potentially clinically important; if more detailed information on recovery can attenuate the impact of aversive feedback, providing more detailed information on recovery to physiotherapy patients may improve adherence and therefore outcome.

The second difference from the pilot study was that the participants were told the rate at which they were to respond. It was established in the pilot study that participants could learn to respond at the correct rate with a small (0.075) tolerance boundary, therefore, as

physiotherapy patients are informed at what rate to exercise, to make the simulation more comparable to real physiotherapy, the participants were told what rate to respond at.

7.2.1 Hypotheses

The literature suggests that aversive feedback would have a negative effect on performance at the simulation (e.g. Byerly, Worrell, Gahimer, & Domholdt, 1994; Flor, Knost, & Birbaumer, 2002; Rejeski, Ettinger, Martin, & Morgan, 1998; Waddell et al., 1993; Williams, 2001). Based on the results of the pilot study and the model proposed in Chapter 4, it was hypothesised that those in the auditory feedback condition would drop out more, respond slower and therefore recover less than those in the visual condition. The performance of those in the combined feedback condition was uncertain.

As it has been found that self-efficacy and outcome expectations are important to adherence to health behaviours (e.g. Brady et al., 1997; Brewer et al., 2003; Resnick, Palmer, Jenkins, & Spellbring, 2000; Taylor & May, 1996; Yeung & Hemsley, 1997), it was hypothesised that higher self-efficacy and higher outcome expectations would be associated with better persistence at the task and more recovery.

It has also been suggested that affective state may influence adherence (e.g. Armitage, Conner, & Norman, 1999; Ayres et al., 1994; Salovey & Birnbaum, 1989; Suter & Marti, 1992). However, some studies show that affective state did not influence adherence (Alexandre, Nordin, Hiebert, & Campello, 2002; Belza et al., 2002; Rejeski et al., 1997). The model proposed in Chapter 4 suggested that affective state would influence adherence in that higher positive affective state and lower negative affective state would result in better persistence and more recovery.

7.3 Method

7.3.1 Design

A between participants repeated measures design was used to investigate the effect of the three different feedback conditions, levels of self-efficacy, outcome expectations and affective state on adherence to the physiotherapy simulation. Adherence to the simulation was broken down into three key variables. The first of these was persistence; this variable categorised each participant according to whether they persisted (irrespective of whether

or not they were successful) or whether they dropped out of the simulation. The second was response rate; this variable gave information on how closely the instructions from the experimenter were being followed. This also reflected the negative reinforcement effect of the feedback in the auditory and combined conditions. The third variable was number of steps of recovery; in order to gain recovery, the participants had to respond within the correct tolerance boundaries for a prolonged period of time. This last variable therefore represents an aggregation of the required performance on the first two variables (correct response rate and persistence) and gives an overall indication of quality of adherence.

As participants were required to complete the first four simulated days of the simulation, they were rewarded with £3 or one participation credit (for psychology students) for their time. As in the pilot study, to simulate motivation to recover and to promote engagement with the task, participants were informed that if they successfully recovered they would be entered into a draw to win £20 (and that once entered they had a 1 in 4 chance of winning).

The data from five participants were excluded from all analyses due to errors in the computer programme. Participants' data was excluded from specific analyses if one entire questionnaire scale was not completed on any occasion (i.e. either self-efficacy, outcome expectations, or affective state). Where parts of a scale had missing data, data was replaced with total sample means.

Table 8

Breakdown of number of participants available for analyses

Questionnaire measure	Number of participants missing entire scale	Total sample for analyses
Baseline Outcome expectations	None	84
Day 2 Outcome expectations	None	84
Baseline Self-efficacy	2	82
Day 2 Self-efficacy	None	84
Baseline Positive affective state	5	79
Day 2 Positive affective state	None	84
Baseline Negative affective state	5	79
Day 2 Negative affective state	None	84

7.3.2 Participants

Eighty nine participants took part in this experiment. Data from five of these participants could not be used (because of problems with the computer programme day length being too long). The final sample consisted of 84 participants, 40 males and 44 females. The age range of the sample was 18-55 (mean = 23.20, SD = 6.25). Participants were allocated to one of the three feedback conditions based on order of presentation to complete the simulation. After exclusions had been made (due to computer programme faults), there were 29 (14 male; 15 female) participants in the auditory feedback condition, 28 (16 male, 12 female) in the visual feedback condition, and 27 (10 male, 17 female) in the combined feedback condition. Participants were recruited via the psychology participant pool and poster adverts placed on notice boards around the University of Southampton. The sample size calculations were based on the effect size of condition on response rate (Cohen's $d = 1.31$; very large) in the pilot study. Therefore a minimum of 21 participants were needed in each condition (Cohen, 1992).

7.3.3 Materials

7.3.3.1 Computer Programme

The computer programme used for this study was developed during the pilot study. The workings of the programme are detailed in chapter five (see sections 5.2 and 5.4.3). The tolerance boundaries around the correct response rate were set 0.095 (one response every 2.34 - 4.20 seconds). As noted in section 7.2 above, a third feedback condition in which auditory and visual feedback combined was given which added to the existing auditory only and visual only feedback conditions. All other programme settings remained the same as used in the pilot study (3 minute epoch length, 3 second target response rate, tolerance calculation, 45 second VI schedule, and moving window taking into account the last 3 responses; see section 5.4.3).

7.3.3.2 Questionnaires

The five questionnaires used in this study (self-efficacy, outcome expectations, affective state, participant information and post participation) were the same as used in the pilot study and are detailed in Chapter five (5.4.3.1). The Cronbach's alphas for each of the

questionnaire measures at baseline were all acceptable (self-efficacy = 0.79; outcome expectations total scale = 0.79 (social subscale = 0.73 (this subscale did not reach acceptance in the pilot study, suspected to be due to small sample size), self-evaluative subscale = 0.80, physical subscale = 0.88; positive affective state = 0.93; negative affective state = 0.90).

7.3.4 Procedure

The procedure used was the same as that detailed in Chapter 6 (see section 6.4.4). After giving informed consent, participants read instructions as to their task from the computer screen. The experimenter then informed the participants that they should respond between once every 2, 3, and 4 seconds (see Appendix P). As in the pilot study, participants were informed that they would earn £3 or 1 credit if they completed the first four 'days' of the simulation. To encourage engagement with the simulation, it was also detailed to the participants that they would be entered into the prize draw with a one in four chance to win £20 should they successfully recover. The participants were given the opportunity to ask questions and once these were answered, they completed the baseline questionnaire measures and began the programme. Questionnaires were completed again at the end of 'day' 2. At the end of 'day' 4 participants were informed that they had finished the compulsory component of the simulation and that they could stop from any point onwards. If the participant chose to stay, they completed questionnaire measures for 'day' 4. For those who chose to continue, questionnaire measures were completed at the end of each subsequent four simulated 'days' (end of day 8, 12, and 16) until they either recovered, dropped out of the programme or reached the end of the 20th 'day' (the end of the programme). When the participant chose to finish, successfully recovered or reached the end of the programme, they completed a final affective state and post-participation questionnaire were debriefed and given £3 or 1 credit for taking part. The top performing participants in each condition were awarded the additional £20 prize[1].

7.4 Results

The results have been organised according to the primary dependent variables. The first of these variables was persistence, this variable categorised participants according to whether they dropped out of the programme (before they recovered or before the end of

[1] The winners of the £20 prize were decided by first ranking according to recovery within each condition. Those who recovered were further ranked according to days to recovery. Of those who did not recover, rankings were decided by number of steps of recovery.

the programme) or whether they stayed until they recovered or the programme ended. The second was response rate, which reflects how well the participants followed the instructions given to them. The third variable was recovery which occurred when the participants were responding at the correct rate for a prolonged period of time, therefore this gave an approximation of the quality of adherence.

Parametric assumptions were checked using skewness scores. All scores were normally distributed except negative affective state at baseline and day 2. Square root transformations resulted in these two variables being normally distributed.

7.4.1 Persistence

A participant was classified as persistent if they continued with the simulation until either the end of the programme or they recovered successfully. Non-persistent participants dropped out of the programme before the end of the programme (having not recovered). To explore the effect of feedback condition on persistence a Chi square test was conducted. To investigate the effect of the questionnaire measures on persistence a MANOVA and logistic regression were carried out.

7.4.1.1 The Relationship Between Feedback Condition and Persistence

A Chi square test was carried out which tested whether the distribution of persistent and non-persistent participants was different across the three feedback conditions. The results showed that there was no significant difference in the numbers of people who were persistent between the feedback conditions ($\chi^2 = 0.57$, $df = 2$, *ns*).

7.4.1.2 The Relationship Between Questionnaire Responses and Persistence

A repeated measures MANOVA was carried out to assess the whether questionnaire responses at baseline and day 2 differed between those who persisted and those who did not. Condition was added as a covariate to control for any differences due to condition.

Table 9

Means and standard deviations for questionnaire scores at baseline and day two in those who were persistent (n = 36) and those who were not persistent (n = 48)

	Baseline		Day 2	
	Persistent	Non-persistent	Persistent	Non-persistent
Outcome expectations				
Mean	35.73	31.51	32.76	27.51
SD	6.74	6.77	5.97	6.04
Self-efficacy				
Mean	15.70	14.51	16.33	12.16
SD	4.10	5.08	4.90	5.29
Positive affective state				
Mean	15.15	12.82	13.97	9.78
SD	4.04	3.97	5.26	4.65
Negative affective state				
Mean	1.87	1.99	1.64	2.26
SD	1.26	1.17	1.53	1.31

Note. Scores for negative affective state have undergone a square root transformation.

The between participants analyses revealed a significant main effect of feedback condition on questionnaire response ($F_{(4,72)} = 3.57, p = 0.01$). The univariate analyses revealed the difference to be in outcome expectations ($F_{(1,75)} = 13.41, p < 0.01$). To investigate where the difference was, a further MANOVA was conducted that looked at the difference in outcome expectations scores at baseline and day 2 between the different feedback conditions. Outcome expectations were significantly different across the feedback conditions at baseline ($F_{(2,81)} = 4.66, p = 0.01$) but not day 2 ($F_{(2,81)} = 1.97, ns$). Post hoc tests using Dunnett's C showed that those in the auditory condition had significantly lower outcome expectations ($M = 31.12$; $SD = 7.68$) than those in the combined group ($M = 36.68$; $SD = 6.64$) at baseline.

There was also a significant between participants main effect that showed that those who were persistent reported significantly different questionnaire responses than those who were not persistent ($F_{(4,72)} = 6.27, p = 0.01$). The univariate tests revealed that those who were not persistent had significantly lower outcome expectations ($F_{(1,75)} = 15.05, p = 0.01$), lower self-efficacy ($F_{(1,75)} = 6.87, p = 0.01$) and lower positive affective state ($F_{(1,75)} = 11.80, p = 0.01$) than those who were persistent.

The within participants tests showed that there was a significant overall change in questionnaire responses between baseline and day 2 ($F_{(4,72)} = 2.59, p = 0.04$). The univariate analyses revealed that positive affective state was lower at day 2 than at baseline ($F_{(1.75)} = 4.86, p = 0.03$). There was a significant interaction between time and persistence on questionnaire responses ($F_{(4,72)} = 3.49, p = 0.01$). The univariate tests revealed this interaction of time and persistence to be for self-efficacy, such that self-efficacy increased from baseline to day 2 in those who were persistent, but fell between baseline and day 2 in those that were not persistent ($F_{(1,75)} = 11.21, p = 0.01$). A significant interaction of time and persistence for positive affective state was found; although positive affective state fell in both the persistent and non persistent groups between baseline and day 2, the scores fell more in those that were non persistent ($F_{(1,75)} = 6.16, p = 0.02$). There was also a significant interaction of time and persistence for negative affective state; in those who were persistent, negative affective state remained relatively stable but increased in those who were non-persistent.

To determine which early predictor variables were independently related to persistence, all questionnaire measures that were significantly different between those who were persistent and those who were not persistent in the MANOVA were entered into a stepwise logistic regression that predicted persistence. To control for any differences due to feedback condition, condition was entered as a categorical covariate into the first block. Outcome expectations, self-efficacy, and positive affective state at baseline and day 2 were entered using the forward stepwise conditional method into the second block. Feedback condition could not predict persistence ($\chi^2 = 0.42, df = 2, ns$). Three questionnaire variables made up the final model and could predict persistence; outcome expectations on day 2, and self-efficacy at baseline and day 2 ($\chi^2 = 33.38, df = 5, p<0.01$). Higher day 2 outcome expectations and higher baseline and day 2 self-efficacy predicted persistence at the simulation task. The overall model could explain 47% of the variance (Nagelkerke $R^2 = 0.47$) and could classify 71.8% of the cases correctly.

Table 10

Summary of logistic regression analysis for questionnaire measures predicting persistence

Predictor	*B*	*S.E.*	Wald
Block 1 Enter			
Condition (1)	-0.52	0.77	0.47
Condition (2)	0.00	0.71	0.00
Block 2 Stepwise			
Day 2 Outcome expectations	-0.20	0.06	13.04**
Baseline Self-efficacy	0.25	0.11	5.17*
Day 2 Self-efficacy	-0.35	0.11	10.22**

* $p \leq .05$; ** $p \leq .01$

7.4.2 Response Rate

The response rate was calculated from the number of responses made during each day during the total amount of time that the participant was in the programme[2]. The correct response rate range was 0.235- 0.425 (one response every 2.35- 4.25 seconds) with a target response rate of 0.33 (one response every 3.3 seconds). The effect of feedback condition on the response rate was investigated using ANOVA controlling for the influence of early questionnaire responses. Correlations and partial correlations were used to test whether there was an association between early questionnaire responses and response rate.

7.4.2.1 The Relationship Between Feedback Condition and Response Rate

To test whether there were any differences in response rate between the feedback conditions an ANOVA was carried out. The results of the analysis showed that there was a significant difference in mean response rate between conditions ($F_{(2,81)} =, p < 0.01$). Post hoc tests using Dunnett's C showed that those in the visual condition responded significantly faster than those in the auditory and combined conditions ($p < 0.05$).

[2] e.g. 252 responses made over 4 simulated days; (no. of responses ÷ (no. of days in programme x 180 seconds)) = response rate; (252 ÷ (4 x 180)) = 0.35.

Table 11

Means and standard deviations for mean response rate by condition (correct response range- 0.235- 0.425)

	Mean	SD
Auditory	0.22	0.17
Combined	0.23	0.15
Visual	0.36	0.12

To test whether there were any differences in response rate between the feedback conditions remained once questionnaire responses were taken into account, a further ANCOVA was carried out that controlled for baseline questionnaire responses (outcome expectations, self-efficacy, positive affective state, negative affective state). The results of the analysis showed that there was a significant difference in mean response rate between conditions when baseline questionnaire measures were controlled for ($F_{(2,71)} = 11.58, p < 0.01$). Three further ANCOVAs were carried out to determine which conditions were responding significantly differently. Using Bonferroni correction method, the acceptable level of significance was set at 0.017. These ANCOVAs showed that those in the visual condition responded significantly faster than those in the auditory condition ($F_{(1,48)} = 27.86, p < 0.017$) and those in the combined condition ($F_{(1,46)} = 8.92, p < 0.017$). Those in the auditory condition did not respond significantly differently to those in the combined condition ($F_{(1,44)} = 0.35, ns$).

Table 12

Means and standard deviations for response rate by condition controlling for baseline and day 2 questionnaire measures (correct response range- 0.235- 0.425)

	Mean	SD
Auditory	0.20	0.11
Combined	0.24	0.16
Visual	0.36	0.12

The follow graphs illustrate the mean response rate each day for the three feedback conditions.

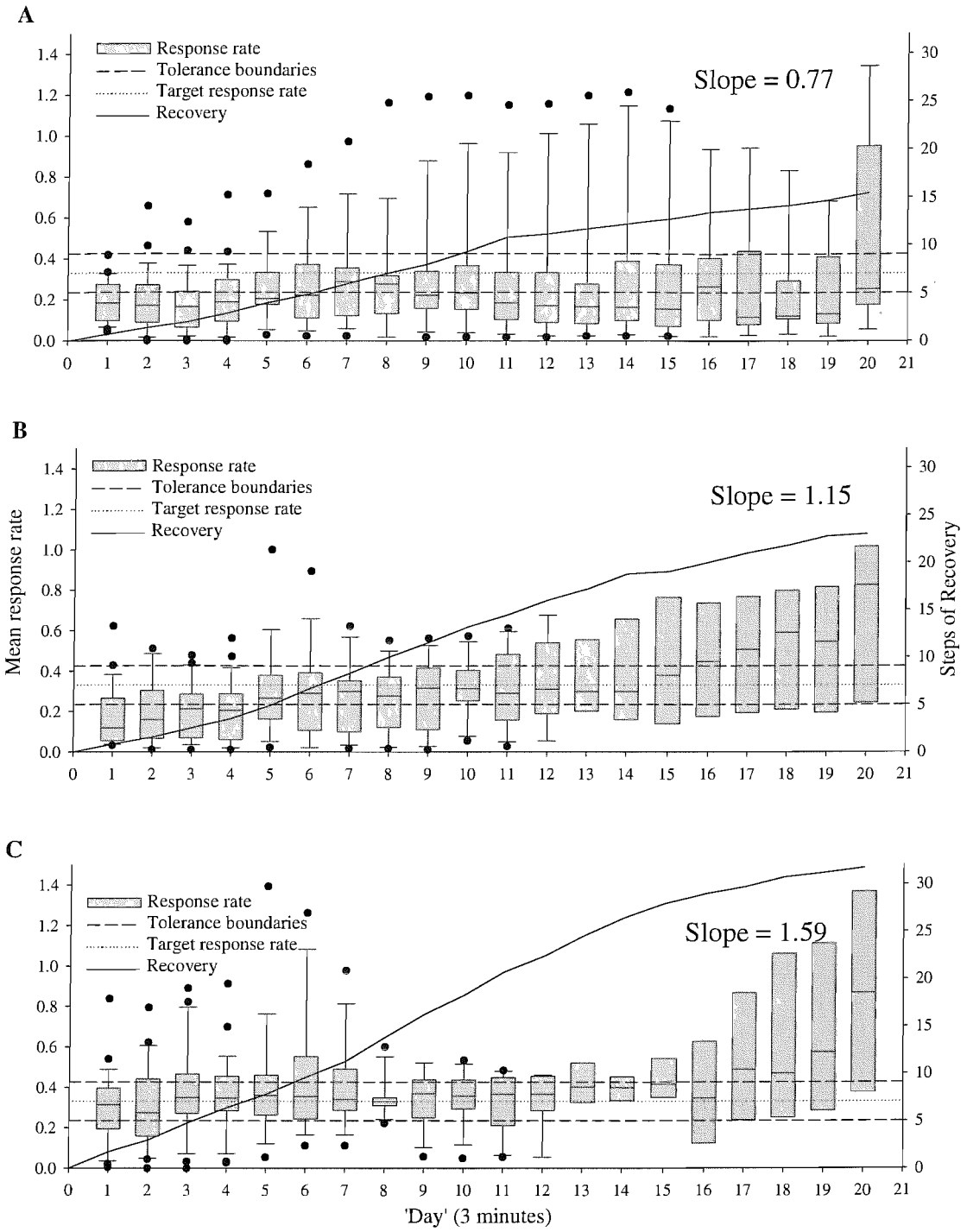


Figure 10

Boxplots displaying the mean response rate and recovery per 'day' for those in the auditory (panel A) combined (panel B) and visual conditions (panel C).

Note. Shaded bars represent from the 25th to 75th percentile, whiskers denote the 10th and 90th percentiles. Lines within the shaded bars indicate the median • represent outliers.

Participants in the auditory condition were consistently responding too slowly and invariably (see Figure 10, Panel A). As a consequence, their mean rate of recovery was slow, as indicated by the shallow slope of the recovery line.

In comparison those in the combined feedback condition responded slightly faster and more variably (see Figure 10, Panel B). Their mean recovery was slightly quicker as can be seen by the steeper slope of the recovery line.

Participants in the visual condition responded within the tolerance boundaries sooner and more consistently than the other two conditions (see Figure 10, Panel C). The participants in this group on the whole therefore recovered more and sooner than participants in the other two groups. This fact is reflected by the steep slope of the recovery line.

To assess how variably those in each condition were responding, variance in responding was calculated for each participant and a mean variance calculated from these values. An ANOVA was then carried out that looked at the difference between mean variance in response rate between the three different feedback conditions. The results showed that there was a significant difference in the variance in response rate between the three conditions ($F_{(2,81)} = 4.83, p = 0.01$). Post hoc tests using Dunnett's C showed that those in the visual condition responded more variably than those in the auditory condition. Those in the combined condition did not respond more variably than those in either of the other feedback conditions.

Table 13

Means and standard deviations for variance in mean response rate by condition

	Mean	SD
Auditory	0.03	0.04
Combined	0.03	0.04
Visual	0.07	0.07

7.4.2.2 The Relationship between Questionnaire Responses and Response Rate

To investigate the effect of questionnaire measures on the response rate a series of partial correlations were carried out. Partial correlations controlling for the effect of condition (because there was a significant effect of condition on response rate) looked at the association between baseline and day 2 questionnaire responses and response rate. Further partial correlations were then carried out that assessed the association between day 2 questionnaire responses whilst controlling for baseline questionnaire responses and condition.

Table 14

Correlation values between questionnaire scores at baseline and day two and response rate, and partial correlations of day two (controlling for baseline scores) and response rate

	Baseline	Day 2	Day 2 controlling for baseline
Outcome expectations	-0.11	-0.11	-0.04
Self-efficacy	-0.13	-0.05	0.07
Positive affective state	-0.10	0.04	0.20
Negative affective state	0.21	0.11	-0.09

Table 14 shows that there was no significant association between baseline and day 2 questionnaire measures and response rate. Therefore no further analyses were conducted.

7.4.3 Recovery

This last dependent variable represented a combination of responding at the correct rate and for a prolonged period of time. In order to investigate the effect of the questionnaire measures on recovery multiple regressions were carried out. The effect of feedback condition on recovery was examined using ANOVA which took account of baseline questionnaire measures.

7.4.3.1 The Relationship between Feedback Condition and Recovery

An ANOVA was carried out that compared the total number of steps of recovery achieved by the participants in each of the three feedback conditions. The results showed that there was a significant difference in the number of steps of recovery achieved between the conditions ($F_{(2,81)} = 3.10$, $p = 0.05$). Post hoc tests using Dunnett's C show that those in the auditory condition recovered significantly less than those in the visual condition. There was no significant difference in total recovery between those in the combined condition and either of the other two feedback conditions.

Table 15

Means and standard deviations for total recovery according to feedback condition

	Mean	SD
Auditory	8.24	11.28
Combined	11.59	13.57
Visual	16.43	12.51

To test whether the effect of the feedback condition remained once questionnaire measures were taken into account, a further ANCOVA was carried out that covaried for baseline and day 2 questionnaire responses (outcome expectations, self-efficacy, positive affective state and negative affective state). The results showed that when the questionnaire measures where taken into account, there was no significant difference in recovery between the three feedback conditions ($F_{(2,71)} = 1.99$, *ns*).

Table 16

Means and standard deviations for total recovery according to feedback condition controlling for baseline and day 2 questionnaire responses

	Mean	SD
Auditory	9.04	11.65
Combined	12.96	13.81
Visual	16.43	12.51

7.4.3.2 The Relationship between Questionnaire Responses and Recovery

Before the regression was carried out, a series of correlations were calculated to determine which variables were related to recovery. Partial correlations were also computed that measured the association between day 2 questionnaire scores whilst controlling for baseline measures.

Table 17

Pearsons r and partial correlation values between questionnaire scores at baseline and day two and day two (controlling for baseline scores) and recovery.

	Baseline	Day 2	Partial
Outcome expectations	0.12	0.17	0.12
Self-efficacy	0.06	0.29**	0.34**
Positive affective state	0.12	0.24*	0.26*
Negative affective state	0.04	-0.05	-0.14

* $p \leq .05$; ** $p \leq .01$

A stepwise multiple regression was carried out to examine the relationship between the questionnaire measures at baseline and day two with the total number of steps of recovery that were made. To control for the effect of condition, dummy variables for condition entered into block one. Self-efficacy at baseline and day two and positive affective state at baseline and day two were entered into the second block using the stepwise method as these had significant correlations and partial correlations. Only day 2 self-efficacy was added to the final model (after controlling for the effect of condition; the first block was not significant (($F_{(2,75)} = 2.30$, *ns*)). The overall model was significant ($F_{(3,74)} = 3.44$, $p = 0.02$) and could explain 12% ($r^2 = 0.12$; adjusted $r^2 = 0.09$) of the variance in the number of steps of recovery achieved.

Table 18

Summary of multiple regression predictors for total recovery

Predictor	*B*	*SE*	β
Block 1 Enter			
Condition (dummy variable)	-3.92	3.48	-0.15
Condition (dummy variable)	1.90	3.48	0.07
Block 2 Stepwise			
Day 2 Self-efficacy	0.61	0.26	0.26*

* $p \leq .05$

Table 18 shows that the only significant individual predictor of total recovery was self-efficacy at day 2. A higher self-efficacy score at day 2 predicted more recovery before finishing the simulation.

As both cognitive and other factors were related to recovery, further analyses were conducted to test whether self-efficacy mediated the influence of aversive feedback. To begin, a new variable was created which dichotomised the feedback conditions into those participants that received aversive feedback (auditory and combined groups) and those that did not (visual group). Sobel's (1982) test for mediation was then conducted. To begin, a linear regression was run with feedback group predicting self-efficacy. This produced unstandarised coefficient (B; *a*) and standard error of *a* (s_a). The overall model was significant ($F_{(1,82)} = 4.53$, $p < 0.05$) and could explain 5% ($r^2 = 0.05$; adjusted $r^2 = 0.04$) of the variance in self-efficacy.

Table 19

Summary of multiple regression predictors for self-efficacy

Predictor	*B*	*SE*	β
Block 1 Enter			
Dichotomised feedback condition	2.73	1.28	0.23*

* $p \leq .05$

Table 19 shows that the dichotomised feedback condition was a significant individual predictor of self-efficacy at day 2. Being in the information group was associated with higher day 2 self-efficacy.

The second step involved a second linear regression which was run with feedback group and self-efficacy predicting recovery. This produced unstandardised coefficient for self-efficacy predicting recovery (with feedback condition taken into account; *b*) and standard error of b (s_b). The overall model was significant ($F_{(2,81)} = 5.45$, $p < 0.01$) and could explain 12% ($r^2 = 0.12$; adjusted $r^2 = 0.10$) of the variance in number of steps of recovery made.

Table 20

Summary of multiple regression predictors for total recovery

Predictor	*B*	*SE*	β
Block 1 Enter			
Dichotomised feedback condition	5.03	1.28	0.23*
Day 2 Self-efficacy	0.56	0.24	0.25*

* $p \leq .05$

Table 20 shows that the dichotomised feedback condition and self-efficacy were significant predictors of self-efficacy at day 2. Being in the information group and having higher day 2 self-efficacy was associated with more recovery.

These figures were then entered into the calculation tool designed by Preacher (2003). This tool used the following formula to calculate z: $a * b / SQRT(b^2 * s_a + a^2 * s_b^2)$. The Sobel's test was significant ($z = 3.58$, $p < .01$) indicating that self-efficacy did mediate the effect of aversive feedback on recovery. Therefore, those people who received aversive feedback had lower day 2 self-efficacy which in turn led to poorer adherence behaviour as assessed by recovery.

7.4.4 Summary of Results

The following table summarizes the main findings of this laboratory study.

Table 21

Summary of associations with and prediction of persistence, response rate and recovery

	Persistence		Response rate		Recovery	
	Associated	Predicts	Associated	Predicts	Associated	Predicts
Outcome expectations	✓+ (Baseline & day 2)	✓+ (Day 2)	×		×	
Self-efficacy	✓+ (Baseline & day 2)	✓+ (Baseline & day 2)	×		✓+ (Baseline & day 2)	✓+ (Day 2)
Positive affective state	✓+ (Baseline & day 2)	×	×		✓+ (Baseline & day 2)	×
Negative affective state	×		×		×	
Feedback condition	×		✓*	✓*	✓*	×

Note. ✓ = significant association or prediction; × = no significant association or prediction; + = higher (more positive score) associated with increased adherence; * = aversive feedback associated with poorer adherence.

Table 21 indicates that higher scores on baseline and day 2 outcome expectations, self-efficacy and positive affective state were associated with persistence. The subsequent regression analyses showed that higher day 2 outcome expectations and baseline and day 2 self-efficacy independently predicted persistence. Only aversive feedback was associated with slower response rate. More recovery was associated with higher self-efficacy and positive affective state at baseline and day 2 and receiving visual feedback. The regression analyses indicated that only higher day 2 self-efficacy independently predicted better recovery. In addition to this, the mediation analysis revealed that higher self-efficacy mediated the effect of aversive feedback on recovery.

7.5 Discussion

The findings of this laboratory study are discussed in terms of the influence of feedback condition and questionnaire measures (self-efficacy, outcome expectations, and affective

state). The influences of each of these variables are discussed with respect to each of the three components of adherence in turn. The theoretical and clinical implications are then discussed, followed by a consideration of the limitations of this study and directions for future research.

7.5.1 Predictors of each Adherence Measure

The hypotheses described in section 7.2.1 above were organised in terms of the independent variables. It was hypothesised that increased self-efficacy and outcome expectations would be related to adherence behaviour. It was also hypothesised that those in the visual condition would respond faster than those in the auditory condition. The current study sought to clarify how those in the combined condition would respond and whether there would be an effect of affective state on adherence behaviour. The results are organised here in terms of the different aspects of adherence behaviour.

7.5.1.1 Persistence

Persistence indicates whether or not the participant dropped out of the simulation before they successfully recovered (before the end of the simulation).

There was no significant effect of feedback condition on whether or not participants were persistent at the simulation task. It can therefore be concluded that receiving aversive feedback did not induce the participants to drop out of the simulation more than those who did not receive aversive feedback.

Higher day 2 outcome expectations, baseline and day 2 self-efficacy predicted persistence at the simulation task. This finding supports the idea that outcome expectations can be important to behaviour independently of self-efficacy. Neither positive nor negative affective state was important to persistence.

7.5.1.2 Response rate

Response rate captures how closely participants were following their instructions to respond at a set rate. The speed at which they responded reflected the negative reinforcement received.

Those who received aversive feedback responded slower than those who did not, after controlling for baseline and day 2 questionnaire responses. This suggests that aversive feedback had a direct effect on response rate. As those in the combined feedback condition did not respond significantly differently from those in the auditory condition, additional visual feedback did not attenuate the negative impact of aversive feedback for response rate.

After controlling for the effect of feedback condition, the stepwise regression showed there was no significant association between affective state, self-efficacy, outcome expectations and response rate. Therefore these variables did not influence this aspect of adherence.

7.5.1.3 Recovery

The last dependent variable was recovery. In order to recover, participants had to respond within the tolerance boundaries for the correct response rate for a prolonged period of time. This last adherence measure therefore reflects both whether the participants were responding at the correct rate and whether they were persistent.

Without controlling for questionnaire responses, it appeared that those in the auditory condition recovered significantly less than those in the visual condition. However, after questionnaire responses were taken into account, it became evident that this effect of feedback condition may have been via questionnaire responses. Therefore both cognitive and additional mechanisms appeared important to recovery.

The analyses showed that after any effect of condition had been controlled for, higher day 2 self-efficacy predicted more recovery. In addition to this, the mediation analysis revealed that higher day 2 self-efficacy mediated the effect of aversive feedback on recovery. Outcome expectations and affective state had no influence on recovery. This suggested that cognitive factors can negate some of the negative effect of aversive feedback.

7.5.2 Theoretical Implications

The results of this laboratory study suggested that different variables are important to different aspects of adherence to this simulated physiotherapy task. There was support

provided for the idea that aversive feedback can have a direct influence on some aspects of adherence behaviour. However, aversive feedback did not influence whether they were persistent or not and did not have an independent influence on how much recovery the participants achieved.

Although affective state was associated with persistence and recovery, it did not have an independent effect on either of these adherence measures. Whilst more positive affective state was associated with being persistent and with more recovery, the regression analyses revealed that once other questionnaire responses were taken into account, affective state did not independently predict persistence or recovery. There was no evidence that affective state had any influence on the speed at which participants were responding.

Whilst support for Bandura's social cognitive theory was provided by some aspects of this study, self-efficacy and outcome expectations were not independently important to all of the components of adherence. Although higher day 2 self-efficacy was associated with faster response rate (once feedback condition and baseline self-efficacy had been taken into account), the regression analyses showed it did not independently predict response rate once feedback condition had been taken into account. Therefore there must be other important factors that influenced adherence behaviour in this simulation that were not accounted for by Bandura's (1986; 1997) theory.

Higher outcome expectations at day 2 and self-efficacy at baseline and day 2 were all independent predictors of persistent behaviour. Together these three variables could explain a significant 47% of variance in persistence. It has been proposed in the literature that outcome expectations may not add to the variance in behaviour once self-efficacy has been controlled (Brady et al., 1997). The fact that outcome expectations were independently important distinct from self-efficacy confirms that outcome expectations had an influence beyond that of self-efficacy in this study.

Self-efficacy at day 2 alone explained 12% of the variance in recovery once condition had been statistically controlled for. The fact that self-efficacy was important to this complex measure of adherence and the fact that self-efficacy was associated with (but not significantly independently predictive) of response rate and was independently important to persistence suggests that self-efficacy played an important role in adherence in this study.

7.5.3 Clinical Implications

The methodology employed to conduct this study enabled adherence to be broken down into different components and for each aspect to be closely monitored. The functioning of the programme dictated that in order to recover, participants had to adhere to both the correct response rate and to persist with the task for a prolonged period of time. These requirements of the programme were based on the requirements for recovery in real life physiotherapy. The findings of this study showed that both cognitive and other variables were important to adherence, and that when adherence was broken down, different variables influenced response rate and persistence at the task. Aversive feedback had a direct influence on the speed at which the participants responded; whilst self-efficacy and outcome expectations predicted persistence at the task independent of feedback the participants received.

These results suggest that it will be the cognitive variables that influence whether the physiotherapy patients turn up at their appointments and/or attempt to carry out their exercises at home, but the aversive nature of the therapy is likely to determine how well the patient carries out their exercises. In addition, cognitive variables may temper the negative influence of aversive feedback.

The fact that few baseline questionnaire measures were important to the components of adherence suggests that these early beliefs that have not been based on experience may have limited predictive power. These beliefs may be subject to change due to experience, and may therefore be less useful to measure and target in clinical populations than beliefs formed early after therapy. Early (day 2) cognitive variables do appear important to later adherence. Therefore interventions aimed at increasing adherence should possibly target these beliefs that have developed after patients have started their therapy.

Additional feedback did not attenuate the negative influence of aversive feedback in the case of response rate, neither did those in the combined feedback condition recovery significantly differently to those in the auditory or visual conditions. This suggests that giving additional feedback on recovery is unlikely to influence adherence.

7.5.4 Limitations

7.5.4.1 Sample

The sample used in this study consisted of students. Therefore they were likely to be better educated than the general population. Whilst it has been found in some research that those with higher education are likely to be less adherent (Sluijs, Kok, & van der Zee, 1993), the majority of research that has looked at the effect of education on adherence has found no influence (Alexandre et al., 2002; Belza et al., 2002; Seçkin, Gündüz, Borman, & Akyüz, 2000). This sample were also comparatively young. Similar to the research on education, some find that younger age was associated with decreased adherence (Oldfors Engstrom & Oberg, 2005; Sluijs et al., 1993), but the majority of research found no association between age and adherence (Alexandre et al., 2002; Belza et al., 2002; Kolt & McEvoy, 2003; Lowdermilk, Panus, & Kalbfleish, 1999; Oldfors Engstrom & Oberg, 2005; Preisinger et al., 1996; Rejeski et al., 1997).

Therefore, although this sample were comparatively young and well educated, on balance research suggests that this should not have influenced the adherence behaviour recorded in this study.

7.5.4.2 Nature of the Simulation of Physiotherapy

As discussed in chapter 5, simulation studies have been criticised for having limited external validity (e.g. Coolican, 2004). However, one of the primary aims of this study was to investigate whether aversive feedback could affect behaviour during the simulation. The use of simulation studies for this purpose has been supported (Berkowitz & Donnerstein, 1982; Henshel, 1980; Mook, 1983).

However, despite the fact that the design of this study aimed to simulate as many aspects of physiotherapy as possible, a number of aspects could not be addressed. For example, the length of participation in this study was a maximum of 1½ hours. This was obviously considerably different to real life physiotherapy where patients may have to spend time every day for a number of weeks (or months) on their treatment. In addition to this, the participants in this study could only vary how often they performed the physiotherapy exercises. In real world physiotherapy, patients can vary how long they perform their physiotherapy for, how accurately they follow the instructions for each exercise and how often they performed their physiotherapy for.

The field study (reported in chapter 8) therefore aimed to test whether the results found in this laboratory study were mirrored in real world physiotherapy.

7.5.5 Conclusions

Both cognitive and other variables appeared important to different aspects of adherence in this study. The findings showed that aversive feedback directly influenced how fast the participants responded and that cognitive variables determined persistence at the simulation task. These findings have theoretical implications in that both cognitive and additional variables have been shown to be important to behaviour whilst carrying out the simulation. The findings also suggested that cognitions can change from baseline to early points within the simulation and that these cognitions that have been formed after experience of the task were better predictors of adherence behaviour. The fact that cognitions could change and that these later cognitions were better predictors of adherence behaviour, suggested that interventions aimed at changing cognitions might be a viable way to influence adherence behaviour. Clinicians may find it helpful to address both cognitive beliefs and the influence of the aversive feedback that a patient may receive in the form of pain when completing their exercises during attempts to increase adherence (and recovery).

CHAPTER 8: FIELD STUDY

8.1 Rationale and Aims

The primary aim of this field study was to test the findings of the laboratory studies (reported in chapters 6 and 7) in a real world setting by testing the influence of cognitive (self-efficacy, outcome expectations and anticipated problems with physiotherapy) and other variables (affective state and aversive feedback (pain)) on adherence to physiotherapy. Conducting this research in a field setting benefits from higher ecological validity than the previous laboratory studies.

8.2 Introduction to the Study

The participants in the current study were physiotherapy patients who had been referred to the physiotherapy department at Southampton General Hospital for treatment of musculoskeletal problems. Their task as patients was to carry out physiotherapy exercises in the physiotherapy gym and/ or at home as prescribed by their physiotherapist. As a participant in this study, they were asked to complete questionnaires at various points though their treatment.

8.2.1 Hypotheses

8.2.1.1 Persistence

Based on the results of the laboratory studies and the literature (e.g. Brady, Tucker, Alfino, Tarrant, & Finlayson, 1997; Brewer et al., 2003; Copeland & Brandon, 2000; Poulton, Trevena, Reeder, & Richards, 2002; Resnick, Palmer, Jenkins, & Spellbring, 2000; Taylor & May, 1996; Yeung & Hemsley, 1997), it was hypothesised that increased self-efficacy and outcome expectations and less anticipated problems would be associated with increased adherence in terms of persistence over time on the physiotherapy programme (equivalent to persistence in the laboratory studies).

8.2.1.2 Adherence during each Bout of Physiotherapy

Based on the results of the laboratory studies and on the literature that suggested that aversive feedback would have a negative effect on performance of physiotherapy (e.g.

Byerly, Worrell, Gahimer, & Domholdt, 1994; Flor, Knost, & Birbaumer, 2002; Rejeski, Ettinger, Martin, & Morgan, 1998; Waddell, Newton, Henderson, Somerville, & Main, 1993; Williams, 2001), it was hypothesised that increased reported pain would be associated with poorer adherence in terms of the amount of time spent on each bout of physiotherapy (analogous to response rate in the laboratory studies).

It has also been suggested that affective state may influence adherence (e.g. Armitage, Conner, & Norman, 1999; Ayres et al., 1994; Belza, Topolski, Kinne, Patrick, & Ramsey, 2002; Salovey & Birnbaum, 1989; Suter & Marti, 1992). However, the results of the main laboratory study suggested that although positive affective state was associated with persistence and recovery, once other variables had been controlled for, affective state did not add to the variance explained. Negative affective state was not associated with any of the adherence measures in the laboratory studies. The current study therefore aimed to test the hypothesis that increased positive affective state and decreased negative affective state would be associated with better adherence in terms of the amount of time spent on each bout of physiotherapy.

8.2.1.3 Recovery

The results of the laboratory studies suggested that both cognitive and other variables would be important to recovery. It was therefore hypothesised that increased self-efficacy, outcome expectations, fewer anticipated problems with physiotherapy and lower pain would be predictive of recovery. There was no relationship between affective state and recovery in the laboratory studies, although the literature suggests that affective state may influence adherence. The hypothesis that this research sought to test was increased positive affective state, decreased negative affective state and lower reported pain would be related to increased self-reported recovery.

8.3 Method

8.3.1 Design

A longitudinal design was used to determine the predictors of adherence to physiotherapy over an 8 week period. As in the laboratory study, measures of cognitions about the task and affective state were taken. In the current study, aversive feedback in the form of pain was measured rather than manipulated as it was in the laboratory. Measurement of these

cognitions and additional variables (affective state and pain) were made at baseline and after early experience of physiotherapy (2 weeks) and 8 weeks from the start of treatment. As in the laboratory study, a number of different adherence measures were employed. Measures for the current field study were chosen that resembled those of persistence, response rate and recovery that were used in the laboratory.

The independent variables used for the analyses were: outcome expectations, with three subscales; assessing social expectations (pleasing the physiotherapist), self-evaluative expectations (sense of accomplishment) and task expectations (experience of pleasantness / aversiveness if task); self-efficacy for exercise (Resnick et al., 2000); positive and negative affective state (Diener, Larsen, Levine, & Emmons, 1984); and Anticipated Problematic Experiences of Therapy Scale (APETS; based on Yardley & Kirby, 2006). All of these variables were ordinal (see table 42 below for possible range of scores, means and standard deviations).

8.3.1.1 Measurement of adherence

As mentioned above, in order to keep the laboratory and field study as comparable as possible, it was planned that the adherence measures used in the field study should map onto those used in the laboratory study. For this reason, measures of persistence at the overall length of therapy, rate of exercising and recovery were elicited from the participants. The first planned persistence measure consisted of a comparison of the self reported length of therapy completed with the self reported duration of therapy prescribed at baseline (for both gym and home-based components of treatment). The second planned persistence measure was a comparison of the number of weeks the participant had attended appointments at the physiotherapy department for (an objective measure collected from patient records) with self reported duration of attendance prescribed at baseline (for gym based patients only). However, on calculating both these measures a number of problems were encountered.

The first problem that was encountered whilst calculating the self-report home based treatment persistence measure was that whilst 78 participants had answered the question relating to the length of their prescribed treatment at home at baseline, 37 had responded that they were 'not sure' how long their physiotherapy had been recommended for. Together with missing data at week 8, this left only 36 participants with a calculable score for the self-report persistence measure. A second problem with this measure was that it

did not take into account whether the length of treatment had been changed mid-treatment. Therefore, a participant could have been recorded as less adherent to the treatment that they were prescribed, whereas this may reflect a quicker than expected recovery and therefore completion of treatment. Similarly, a participant could have been recorded as more adherent than prescribed, whereas this may reflect a slower than anticipated recovery and a need for extended treatment. Examination of the scores attained by the 36 participants who supplied sufficient data for this variable to be calculated, only 1 participant was recorded as less adherent, while 13 performed the initially recommended amount and 22 appeared more adherent. It was therefore likely that treatment was extended in many of the cases. As a result of the problems described here, analyses using this persistence measure for home-based physiotherapy were not conducted. The measurement of persistence at therapy is instead partly captured in the Problematic Experiences of Therapy Scale (PETS; discussed below).

In addition to these problems encountered with the self report measure, the following problems were encountered with the measure of attendance at gym appointments. Only 12 participants knew how long they had been prescribed treatment for in the gym at baseline. Twenty nine reported that they were 'not sure' how long they had been prescribed treatment in the gym for and an additional 29 indicated on their questionnaires that they were not being treated in the gym. After taking into account objective data being unavailable from the physiotherapy department for some participants, there were only 9 participants available for analysis for the objective measure of persistence in the gym. Examination of other questions pertaining to gym treatment revealed a maximum of 26 participants were prescribed treatment in the gym. Due to the small sub-sample receiving treatment in the gym, no analyses were conducted on gym-based treatment.

Creating a ratio of the time spent on each bout of physiotherapy of that prescribed at baseline, provided a measure of how well participants followed recommendations within each bout of physiotherapy.

Instead of a specific measure of persistence, two more general retrospective measures of adherence had to be employed. The Problematic Experiences of Therapy Scale (PETS) and an item assessing frequency of skipping physiotherapy (see materials section 8.3.2 below) both reflect a combination of how long the participants persisted with their physiotherapy and how well they completed the physiotherapy when they did complete it, and therefore gave a partial indication of the relationship between the predictor variables

and persistence. However, neither the PETS nor the single item regarding frequency of missed therapy specifically distinguish whether skipping therapy relates to skipping some exercises within one bout of physiotherapy, skipping one session or stopping therapy completely. To the extent that these measures can therefore reflect aspects of both persistence and how well the instructions for each bout of physiotherapy are followed, these measures are similar to the recovery measure used in the laboratory studies.

As in the laboratory study, a measure of recovery was used. However, in the laboratory study recovery was a direct function of response rate and persistence; in the field, subjective recovery was likely to have been influenced by medical and psychological factors as well as adherence to treatment. Therefore, the results of the recovery analyses could not be directly compared with those from the laboratory study.

The principle inclusion criteria were that the participant had been referred to the physiotherapy department at Southampton General Hospital for treatment of a musculoskeletal problem. The study aimed to assess adherence to physiotherapy, therefore will recruited those undergoing a new course of physiotherapy. The principle exclusion criteria were a diagnosis of rheumatoid arthritis (as rheumatoid arthritis is an autoimmune disease and is routinely examined separately to osteoarthritis; e.g. Baker et al., 2001; Seçkin, Gündüz, Borman, & Akyüz, 2000; Ettinger et al., 1997) or other chronic medical conditions requiring physiotherapy, as the factors that are important to adherence to physiotherapy in chronic conditions are likely to be different to those in acute conditions. Participants with osteoarthritis and chronic pain were included in the study as excluding them would have left only a small sub-sample of the patients treated at the physiotherapy department. Participants under the age of 18 were also excluded to ensure that all participants are above the legal age at which they can give their own consent.

8.3.2 Materials

8.3.2.1 Measures of Adherence

8.3.2.1.1 Time per bout of physiotherapy.

This measure described how long the participants' carried out their physiotherapy for during each bout of physiotherapy (*time per bout of physiotherapy*). Time spent on each bout of physiotherapy scores were determined by comparing the baseline measures of length of each bout of physiotherapy to the week 8 measures of how long the

physiotherapy was carried out for on a 4-point likert scale ranging from '1-5 minutes' to 'over 45 minutes'. The score given at baseline was subtracted from the score given at 8 week follow-up (e.g. week 8 '6-20 minutes' = 2; baseline '21-45 minutes' = 3; 2 – 3 = -1). Therefore, a score of 0 indicated carrying out the prescribed amount of therapy per bout, a negative score indicated carrying out less than was prescribed and a positive score was indicative that the participant had completed more than was initially prescribed.

8.3.2.1.2 Problematic experiences of therapy scale (PETS).

The Problematic Experiences of Therapy Scale (PETS; see questions 1 -11 in appendix Q; Yardley & Kirby, 2006) is a general adherence measure that was completed by participants at week 8. This questionnaire asked participants about their adherence behaviour in terms of how often they skipped therapy due to 11 socially acceptable reasons. These reasons were divided into problems related to symptoms (3 items), therapy (5 items) and practical problems (3 items). Participants were asked how much they agreed that the problems listed interfered with carrying out their physiotherapy (for example; 'I had to skip the therapy because it made my symptoms worse'; see appendix Q), responding on a scale from 1 (agree strongly) to 5 (disagree strongly). A high score on this scale therefore indicated that the participant had not found that any of the problems listed had interfered with the performance of their physiotherapy. However, a participant need only experience one problem for it to theoretically be reason enough for them to stop physiotherapy. Therefore, a relatively high score on this scale may not have indicated adherence.

Due to the fact that the data for this scale was skewed to such an extent that transformations of the data were not effective, a median split was carried out on this measure; resulting in participants being classed as high (more adherent) or low (less adherent) on this scale. The median score was 51.5 (possible score 11-55). Answering that they strongly agreed that one problem had interfered would result in a maximum possible score of 51, and a classification as less adherent. High scorers had therefore encountered a maximum of three problems which they had dropped one or two points on (i.e. responded 'disagree' or 'not sure' rather than 'strongly disagree'), or had encountered just one problem which they had dropped three points on (i.e. responded 'agree' that the problem had interfered). The scale as a whole attained an acceptable alpha value of 0.89. All the subscales also achieved acceptable alpha values; symptoms subscale 0.89; therapy subscale 0.87; practical subscale 0.93.

8.3.2.1.3 Frequency of skipping physiotherapy.

The next general adherence measure was a single item measure that asked participants at 8 weeks how often they had skipped physiotherapy at home on a 5-point likert scale ranging from 1 = 'very often (daily, or most days)' to 5 = 'never' (see question 15 in appendix Q).

8.3.2.1.4 Recovery.

Participants were required to make an assessment of their subjective recovery on a 5 point likert scale ranging from 1 = 'no progress towards recovery' to 5 = 'totally recovered' (see question 19 in appendix Q).

8.3.2.2 Self-Efficacy Questionnaire

Selection of the self-efficacy measure was based on the criteria that the scale must be applicable to physiotherapy, and that it should be quick to complete (as this questionnaire would form part of a larger batch of questionnaires). The self-efficacy measure that fit these criteria and was used in this study was the Self-Efficacy for Exercise scale (SEE; Resnick et al., 2000). This measure was designed for use in the field of exercise and has been shown to have a good Cronbach's alpha of 0.92 (Resnick et al., 2000). So as to make the questionnaire relevant to the current study, the question stem 'How confident are you right now that you could exercise 3 times per week for 20 minutes if:' was changed to 'How confident are you right now that you could complete your physiotherapy if:'. The stem has been successfully changed in previous research (Gleeson-Kreig, 2006). One of the items was excluded from the scale as used in this study as it was deemed not relevant to the completion of physiotherapy indoors (i.e. 'the weather was bothering you'). The final scale used in this study consisted of eight questions which included potential problems such as "you were bored with the programme or activity" and "you did not enjoy it". Participants were required to indicate how confident they were that they could complete their therapy even if they encountered each of the potential problems listed on 11 point likert scales (0 = not very confident; 10 = very confident). Therefore a high score indicated high self-efficacy. In the current study, the SEE achieved a Cronbach's alpha of 0.91 (see appendix R).

8.3.2.3 Outcome Expectations Questionnaire

The outcome expectations questionnaire used the same questionnaire as that used in the previous laboratory studies and is detailed in chapter 6 (see section 5.4.3.1.2). However, to make it relevant to the physiotherapy patients, the questions were changed from relating to the experimenter (social subscale) and simulation (self-evaluative and task subscales) to the physiotherapist (social subscale) and physiotherapy (self-evaluative and task subscales). As in the laboratory studies, the questionnaire was scored such that a high score equated to more positive outcome expectations. The initial Cronbach's alpha for this scale at baseline was 0.61. The self evaluative subscale achieved a very poor alpha value (-0.06) and was therefore removed to achieve acceptable alpha values (whole scale = 0.70; social sub-scale = 0.84 (this subscale did not reach acceptance in the pilot study, suspected to be due to small sample size); task sub-scale = 0.82; see appendix S).

8.3.2.4 Anticipated Problematic Experiences of Therapy Scale (APETS)

The APETS (see appendix T) was created to assess the possible problems that participants thought they may encounter whilst carrying out their physiotherapy. The problems reported in this questionnaire map directly on to the Problematic Experiences of Therapy Scale used as a measure of adherence (described above in section 8.3.2.1.2). This scale described 11 possible problems that participants may encounter whilst attempting to carry out their physiotherapy and asked participants to consider how much they expected to encounter the given experiences. This scale consisted of three subscales; problems related to symptoms (3 items), the therapy itself (5 items) and practical problems (3 items). Participants were required to indicate how much they expected the experiences listed on a five point likert scale (1 = Agree strongly; 5 = Disagree strongly). Items included: "I expect the therapy will make my symptoms better" and "I expect the therapy will take a lot of time". Items were scored such that a high score indicated higher expectations about the therapy. At baseline the subscales relating to symptoms and therapy achieved acceptable Cronbach's alphas values of 0.64 and 0.85 respectively. The practical subscale had an unacceptable alpha value of 0.27, however once item 10 had been removed the alpha value was raised to 0.75. The initial scale (including item 10) alpha was 0.76; final scale (minus item 10) had an acceptable alpha value of 0.75.

8.3.2.5 Affective State Questionnaire

The affective state questionnaire was the same as that used in the previous laboratory studies and is described in chapter 6 (see section 6.4.3.1.3). The Cronbach's alpha for the positive and negative aspects of this scale at baseline assessments were 0.94 and 0.91 respectively (see appendix G).

8.3.2.6 Pain Questionnaire

Selection of the pain measure was based on the criteria that it must provide an indication of the severity of pain and should also be relatively short (as this questionnaire would form part of a larger batch of questionnaires). The short form of the Brief Pain Inventory (BPI; Cleeland, 1991) was selected for use based on these criteria. The questionnaire consists of two main sections. The first comprises of four questions that relate to the intensity of pain experienced over the past 24 hours, such as "please rate your pain by circling the one number that best describes your pain at its worst in the last 24 hours". Participants were required to indicate on an 11 point likert scale in intensity of their pain (0 = no pain; 10 = pain as bad as you can imagine). These questions make up the intensity subscale and a higher score indicated a worse pain rating. The second comprises of seven questions, each relating to an aspect of life in which pain may interfere, such as "general activity" or "sleep". Participants were required to indicate on an 11 point likert scale how much their pain had interfered with each item (0 = does not interfere; 10 = completely interferes). These questions make up the interference subscale and a higher score indicated more interference. The BPI was originally designed for use in cancer patients but has been validated in arthritis and lower back pain patients (Keller et al., 2004). In previous research in arthritis patients, Cronbach alpha values of 0.89 and 0.95 were achieved for the severity and interference subscales respectively. In lower back pain patients the Cronbach alpha values achieved were 0.82 and 0.93 respectively (Keller et al., 2004). In the current study, Cronbach alpha values of 0.89 were obtained for the both the severity and interference subscales (see appendix U).

8.3.2.7 Additional Baseline Physiotherapy Measures

At baseline the participant's were asked to supply their age and gender, and details about their injury and physiotherapy. The first two questions asked for the date of their first appointment and when they were completing the questionnaire to check that they were

completing the questionnaires at the start of their treatment. They were asked whether they have had this type of physiotherapy or injury before (yes / no), what injury they had (open ended), how long they had had this injury for (in years, months and weeks). Two further questions asked how long they had been asked to spend on each bout of physiotherapy, on a 4-point likert scale ranging from '1-5 minutes' to 'over 45 minutes' (see appendix V).

8.3.3 Procedure

The study was approved by both the University of Southampton School of Psychology Ethics Board and Southampton and South West Hampshire Local Research Ethics Committee. Participants were invited to take part in the study by one of two methods. If their first appointment was booked in writing, participants were sent an information sheet and consent form inviting them to take part in the study and a screening questionnaire from the physiotherapy department (see appendices W and X respectively). Participants who expressed an interest in the study (by returning the screening questionnaire to the researcher), and who met the inclusion criteria, were sent the baseline pack of questionnaires by the researcher and asked to complete them within 2 days of their first appointment. This baseline pack of questionnaires contained a cover letter and the measures of participant characteristics, information about their physiotherapy, outcome expectations, self-efficacy, APETS, affective state and pain (as described in the section 8.3.3 above; see appendices G, R, S, T, U, V and Y). Those that did not meet inclusion criteria were sent a letter that explained why they were ineligible and thanked them for their time (see appendix Z). If their first appointment was booked by telephone, participants were given the cover letter, information sheet and consent form, screening questionnaire and baseline pack of questionnaires at their first physiotherapy appointment by their physiotherapist (see appendices AA, AB, AC, G, R, S, T, U and V). Those participants who returned their screening questionnaire and baseline pack of questionnaires to the researcher were checked for eligibility. Those who did not meet the inclusion criteria were sent a letter that explained why they were ineligible and thanked for their time.

Two weeks after their initial appointment, all participants were sent the second batch of questionnaires. These contained the cover letter, and measures of outcome expectations, self-efficacy, APETS, affective state and pain (as described in the section 8.3.3 above; see appendices AD, G, R, S, T and U).

Eight weeks after their initial appointment, participants were sent the final batch of questionnaires. These contained a cover letter, and measures of adherence (PETS and physiotherapy details), outcome expectations, self-efficacy, affective state and pain (as described in the section 8.3.3 above; see appendices AE, G, Q, R, S, U).

If the participants failed to return questionnaires after 1 week at any point through the study, they were sent a reminder containing the appropriate questionnaires again (see appendix AF for each of the reminder cover letters). If the questionnaires had still not been returned after another week, the participants received a phone call asking whether they had received the questionnaires and whether they still wished to take part.

On completion of the data analysis, the participants were sent a debrief thanking them for their participation and informing them of the results of the study (see appendix AG for a copy of the debrief).

Two posters advertising the study were put up in the waiting area of the Physiotherapy department at Southampton General Hospital (see appendix AH) as research has shown that such advertising can increase participation (Reiso, Baltch, & Smith, 2004; Simpson et al., 2000).

On completion of data collection, the researcher collected information on the duration of treatment, number of appointments scheduled and those attended for all those participants who had completed their physiotherapy treatment (this data was not available to the researcher if treatment was ongoing or if records had been transferred to another location).

8.3.4 Participants

Between April 2005 and April 2006 551 invitation letters were sent out from the physiotherapy department to participants who had their first appointment booked in writing and 592 invitation packs were given out by physiotherapists to participants at their first physiotherapy appointment. One hundred and thirty seven patients expressed an interest in taking part in the study. Of these, 31 were excluded from the study (under 18 years of age $n = 4$; chronic condition requiring physiotherapy (other than chronic pain or osteoarthritis) $n = 6$; had not started physiotherapy recently $n = 2$; no contact details supplied $n = 3$; not prescribed physiotherapy at first appointment $n = 8$; were taking part

or had recently taken part in other research $n = 8$). A further 25 did not return baseline measures (these participants had their first appointment booked in writing so had expressed an interest in the study before seeing the first questionnaire pack). The final sample consisted of 81 participants; 30 males, 51 females. The age range for the sample was 20 - 79 (mean = 49.07, SD = 16.07). Participants had had their injury / condition for between 1 week and 30 years; mean = 120.06 weeks (2.31 years), SD = 250.43 weeks (4.82 years). Eighteen participants had had physiotherapy before, 61 had not (2 participants did not supply this data). Sixteen participants had had the same injury / condition before, 60 had not (5 participants did not supply this data). There were a variety of different types of injuries reported; neck ($n = 4$); knee ($n = 9$); shoulder ($n = 10$); hand/wrist ($n = 16$); spine/ back ($n = 9$); foot/ ankle ($n = 3$); arm ($n = 5$); hip ($n = 3$); rib ($n = 1$); osteoarthritis ($n = 5$); lower back pain ($n = 3$); leg ($n = 4$); osteoporosis ($n = 1$); repetitive strain injury ($n = 1$); jaw ($n = 1$); multiple ($n = 6$). Fifty of the participants reported having a chronic condition whilst 31 did not. Of those who had a chronic condition, 14 had osteoarthritis, 11 had pain, 2 had sciatica, and the remaining four participants had osteoporosis, tendonitis, hypermobility syndrome or cervical spondylitis.

8.4 Results

Participants' data was excluded from specific analyses if one entire questionnaire scale was not completed on any occasion. Where parts of a scale had missing data, data was replaced with total sample means. Parametric assumptions were checked using skewness scores. All scores were normally distributed except frequency of skipping therapy and PETS (as discussed above, no transformations were effective therefore a median split was performed on this variable). Frequency of skipping therapy was reflected and had a square root transformations performed on it which resulted in it being normally distributed.

Table 22

Breakdown of number of participants available for analyses and means and standard deviations and possible scores for questionnaire measures

Questionnaire measure (possible score range)	Number of participants missing entire scale	Total sample for analyses	Mean	SD
Predictors				
Baseline Outcome expectations (total; 0 – 36)*	2	79	24.64	4.94
Week 2 Outcome expectations (total; 0 – 36)*	11	70	24.40	4.87
Baseline Social outcome expectations (0 – 18)*	2	79	14.85	3.04
Week 2 Social outcome expectations (0 –18)*	11	70	14.71	3.16
Baseline Task outcome expectations (0 – 18)*	2	79	9.80	3.67
Week 2 Task outcome expectations (0 – 18)*	11	70	9.69	3.55
Baseline Self-efficacy (0 – 80)*	4	77	51.65	15.51
Week 2 Self-efficacy (0 – 80)*	9	72	50.01	16.16
Baseline Positive affective state (0 – 24)*	2	79	12.89	5.57
Week 2 Positive affective state (0 – 24)*	9	72	12.81	5.79
Baseline Negative affective state (0 – 30)*	2	79	9.00	7.86
Week 2 Negative affective state (0 – 30)*	9	72	8.20	6.67
Baseline Anticipated Problematic experiences of Therapy (APETS; 10 – 50)*	1	80	36.77	5.72
Week 2 APETS (10 – 50)*	9	72	37.97	4.08
Baseline Pain (0 – 40)*	2	79	13.63	7.15
Week 2 Pain (0 – 40)*	9	72	14.22	8.53
Baseline Pain interference (0 – 70)*	2	79	24.51	15.66
Week 2 Pain interference (0 – 70)*	10	71	23.70	16.54
Outcome variables				
Time per bout of physiotherapy at home (-3 – 3) †	21	60	0.30	1.05
Problematic Experiences of Therapy (PETS; 11 – 55) †	17	64	48.58	7.04
PETS symptoms subscale (3 – 15) †	16	65	13.34	2.59
PETS therapy subscale (5 – 25) †	15	66	23.12	2.85
PETS practical subscale (3 – 15) †	16	65	12.13	3.21

Frequency of missed physiotherapy (1 – 5) †	15	66	3.79	1.10
Subjective recovery (1 – 5)*	14	67	2.84	0.95

Note. * low score = low expectations / anticipated problems etc; † low score = low adherence

The information about the treatment received by the participants collected from the physiotherapy department records was available for 54 of the 81 participants. The length of treatment for these participants ranged between 1 and 38 weeks, with a mean of 11.76 (SD = 8.19). The number of appointments that the participants had during their treatment ranged from 1 to 37, with a mean of 7.91 (SD = 7.49). Eight participants did not attend one or two of their appointments (without rescheduling). Of these, five were subsequently discharged due to the physiotherapy department receiving no further contact from the patient; the remaining three participants did respond to attempts made by the physiotherapy department to contact them and continued their treatment. The overall percentage of appointments attended of those scheduled was 96.64%.

The data analyses are presented in a similar manner to those in the laboratory study. Each section relates to one aspect of adherence behaviour. The first section describes how long the participants' carried out their physiotherapy for during each bout of physiotherapy (*time per bout of physiotherapy*). The second section presents analyses relating to general adherence assessed by self-reported Problematic Experiences of Therapy (*PETS*) and frequency of physiotherapy that was missed (*frequency of skipping physiotherapy*). The last section relates to the level of perceived recovery achieved (*subjective recovery*).

To check whether any of the patient characteristics as assessed at baseline were related to the outcome measures (the three adherence measures and self-report perceived recovery), correlations, ANOVA and χ^2 analyses were carried out as appropriate. There were no significant associations between any of the adherence measures or subjective recovery and: gender (time per bout of physiotherapy - $F_{(1,59)} = 0.03$, *ns*; PETS - $\chi^2 = 2.40$, df = 1, *ns*; frequency of skipping physiotherapy - $F_{(1,65)} = 1.31$, *ns*; subjective recovery - $F_{(1,66)} = 0.11$, *ns*); whether the participants had had physiotherapy before (time per bout of physiotherapy - $F_{(1,58)} = 0.03$, *ns*; PETS - $\chi^2 = 0.43$, df = 1, *ns*; frequency of skipping physiotherapy - $F_{(1,64)} = 0.28$, *ns*; subjective recovery - $F_{(1,65)} = 0.87$, *ns*); whether the participants had a chronic or acute injury (time per bout of physiotherapy - $F_{(1,59)} = 1.10$, *ns*; PETS - $\chi^2 = 0.61$, df = 1, *ns*; frequency of skipping physiotherapy - $F_{(1,65)} = 0.19$, *ns*; subjective recovery - $F_{(1,66)} = 0.76$, *ns*); and whether the participants had had the injury

before (time per bout of physiotherapy - $F_{(1,56)} = 0.00$, *ns*; PETS - $\chi^2 = 1.02$, df = 1, *ns*; frequency of skipping physiotherapy - $F_{(1,62)} = 3.87$, *ns*; subjective recovery - $F_{(1,63)} = 0.10$, *ns*). Age was related to some outcome measures, in that the older participants were more adherent on two of the adherence measures (*time spent on each bout of physiotherapy at home* ($r = 0.31$, $p = .02$), and *PETS* ($F_{(1,63)} = 6.61$, $p = .01$; higher adherence mean age 55.16, lower adherence mean age 45.38)). Age did not correlate with recovery ($r = 0.13$, *ns*) or how often participants reported having skipped therapy ($r = 0.13$, *ns*). Length of injury prior to beginning treatment was unrelated to the adherence measures (*time per bout of physiotherapy-* $r = -0.22$, *ns*; *PETS-* $F_{(1,60)} = 0.82$, *ns; and frequency of skipping physiotherapy-* $r = -0.06$, *ns*) or recovery ($r = -0.05$, *ns*). As a result, age was controlled for in those analyses that were concerned with *time per bout of physiotherapy*, and *PETS.*

8.4.1 Time Spent on each Bout of Physiotherapy

To investigate the predictors of the time spent on each bout of physiotherapy a series of correlations and partial correlations were carried out. Correlations looked at the association between baseline and week 2 questionnaire responses and week 8 time spent on each bout of physiotherapy. Partial correlations were then carried out that assessed the association between week 2 questionnaire responses and time spent on each bout of physiotherapy whilst controlling for baseline questionnaire responses. One-tailed tests were used as the expected direction of associations was predicted from the laboratory studies.

Table 23

Correlation values between questionnaire scores at baseline and week two and time spent on each bout of physiotherapy at home, and partial correlation values for week two (controlling for baseline scores) and time spent on each bout of physiotherapy at home.

	Baseline	Week 2	Week 2 controlling for baseline
Outcome expectations (total)	0.27*	0.21	-0.01
Self-efficacy	0.17	0.24*	0.17
APETS	0.03	0.30*	0.32*
Positive affective state	0.13	0.20	0.14
Negative affective state	-0.14	0.00	0.15
Pain	-0.22	-0.16	-0.05
Pain interference	-0.01	0.03	0.07

* $p \leq .05$ 1 tailed test

Table 23 shows that a number of the cognitions about treatment were significantly correlated with how long each bout of physiotherapy was carried out for. Outcome expectations were significantly correlated with time per bout at baseline, indicating that participants with higher outcome expectations at baseline spent more time completing their physiotherapy during each bout. At week 2, outcome expectations were still associated with time per bout in the same direction, however the relationship was no longer significant. Higher self-efficacy and APETS (less expected problems) at week 2 were significantly associated with more time spent per bout of physiotherapy. The partial correlation of week 2 APETS and time per bout controlling for baseline APETS was also significant, indicating that it was the change in expectations from baseline to week 2 that were more closely associated with this measure of adherence. Of the other variables, none revealed a significant association with time per bout spent on physiotherapy. However, the baseline associations were in the directions expected; higher positive and lower negative affective state and lower pain were associated with higher adherence. There was no discernable relationship between pain interference and this measure of adherence.

A follow up analysis was carried out that examined the relationship between the subscales of outcome expectations and the time spent on each bout of physiotherapy.

Table 24

Correlation values between subscales of outcome expectations questionnaire scores at baseline and week two and time spent on each bout of physiotherapy at home, and partial correlation values for week two (controlling for baseline scores) and time spent on each bout of physiotherapy at home.

	Baseline	Week 2	Week 2 controlling for baseline
Social outcome expectations	0.08	0.01	-0.07
Task outcome expectations	0.30*	0.28*	0.05

* $p \leq .05$ 1 tailed test

This analysis revealed that it was only the task subscale of outcome expectations that was associated with increased adherence to time per bout spent on physiotherapy. The social aspect of outcome expectations relating to pleasing the physiotherapist was unrelated to adherence.

As age was significantly correlated with time spent on each bout of physiotherapy, follow-up correlation and partial correlation analyses were conducted controlling for age. Week 2 negative affective state controlling for baseline measures ($r_p = 0.23$, $p < .05$) and baseline pain ($r_p = -0.28$, $p < .05$) became significantly correlated with the time spent on each bout of physiotherapy, while task outcome expectations at week 2 ($r_p = 0.19$, *ns*) was no longer significantly correlated with time spent on each bout of physiotherapy.

A stepwise multiple regression was carried out to further examine the relationship between the questionnaire measures at baseline and week two with adherence to the prescribed time for each exercise. As some of the relationships between the predictors and this measure of adherence changed after controlling for age, age was entered as a covariate into the first block. Baseline assessments of the physical subscale of outcome expectations and pain, week 2 self-efficacy, and baseline and week 2 negative affective state and APETS were added into the second block using the stepwise method as these had significant correlations and/or partial correlations with adherence after controlling for age. Age added significantly to the model. Week 2 self-efficacy and baseline pain were added to the final model (probability to enter- 0.1, probability to remove- 0.2). The overall model was significant ($F_{(3,55)} = 4.87$, $p < 0.01$) and could explain 22% ($r^2 = 0.22$;

adjusted $r^2 = 0.17$) of the variance in adherence to the prescribed time per bout of physiotherapy.

Table 25

Summary of multiple regression predictors for time spent on each bout of physiotherapy at home

Predictor	*B*	*SE*	β
Block 1 Enter			
Age	0.02	0.01	0.33**
Block 2 Stepwise			
Week 2 Self-efficacy	0.02	0.01	0.27*
Baseline Pain	-0.04	0.02	-0.23

* $p \leq .05$; ** $p \leq .01$

Table 25 shows that week 2 self-efficacy was the only significant individual predictor of adherence to the prescribed time for therapy. Baseline pain was also a marginally significant individual predictor of time spent per bout of physiotherapy. Higher self-efficacy at week 2 and lower pain at baseline predicted better adherence to prescribed time for therapy.

As both cognitive and other factors were related to time spent on each bout of physiotherapy, further analyses were conducted to test whether self-efficacy mediated the influence of pain. Sobel's (1982) test for mediation was conducted, however, the initial regression predicting week 2 self-efficacy from baseline pain was not significant ($F_{(1,68)} = 0.18$, *ns*). Therefore, week 2 self-efficacy did not mediate the effect of pain on time spent exercising per bout of physiotherapy.

8.4.2 General Adherence

8.4.2.1 Problematic Experiences of Therapy (PETS)

To test whether there were any differences in baseline and week 2 questionnaire measures in those that were low or high adherent (according to the median split of PETS) two repeated measures MANOVAs were carried out. The first MANOVA looked at differences in cognitions about treatment (outcome expectations, self-efficacy and APETS). The second MANOVA looked at the other variables (positive and negative

affective state, and pain). The analyses of cognitions about treatment are presented below first.

Table 26

Means and standard deviations for cognitions about treatment questionnaire scores at baseline and week two in those who were low adherent (n=31) and those who were high adherent (n=28).

		Baseline		Week 2	
		Low adherence	High adherence	Low adherence	High adherence
Outcome expectations					
	Mean	23.19	25.75	22.16	26.32
	SD	4.34	5.32	3.85	4.78
Self-efficacy					
	Mean	49.74	57.68	49.23	57.14
	SD	13.17	17.91	12.54	15.37
APETS					
	Mean	35.94	36.96	36.58	39.32
	SD	4.39	6.90	3.85	4.17

Table 26 shows that those classed as high adherers had higher baseline and week 2 outcome expectations and self-efficacy. The between participants analyses confirmed that there was a significant main effect of being classified as high or low adherent and the early cognitions about treatment ($F_{(3,55)} = 3.96$, $p = 0.01$). The univariate analyses revealed that the main effect was due to outcome expectations ($F_{(1,57)} = 8.87$, $p = 0.04$) and self-efficacy ($F_{(1,57)} = 5.25$, $p = 0.03$). Those participants who were later classified as being more adherent on the PETS reported higher early outcome expectations and self-efficacy.

The within participants effects revealed that there were no significant main effects of time ($F_{(3,55)} = 1.44$, *ns*) and there was no significant interaction between time and whether the participants were classified as high or low adherent on the PETS ($F_{(3,55)} = 1.86$, *ns*).

Follow up analyses that examined the scores on the subscales of the outcome expectations scale and those who were classed as low or high adherent on the PETS were carried out.

Table 27

Means and standard deviations for outcome expectations questionnaire scores at baseline and week two in those who were low adherent (n=31) and those who were high adherent (n=30).

	Baseline		Week 2	
	Low adherence	High adherence	Low adherence	High adherence
Outcome expectations – social subscale				
Mean	14.87	14.90	14.26	15.30
SD	3.22	3.03	3.43	2.71
Outcome expectations – task subscale				
Mean	8.32	10.67	7.90	10.97
SD	3.72	3.30	2.99	3.47

The pattern of results displayed in table 27 revealed that those classed as less adherent score similarly to the more adherent participants on the social subscale scores at both time points, but less adherent participants report lower task outcome expectations at baseline and week 2. Scores on both subscales remain relatively stable over time. The between participants comparisons confirmed a significant main effect of questionnaire responses between those classed as low and high adherent ($F_{(2,58)} = 5.61, p < 0.01$). The univariate tests showed that the scores on the task subscale were significantly higher in those that were more adherent ($F_{(1,59)} = 10.81, p < 0.01$). The within participants effects revealed no significant effect of time ($F_{(2,58)} = 0.09$, *ns*) nor an interaction between time and the responses of low and high adherent participants ($F_{(2,58)} = 2.36$, *ns*).

As the mean age of those classified as high and low adherers on the PETS was significantly different, a further repeated measures MANOVA was carried out that controlled for the effect of age (using all of the cognitions tested above, including the subscales of outcome expectations). The main effect of age was not significant ($F_{(4,53)} = 1.31$, *ns*) and the pattern of results did not change from the previous MANOVAs.

To determine which baseline and week 2 cognitions about treatment were independently related to being classified as high or low adherent on the PETS, all questionnaire measures that were significantly different between those who were high adherent and those who were low adherent in the MANOVA were entered into a stepwise logistic regression that predicted persistence. The task subscale of outcome expectations and self-efficacy at

baseline and week 2 were entered using the forward stepwise conditional method into the first block (probability to enter- 0.1, probability to remove- 0.2). One questionnaire measure made up the final model and could significantly predict persistence; task outcome expectations at week 2 ($\chi^2 = 12.64$, $df = 1$, $p<0.01$). Higher week 2 outcome expectations predicted persistence at physiotherapy. The overall model could explain 26% of the variance (Nagelkerke $R^2 = 0.26$) and could classify 69.5% of the cases correctly.

Table 28

Summary of logistic regression analysis for questionnaire measures predicting PETS

Predictor	*B*	*S.E.*	Wald
Block 1 Stepwise			
Week 2 Task outcome expectations	0.31	0.10	9.48**

** $p \leq .01$

The next repeated measures MANOVA tested whether there were any differences in other questionnaire measures (affective state and pain) at baseline and week 2 in those that were low or high adherent (according to the median split of PETS). The results of this MANOVA are presented below.

Table 29

Means and standard deviations for other questionnaire scores at baseline and week two in those who were low adherent (n=30) and those who were high adherent (n=30).

	Baseline		Week 2	
	Low adherence	High adherence	Low adherence	High adherence
Positive affective state				
Mean	12.97	13.11	12.60	13.10
SD	6.19	5.46	5.96	5.90
Negative affective state				
Mean	9.70	6.30	8.00	7.07
SD	7.38	6.78	6.37	7.08
Pain				
Mean	13.90	13.57	15.57	13.00
SD	6.72	7.31	8.87	8.07
Pain interference				
Mean	27.10	22.18	27.40	19.30
SD	14.92	16.88	17.50	16.25

The between participants analyses revealed that the main effects of adherence classification according to the PETS was not significant ($F_{(4,55)} = 1.02$, *ns*). The within participants effects also revealed no significant effect of time ($F_{(4,55)} = 1.12$, *ns*) and there was no significant interaction between time and adherence classification ($F_{(4,55)} = 2.03$, *ns*).

As the mean age of the participants who were classified as reporting high or low adherence on the PETS were significantly different, a further repeated measures MANOVA was conducted controlling for age. The between participants analyses revealed that there was a significant main effect of age ($F_{(4,54)} = 3.45$, $p = 0.01$). There were no changes to the pattern of results for the remaining between and within participants analyses.

As none of these questionnaire measures differed significantly between those participants that were classed as low or high adherent, no further analyses were conducted.

8.4.2.2 Frequency of Skipping Therapy

A further general adherence measure was the item relating to how often people skipped therapy at home. To analyse the relationship of the predictor variables to the frequency of missed therapy, correlations and partial correlations were carried out. The table 50 below reports the results of these analyses. One-tailed tests were used as the expected direction of associations with adherence was known from the laboratory studies.

Table 30

Correlation values between questionnaire scores at baseline and week two and frequency of skipping physiotherapy (self-report), and partial correlation values for week two (controlling for baseline scores) and skipping physiotherapy (self-report).

	Baseline	Week 2	Week 2 controlling for baseline
Outcome expectations (total)	-0.42**	-0.26*	0.15
Self-efficacy	-0.29**	-0.29*	-0.06
APETS	0.05	-0.09	-0.08
Positive affective state	-0.05	0.08	0.27
Negative affective state	0.22*	0.11	-0.13
Pain	-0.08	-0.18	-0.18
Pain interference	-0.05	-0.07	-0.06

* $p \leq .05$; ** $p \leq .01$ 1 tailed test. *Note.* A low score on this measure indicates high adherence as this measure has been reflected.

Of the cognitions about treatment, higher outcome expectations and self-efficacy at baseline and week 2 were significantly correlated with better adherence in terms of how often participants reported skipping physiotherapy. The non-significant partial correlations indicated that the level of cognitions rather than the change from baseline to week 2 was more important for this measure of adherence. The correlations of the other variables with skipping physiotherapy revealed that only baseline negative affective state was associated with less adherent behaviour. The partial correlation between week 2 positive affective state and frequency of skipping physiotherapy was not in the direction expected and therefore was not significant. There was little association of either aspect of pain with reporting skipping physiotherapy.

A follow-up analysis was conducted that examined the relationships between the subscales of outcome expectations and skipping physiotherapy. The results are presented below in table 31.

Table 31

Correlation values between subscales of outcome expectations questionnaire scores at baseline and week two and frequency of skipping therapy, and partial correlation values for week two (controlling for baseline scores) and frequency of skipping therapy.

	Baseline	Week 2	Week 2 controlling for baseline
Social outcome expectations	-0.15	-0.06	0.11
Task outcome expectations	-0.43**	-0.30**	0.09

* $p \leq .05$ 1 tailed test

The results of this analyses revealed that task subscale was the only subscale of outcome expectations that was associated with the frequency of skipping physiotherapy. Those participants who scored higher on baseline and week 2 task outcome expectations were less likely to report skipping physiotherapy at 8 weeks.

To test which of the predictor variables independently predicted whether participants reported skipping therapy, a stepwise linear regression was carried out. Baseline and week two task outcome expectations, self-efficacy and negative affective state at baseline were added into the first block using the stepwise method as these had significant correlations and/or partial correlations with skipping physiotherapy (probability to enter- 0.1, probability to remove- 0.2; positive affective state was not included in this regression due to the 1 tailed partial correlation not being in the direction expected). Baseline task outcome expectations and baseline self-efficacy contributed to the final model. The overall model was significant ($F_{(3,61)} = 9.03$, $p < 0.01$) and could explain 23% ($r^2 = 0.23$; adjusted $r^2 = 0.21$) of the variance in reported frequency of missed therapy.

Table 32

Summary of multiple regression predictors for reported skipping physiotherapy

Predictor	*B*	*SE*	β
Block 1 Stepwise			
Baseline Task outcome expectations	-0.05	0.01	-0.39**
Baseline Self-efficacy	-0.01	0.00	-0.24*

* $p \leq .05$; * *$p \leq .01$

Table 32 shows that baseline task outcome expectations and self-efficacy were significant individual predictors of skipping physiotherapy. Better task outcome expectations and self-efficacy at baseline predicted better adherence.

8.4.3 Subjective Recovery

To investigate the predictors of subjective recovery a series of correlations and partial correlations were carried out. The correlations looked at the association between baseline and week 2 questionnaire responses and week 8 subjective recovery. Partial correlations were then carried out that assessed the association between week 2 questionnaire responses and subjective recovery whilst controlling for baseline questionnaire responses. One-tailed tests were used as the expected direction of associations with adherence was known from the laboratory studies.

Table 33

Correlation values between questionnaire scores at baseline and week two and subjective recovery, and partial correlation values for week two (controlling for baseline scores) and subjective recovery.

	Baseline	Week 2	Week 2 controlling for baseline
Outcome expectations (total)	0.29**	0.24*	0.01
Self-efficacy	0.32**	0.29**	0.07
APETS	0.38**	0.43**	0.33**
Positive affective state	0.15	0.14	0.01
Negative affective state	-0.08	0.05	0.16
Pain	-0.14	-0.27*	-0.27*
Pain interference	-0.17	-0.17	-0.07

* $p \leq .05$; ** $p \leq .01$ 1 tailed test

The cognitions about treatment (outcome expectations, self-efficacy and APETS) revealed strong associations with subjective recovery, such that more positive cognitions were associated with better subjective recovery. The partial correlations indicated that it was the level of outcome expectations and self-efficacy rather than the change from baseline to week 2 that were more important to subjective recovery. However, the change from baseline to week 2 APETS was important to later subjective recovery. Of the other measures, only pain had a significant association with subjective recovery. The significant partial correlation showed that it was the change in pain reported at week 2 from baseline that was most important for subjective recovery. Positive affective state was related to increased subjective recovery, although not significantly. Pain interference was associated with decreased recovery although not significantly. There was very little association between negative affective state and subjective recovery.

Follow up analyses were carried out that examined the influence of each of the subscales of outcome expectations on subjective recovery.

Table 34

Correlation values between subscales of outcome expectations questionnaire scores at baseline and week two and subjective recovery, and partial correlation values for week two (controlling for baseline scores) and subjective recovery.

	Baseline	Week 2	Week 2 controlling for baseline
Social outcome expectations	0.14	0.07	-0.02
Task outcome expectations	0.27*	0.26*	0.06

* $p \leq .05$ 1 tailed test

This follow up analysis showed that the task subscale of outcome expectations was the only subscale that was associated with subjective recovery. Those participants who had higher task outcome expectations at baseline and week 2 reported better subjective recovery at week 8.

A stepwise multiple regression was carried out to examine the relationship between the questionnaire measures at baseline and week two with subjective recovery. Baseline and week 2 task outcome expectations, self-efficacy and expectations about treatment and pain were added into the first block using the stepwise method as these had significant correlations and/or partial correlations (probability to enter- 0.1, probability to remove- 0.2). Expectations about treatment at baseline and week two and baseline self-efficacy contributed to the final model. The overall model was significant ($F_{(3,61)} = 10.38, p < 0.01$) and could explain 35% ($r^2 = 0.35$; adjusted $r^2 = 0.32$) of the variance in recovery reported.

Table 35

Summary of multiple regression predictors for subjective recovery

Predictor	*B*	*SE*	β
Block 1 Stepwise			
Week 2 APETS	0.05	0.03	0.22
Baseline APETS	0.07	0.02	0.41**
Baseline Task outcome expectations	0.07	0.03	0.28*

* $p \leq .05$; ** $p \leq .01$

Table 55 shows that expectations about therapy and task outcome expectations at baseline were significant individual predictors of subjective recovery. Week 2 APETS was a marginally significant predictor of subjective recovery. Better expectations about the therapy score at baseline and week two and higher physical outcome expectations at baseline predicted more subjective recovery.

8.4.4 Summary of Results

The following table summarizes the main findings of this laboratory study.

Table 36

Summary of associations with and prediction of time spent exercising per bout of physiotherapy, Problematic experiences of therapy, frequency of skipping therapy and subjective recovery

	Time per bout		PETS		Skipping therapy		Subjective Recovery	
	Associated	Predicted	Associated	Predicted	Associated	Predicted	Associated	Predicted
Outcome expectations	✓+ (B)	×	✓+ (B & w2)	✓+ (w2)	✓+ (B & w2)	✓+ (B)	✓+ (B & w2)	✓+ (B)
Self-efficacy	✓+ (w2)	✓+ (w2)	✓+ (B & w2)	×	✓+ (B & w2)	✓+ (B)	✓+ (B & w2)	×
APETS	✓+ (w2)		×		×		✓+ (B & w2)	✓+ (B & w2)
Positive affective state	×		×		×		×	
Negative affective state	✓- (B)	×	×		✓- (B)	×	×	
Pain	✓- (B)	✓- (B)	×		×		✓- (B & w2)	×
Pain interference	×		×		×		×	

Note. ✓ = significant association or prediction; × = no significant association or prediction; + = higher (more positive score) associated with increased adherence; - = higher (more negative score) associated with decreased adherence; (B) = Baseline; (w2) = week 2.

Table 36 indicates that higher baseline outcome expectations, higher week 2 self-efficacy and expectations about therapy and lower baseline negative affective state and pain were associated with completing more time of that prescribed during each bout of physiotherapy. However, only higher week 2 self-efficacy and lower baseline pain independently predicted time spent exercising during each bout. Higher baseline and

week 2 outcome expectations and self-efficacy were associated with general adherence as measured by problematic experiences of therapy. Only higher week 2 outcome expectations independently predicted this measure of adherence. Higher baseline and week 2 outcome expectations and self-efficacy and lower baseline negative affective state were associated with less skipping of therapy. However, only higher baseline outcome expectations and self-efficacy independently predicted less skipping of therapy. Finally, more subjective recovery was associated with higher outcome expectations, self-efficacy, expectations about therapy and lower pain at baseline and week 2. However, only higher baseline outcome expectations and higher baseline and week 2 expectations of treatment were independently predictive of more subjective recovery.

8.5 Discussion

To begin this discussion, general information on the adherence of the sample is briefly discussed, followed by a consideration of the relationship of the predictor variables to the four different adherence measures. The theoretical and clinical implications are then presented, followed by a consideration of the limitations of this study and directions for future research.

Statistics on attendance at appointments revealed that nearly all of the scheduled physiotherapy appointments were kept (96.64%; $n = 54$). However, due to the fact that the majority of participants were prescribed home-based treatment, this statistic does not strictly reflect adherence to treatment. Rather than completing a bout of physiotherapy during the appointment, these sessions may have offered an opportunity for patient and physiotherapist to check on recovery progress and to discuss any problems with or changes to the treatment. Attendance at appointments may therefore have underestimated non-adherence to treatment. According to the self-report measures of adherence, 9 participants were less adherent than prescribed with regards to the amount of time spent on each bout of physiotherapy. Only 17 (of 66) reported that they had never missed physiotherapy at home whilst 31 reported that they had missed physiotherapy 'a few times' and the remaining 18 reported skipping physiotherapy more often than that. Similarly, only 18 participants reported the highest possible score on the PETS (indicating that no problems that they encountered interfered with performance of their physiotherapy). The category that seemed to cause most problems was the practical category (lack of time or tiredness). Therefore it appears that attendance statistics yielded the highest estimates of adherence.

8.5.1 Predictors of each Adherence Measure

8.5.1.1 Time Spent on each Bout of Physiotherapy

The hypotheses regarding the time spent on each bout of physiotherapy, based primarily on the results of the laboratory study, stated that pain would be related to this aspect of adherence. The results of the analyses showed that once age had been controlled for, lower baseline pain predicted better adherence to the time prescribed per bout of physiotherapy. The hypothesis for this adherence measure was therefore supported. In addition, higher self-efficacy at week 2 also independently predicted this measure of adherence. It is not entirely surprising that self-efficacy would also influence adherence, as an influence of self-efficacy on adherence behaviour has been previously reported (e.g. Brewer et al., 2003; Milne, Hall, & Forwell, 2005; Taylor & May, 1996).

Additional explanations as to why self-efficacy was also important to this aspect of adherence might be a reflection of the differences between the laboratory and field studies. The self-efficacy measure used in this field study included one item on the participants' belief that they could complete treatment even if the physiotherapy caused pain. Once the participants had experienced some physiotherapy (week 2), they were likely to have known whether pain would result from their physiotherapy and whether they believed they could continue physiotherapy despite the pain. Pain may therefore have become less relevant to adherence. Additionally, in the laboratory studies, aversive feedback was given each time that a physiotherapy exercise was completed (for those who received aversive feedback), whereas in the field study pain may not have been contingent with performance of physiotherapy. Therefore, if pain did not change as a result of performing physiotherapy, pain was less likely to influence adherence to physiotherapy.

Of the demographic characteristics of the participants, only age was related to time per bout of physiotherapy, in that the older participants reported better adherence. This finding is consistent with previous research (Oldfors Engstrom & Oberg, 2005; Sluijs, Kok, & van der Zee, 1993).

The bivariate correlations indicated that a number of the cognitions were significantly related to this measure of adherence (but were not significant individual predictors). With the exception of outcome expectations, week 2 cognitions were more strongly associated

with adherence than baseline measurements. This suggests that it was the cognitions that had developed after some experience of physiotherapy that were more important to this aspect of adherence behaviour. It was also found that task outcome expectations (pleasantness / aversiveness of the task itself) were the only aspect of outcome expectations that were important to adherence. Of the additional variables, positive affective state at week 2 was more strongly associated with adherence, whereas negative affective state and pain at baseline were more strongly associated with adherence. This indicated that it was very early levels of additional variables (negative affective state and pain) that were important to this aspect of adherence and that even though these may have changed after some treatment (baseline and week 2 negative affective state $r = 0.73$, $p < .01$ and pain $r = 0.57$, $p < .01$), the baseline levels still held an influence over behaviour.

8.5.1.2 General Adherence

8.5.1.2.1 Problematic Experiences of Therapy

Since the PETS assessed aspects of persistence and how well participants followed advice, the hypotheses regarding the PETS based on the findings from recovery in the laboratory stated that cognitive variables and pain would both be predictive of this aspect of adherence. Those who were more adherent had significantly higher task outcome expectations and self-efficacy at baseline and week 2 than those who were less adherent. As with the proportion of time spent on each bout of physiotherapy, it was the beliefs formed after experience of physiotherapy that were most important to adherence behaviour. The other variables, and in particular pain, were not associated with this measure of adherence in contrast to predictions.

Pain may not have been associated with adherence for similar reasons as those given cited for adherence to the time spent on each bout of physiotherapy; namely that the pain experienced in the field may not have been contingent on physiotherapy and therefore conditions necessary for learning were not met. In addition to this, pain might be accepted as a part of treatment by those participants in the field study, therefore their adherence may be less influenced by experiencing pain. Similarly, the motivation to recover may have been stronger in the participants undergoing physiotherapy; recovery for them was likely to have been more tangible and more of a motivating force than the chance of winning £20 in the laboratory. Perhaps in the laboratory the manipulation of aversive feedback produced a more obvious and immediate effect which acted as a stronger

learning stimulus, whereas pain may not have been equivalently aversive (to the aversive feedback in the laboratory) for all participants in the field. It may therefore be that although the laboratory study results indicated that aversive feedback (pain) would be the strongest predictor of adherence, in the field, where pain was more variable, other factors were more strongly associated with adherence. In addition to this, change in pain following correct adherence may not have been clearly linked to recovery; for example, on average, pain did not change between baseline and week 2 in the field study, whereas in the laboratory reduced aversive feedback was a direct result of adherence. Consequently, changes in pain may not have been associated with adherent behaviour, which would reduce the likelihood that pain would be predictive of further adherence.

8.5.1.2.2 Frequency of skipping therapy

The hypotheses regarding the frequency of skipping physiotherapy (based on recovery in the laboratory) also stated that both cognitive variables and pain would be predictive of adherence. The findings showed that of the cognitive variables, higher task outcome expectations and self-efficacy at baseline and week 2 were associated with adherence. Once again, it was the task rather than the social outcome expectations that were more strongly associated with adherence. Of the other variables, only lower baseline negative affective state was significantly associated with better adherence. Higher baseline task outcome expectations and self-efficacy were predicted adherence. Therefore, the hypothesis that both cognitive variables and pain would be important to this measure (which reflects persistence and how well instructions were followed within each session) was partially supported. As with the two adherence variables already discussed, pain may not have been related to this measure of adherence because: pain may not have been contingent on physiotherapy; pain may have been expected as a part of physiotherapy; increased motivation to recover in the field; aversive feedback in the laboratory was a stronger learning stimulus and change in pain may not have been contingent on correct adherence and indicative of recovery.

Regarding the hypothesis concerning affective state, it appeared that although negative affective state was important to the frequency with which participants skipping physiotherapy, it did not predict independently which suggests that additional variables did not influence this aspect of physiotherapy behaviour.

8.5.1.3 Subjective Recovery

Based on the previous literature and the laboratory studies it was hypothesised that subjective recovery would be explained by both cognitive variables and additional variables. The bivariate correlations showed that subjective recovery was significantly associated with some cognitive variables (task outcome expectations, self-efficacy and APETS) and pain at week 2. Only baseline and week 2 APETS and baseline task outcome expectations independently predicted subjective recovery. Therefore, the hypothesis was partially supported. Pain may not have influences subjective recovery for reasons discussed above. Affective state in this case, was not important to subjective recovery.

8.5.2 Limitations

The limitations of the current study are discussed below with reference to limitations of the measures that were used, the sample of participants that was recruited and limitations due to the nature of physiotherapy.

8.5.2.1 Measures Used

One of the main limitations of the current study was the necessary reliance on self-report measures. For practical reasons it was not possible to get objective measures of how long each participant was carrying out their physiotherapy at home. However, it has been found that self-report measures of adherence can yield similar estimates of adherence to objective measures (see chapter 2).

The planned persistence measure could not be used due to the fact that so many participants were unsure of how long their treatment would last at baseline. This lack of knowledge at baseline may reflect an uncertainty of the physiotherapist (rather than of the patient) as to how long treatment will need to be conducted for. In addition to this problem, the length of treatment could have changed once treatment had started, if the participants got better more quickly or slowly than expected, so if reports of length of treatment were given at baseline this could have led to inaccurate reports of adherence.

As discussed above (in section 8.3.2.1.2) the PETS recorded whether the participant's adherence was influenced by any of the problems listed. A high score on this measure may therefore not be a direct measure of adherence, as participants may have not adhered

well, but for reasons other than those included in this scale. Alternatively, participants need only to have encountered one of the listed problems for adherence to be very badly affected. An additional problem with this measure was that participants could not have recorded an over-adherent score.

Adherence may have been over/under estimated because of the categories used for the response scales for time spent on each bout of physiotherapy. For instance, participants could have been prescribed 45 minutes per bout, but actually only completed 25 minutes each time. Using the categorical response scales they would still have been classified as adherent. Using smaller categories (e.g. 5 minute intervals) or asking participants to report the number of minutes they were prescribed / completed would have given more accurate information. However, the distribution of the variables revealed that some people were less adherent than prescribed and some were over-adherent. This indicated that this measure was sensitive to different levels of adherence.

The measure for frequency of skipping physiotherapy had additional descriptors which may have restricted the options available to those participants who did not have to complete physiotherapy very frequently (e.g. once a week). For example, the least adherent category was 'very often (daily or most days)'. A participant may have been asked to complete physiotherapy once a week, but had missed physiotherapy very often, but may have recorded a more adherent score because they had not missed physiotherapy daily. Additional items for this measure would have also increased its reliability. It was also not possible for participants to record any over-adherent behaviour.

The pain measure used was a general measure of pain, rather than a measure of the pain caused by physiotherapy. Although this measure had some success at predicting adherence, a more specific measure in addition to the current one may help clarify whether pain caused by physiotherapy may have more of an impact on adherence than the general pain measured here. The fact that the pain measure used was general rather than specific may also explain part of the reason why pain was not as strongly associated with the adherence measures as was expected (as discussed above in section 8.5.1).

Due to practical restrictions, measurement of recovery was also self-report. However, it may be that a participant's perceptions of recovery are more important to their adherence than objective measures. The reliability of this measure would have been improved if it had had multiple items.

On calculating the total length of treatment and number of appointments attended of those prescribed, these data were not available for all participants. The reasons for this included the fact that some participants had not completed their treatment when data was collected, therefore their files were unavailable to the researcher. In addition, some notes were transferred to other facilities.

8.5.2.2 Sample

The participants who took part in the study reported a variety of different diagnoses, including some participants who had osteoarthritis and chronic pain. However, there were no significant differences in adherence between those had acute or chronic conditions.

A common problem that faces studies that rely on volunteers is that people who offer to participate may well differ from those who do not volunteer (Rosnow & Rosenthal, 1997). In the case of physiotherapy, volunteers may be more representative of a more motivated and possibly more adherent population than those who choose not to participate. Adherence rates may therefore be higher than in the general physiotherapy population. As a result, there may be less variation in the adherence scores, which may make investigating those factors that predict adherent behaviour more difficult and may influence the validity of findings.

There was a dropout rate of 14.81%, which was similar to that found in the systematic review of chapter 2 of 14.82%. Although dropout can potentially influence the findings of a study, the dropout rate is representative of other studies in the area of physiotherapy.

8.5.2.3 Nature of physiotherapy

The majority of participants' treatment lasted for less than 6 months (only 4 participants had treatment lasting over 26 weeks). Therefore, these findings only apply to relatively short-term treatment. As it has been suggested that maintenance of behaviour involves other mechanisms in addition to cognitive ones, the influence of pain / affective state might be underestimated in this study, as behaviour was carried out for only a relatively short time period. Investigating the effects of other variables over a longer treatment period may produce stronger evidence for additional variables being important.

8.5.3 Conclusions

Both cognitive variables and pain were related to different aspects of adherence in this field study. The findings showed that aversive feedback directly influenced how long the participants carried out each bout of their physiotherapy for and that cognitive variables determined general adherence. Clinicians may find it helpful to address both cognitive beliefs that have developed after starting treatment and the influence of the aversive feedback that a patient may receive in the form of pain when completing their exercises, in order to increase adherence (and recovery).

CHAPTER 9: GENERAL DISCUSSION

9.1 Rationale and Research Questions

The aims of this programme of research were to clarify the role of both cognitive and additional mechanisms on adherence behaviour. These aims were addressed using both laboratory and field methodologies. The current literature did not allow for specific predictions regarding each aspect of adherence that was to be measured; therefore the research questions did not specify in particular, which aspect of adherence cognitive and additional factors would influence. The findings from both the laboratory and field studies were organised according to the different aspects of adherence because the precision of measurement afforded by the laboratory study enabled clarification of the influence of the cognitive and additional variables on the different aspects of adherence. Sections 9.2.1 – 9.2.3 below therefore integrate the main findings of the laboratory and field studies according to the three aspects of adherence delineated in the laboratory study, and section 9.2.4 relates these findings back to the initial research questions and the model proposed in Chapter 4.

9.2 Main Findings

9.2.1 Persistence at Task

The laboratory study revealed that it was only cognitive variables (day 2 outcome expectations and baseline and day 2 self-efficacy) that independently predicted whether the participants were persistent with their task. There was no pure measure of persistence in the field study.

9.2.2 Adherence Whilst Persistent

Only feedback condition had an influence on how well participants in the laboratory study followed instructions whilst they were persistent at the study in the laboratory, in that aversive feedback slowed responding. In addition to pain being important, week 2 self-efficacy was also independently related to adherence whilst the participants were persistent in the field study.

9.2.3 Combination of Persistence at Task and Adherence Whilst Persistent

Both cognitive and additional variables were important to those adherence measures that combined aspects of persistence and adherence whilst persistent. The results from the laboratory study indicated that the recovery achieved was less in those participants who received aversive feedback only versus those who received visual feedback only. However, once questionnaire measures had been taken into account, there was no longer a significant difference in recovery achieved between the feedback conditions. In addition to this, the mediation analysis showed that self-efficacy mediated the influence of aversive feedback on recovery. Increased day 2 self-efficacy was the only independent predictor of recovery in the laboratory.

In the field, three of the adherence measures assessed this aspect of adherence. Subjective recovery was associated with both cognitive variables (increased outcome expectations, self-efficacy and less anticipated problems (APETS) at baseline and week 2) and decreased pain at week 2. However, only anticipated problems at baseline and week 2 and task outcome expectations at baseline contributed independently to the variance explained in subjective recovery. Less frequency of skipping physiotherapy was associated with a number of the cognitive variables (increased outcome expectations and self-efficacy and baseline and week 2). Baseline measures of task outcome expectations and self-efficacy independently added to the variance explained in skipping physiotherapy. Classification of high or low adherer based on the PETS was associated only with cognitive variables (higher outcome expectations and self-efficacy at baseline and week 2), with only week 2 task outcome expectations adding independently to this classification.

9.2.4 Relation to Research Questions

9.2.4.1 Cognitive Variables and Adherence

The cognitive variables assessed during this programme of research did independently add to the variance in adherence. They were particularly important to persistence in the laboratory, and were important to each aspect of adherence in the field study. These finding provide further support for the operation of a cognitive mechanism that influences adherence behaviour (e.g. Bandura, 1997; Toates, 1998). In relation to the model proposed in Chapter 4, these results support the existence of a direct path between cognitive variables and adherence.

9.2.4.2 Additional Variables and Adherence

The findings regarding the effect of aversive feedback and affective state showed that these variables were associated with adherence (lower week 2 negative affective state was associated with increased time spent on each bout of physiotherapy; lower week 2 pain was associated with increased subjective recovery in the field) and that some independently added to the variance for an aspect of adherence (lower baseline pain predicted more time spent on physiotherapy per bout). Aversive feedback was important to the speed at which participants responded and aversive feedback and positive affective state were important to the amount of recovery that was achieved in the laboratory. The results from the laboratory also offer support for the idea that it was the aversive nature of the feedback rather than the information that carried most of the effect on response rate. This was illustrated by the fact that additional visual feedback did not significantly attenuate the negative effect of aversive feedback. The finding that aversive feedback in the laboratory and pain in the field study were independently related to certain aspects of adherence offers some support to the direct connection between additional variables and adherence as suggested in the model proposed in Chapter 4.

The fact that affective state was not found to be more influential may have been because affective state might have an indirect path of influence via cognitive variables (Salovey & Birnbaum, 1989). Alternatively, the effect of affective state may not be observed until later on in treatment, as it was changes in affective state during the first 4 months that were predictive of adherence for exercise adherence (Suter & Marti, 1992).

9.2.4.3 Interaction of Cognitive and Additional Variables on Adherence

Two of the adherence variables were predicted by both cognitive and additional variables; recovery in the laboratory study and time spent exercising per bout of physiotherapy in the field study. Mediation analyses were conducted to test whether the indirect paths in the model suggested in Chapter 4 were supported. The results revealed that self-efficacy mediated the effect of aversive feedback in the laboratory study, however, there was no evidence of self-efficacy mediating the influence of pain in the field study. The evidence for an indirect path between additional variables and adherence via cognitions is therefore partially supportive.

Adherence to physiotherapy is a complex behaviour that cannot be fully measured or understood unless it is broken down into dropout, attendance at sessions/ completion of sessions as a function of those prescribed and adherence during sessions.

Both the laboratory and field studies found that different variables were important to different aspects of adherence. In particular, cognitive variables were important to persistence and both cognitive and other variables were important to adherence during the sessions.

It has been proposed in the literature that outcome expectations may not add to the variance in adherence behaviour once self-efficacy has been controlled (Brady, Tucker, Alfino, Tarrant, & Finlayson, 1997). A number of analyses in this thesis (persistence in the laboratory study; PETS, skipping physiotherapy and subjective recovery in the field) showed that outcome expectations were important to behaviour even after self-efficacy had been controlled for. The fact that outcome expectations were independently important distinct from self-efficacy confirms that outcome expectations had an influence independent to that of self-efficacy in both the laboratory and field studies.

In addition to outcome expectations being independently important to adherence behaviour, the subscale analyses of outcome expectations indicated that task outcome expectations, but not social outcome expectations were related to some aspects of adherence in the field. The task outcome expectations were specifically related to expectations about the pleasantness / aversiveness of the physiotherapy itself, whereas the social outcome expectations were concerned with the participants' beliefs about how the physiotherapist would feel if they completed their physiotherapy. It may have been that the influence of the desire to please the physiotherapist (assessed in the social subscale of outcome expectations) was attenuated by the importance of the physiotherapist to the patient.

A number of cognitions that were reported after some experience of physiotherapy or the simulation (i.e. week 2 / 'day' 2 assessments) were more important to adherence behaviour than baseline cognitions (i.e. week 2 self-efficacy on time spent exercising per bout, task outcome expectations on PETS, APETS on subjective recovery in the field; 'day' 2 outcome expectations and self-efficacy on persistence and self-efficacy on

recovery in the laboratory). Whilst it is not clear why cognitions may have changed based on the results of this study, social cognitive theory (Bandura, 1986; 1997) does suggest various mechanisms by which self-efficacy may be changed (discussed in chapter 3). The first reason for this change may have been due to enactive mastery experience altering cognitions such that they more closely match experience. Alternatively, verbal persuasion by their physiotherapist or significant others may have had an influence on cognitions. However, it may also have been physiological / affective state resulting from performing the tasks (if pain or negative affective state leads to decreased self-efficacy) that effected a change. These reasons suggested by social cognitive theory may explain how cognitions may have changed. As to why later cognitions were better predictors of behaviour than baseline assessments, previous research has also suggested that both level and change in outcome expectations and self-efficacy are important (Brassington, Atienza, Perczek, DiLorenzo, & King, 2002). There is existing evidence that cognitions are brought in line with experience. For example, expectations relating to how painful a movement would be have been found to alter after experience of pain, such that subsequent expectations were brought in line with experience (Crombez, Vervaet, Baeyens, Lysens, & Eelen, 1996). Early cognitions about treatment change as a result of experience of the task, so perhaps 'faulty' cognitions may be corrected by experience. Baseline assessments may therefore have limited predictive ability because of potential change. The effect of outcome expectations on adherence may be moderated by whether the expectations were met. If initial expectations are high and are not met, decreased adherence may result, whereas if high expectations were met, adherence may be higher (Rothman, 2000).

Kirsch and Lynn (1999) suggested that expectations would lead to recovery via self-fulfilling prophecies. The variables that independently added to the variance explained in recovery in the field were the APETS and task outcome expectations. Therefore, in this case, expectations may have influenced subjective recovery.

It has been suggested that during long-term maintenance of behaviour, resources additional to those assessed by social cognition models may have an influence on behaviour (Karoly, 1993; Rothman, 2000). However, a definition of a distinct boundary between short- and long-term behaviour may not be useful as this would imply a distinct change in the resources used to guide behaviour at a particular point in time. Instead, it may be more useful to conceptualise the change in the variables regulating behaviour as a gradual one. Therefore, even though the majority of participants' treatment was complete before 6 months, the influence of other mechanisms (i.e. pain) may already be observed.

The fact that pain and affective state did have an influence on adherence behaviour over a relatively short period of time (the 8 weeks of the study or 1½ hours in the laboratory), suggests that self-regulation using both cognitive and additional mechanisms to guide it (Karoly, 1993; Rothman, 2000) may begin quite early in the performance of a behaviour. The influence of other variables may nevertheless have been underestimated in this research as the majority of participants' participation in the study was complete in 8 weeks or 1½ hours, which arguably may not be classified as long-term maintenance of behaviour.

9.4 Clinical Implications

One of the primary clinical implications is that adherence to a treatment such as physiotherapy must assess and address different aspects of adherence behaviour. The studies that form this programme of research revealed that different variables were associated with different aspects of adherence behaviour. The implication is that interventions that aim to improve adherence need to acknowledge the different aspects of adherence behaviour and those variables that predict each aspect.

The studies carried out during the course of this programme of research suggested that it was the cognitive variables that influence whether the physiotherapy patient persists at the programme of physiotherapy, but the aversive nature of the therapy is also likely to have an influence on how well the patient carries out their exercises. Therefore, when clinicians have identified whether an aspect of adherence needs improving, different intervention approaches may be needed.

Baseline cognitions tended to be less important to the various components of adherence than later cognitions, which suggested that these early beliefs that have not been based on experience have limited predictive power. As discussed above, these beliefs may be subject to change due to experience, and may therefore be less useful to measure and target in clinical populations, than beliefs formed early after the start of therapy. Cognitive variables based on early experience were important to later adherence. Therefore, interventions aimed at increasing adherence should target the beliefs that are developing immediately after patients have started their therapy. At the same time, the fact that cognitions formed after the start of treatment are related to adherence offers the benefit that initial negative views of physiotherapy may be made less negative with

experience. However, change in cognitions could also be detrimental to adherence; for example, if positive expectations are not met, cognitions about treatment may become less positive.

In contrast to the cognitions, how long was spent on each bout of physiotherapy exercises at home was predicted by baseline pain. Identifying those with higher baseline pain and implementing interventions to increase adherence may be particularly beneficial in this population.

9.5 Limitations

This section divides the limitations of the current programme of research into those concerned with the comparison of the measures, the samples used and the comparison of the methodologies.

9.5.1 Comparison of Measures

Due to the differences regarding the possible variability in behaviour during the period which participants were adherent for (i.e. response rate in the laboratory and time spent on exercising in the field, as discussed above in section 9.3), the measures that assessed this aspect of adherence were not measuring exactly the same aspect of behaviour. As the task in the laboratory was less complex than the field, the response rate measure informed exactly how well instructions were followed. In the field however, participants' behaviour during each bout of physiotherapy could vary in terms of how long the participants exercised for, which exercises they performed and how accurately they carried out each exercise. This limitation could be addressed in future studies by asking for details of how many exercises were completed during each bout as well as the time spent on exercising. A response rate could then be calculated from this information. In addition to this, some measure of accuracy of performance of exercises would be needed to make the measures more directly comparable.

A second limitation of the measures used was that because the same outcome expectations questionnaire was used in both the laboratory and the field, no reference could be made to pain as the participants in the laboratory did not experience pain (as a result of participating in the study). Therefore, the influence of expectations relating to pain in the field were not specifically assessed using the outcome expectations measure. However,

expectations regarding the symptoms were assessed in the APETS which may include beliefs about pain expectations. Previous research has suggested that pain expectations may be an important mechanism by which pain may have and influence on adherence behaviour (Poulton, Trevena, Reeder, & Richards, 2002). Future research may benefit from assessing pain expectations more specifically.

Due to the measures used, some over- adherent behaviour could not accurately estimated. Depending on the treatment, over-adherence may be detrimental to the treatment and outcome, i.e. there may therefore be a non-linear pattern between adherence and recovery. If this is the case, then it may be particularly beneficial to acknowledge those participants who were over-adherent (and possibly those factors that predict over-adherence) as well as those who were less adherent. However, due to factors that influence recovery other than adherence, the amount of physiotherapy needed to achieve recovery is not uniform, and therefore the exact length of physiotherapy needed to achieve recovery is not known at the beginning of physiotherapy. As it cannot be ascertained precisely how much physiotherapy would be needed in the field, completing more than initially prescribed may not be detrimental to recovery. In future studies, in order to help clarify whether over-adherence was detrimental to recovery, it would be advantageous for all the adherence measures to be able to record over-adherent behaviour.

As the adherence measures used in the laboratory and field study were not assessing exactly the same aspects of behaviour, comparisons of adherence rates could not be made between the laboratory and field studies.

9.5.2 Comparison of the Samples

As was expected, the mean age of the participants in the field study was older than those in the laboratory study. This may have had an influence on the adherence of the two samples, as it has been found that younger age can be associated with less adherence (e.g. time per bout, PETS measure of adherence in the current field study and Oldfors Engstrom & Oberg, 2005; Sluijs, Kok, & van der Zee, 1993). However, many studies have found no such association between age and adherence (subjective recovery, skipping therapy in current field study; Alexandre, Nordin, Hiebert, & Campello, 2002; Belza, Topolski, Kinne, Patrick, & Ramsey, 2002; Kolt & McEvoy, 2003; Lowdermilk, Panus, & Kalbfleish, 1999; Oldfors Engstrom & Oberg, 2005; Preisinger et al., 1996; Rejeski, Brawley, Ettinger, Morgan, & Thompson, 1997). Therefore, it is unclear whether those

factors that predicted adherence in the laboratory were different (in some cases) to those in the laboratory due to the moderating effect of age. Similarly, the education status of the participants in each of the studies may have differed, which may have had an influence on how adherent the participants were (Alexandre et al., 2002; Belza et al., 2002; Seçkin, Gündüz, Borman, & Akyüz, 2000; Sluijs et al., 1993).

The reasons as to why the participants took part may have been different in each of the studies. Whilst neither sample were under any obligation to take part, those in the laboratory study took part to gain either participation credits or money, i.e. for direct personal gain. Those in the field study took part without any offer of tangible personal gain. They were informed that their participation would be used to help future physiotherapy patients, so they may have taken part for reasons connected to this. Those in the field study may therefore represent systematically different sections of the population. However, as no measures were taken that could distinguish how these populations may have differed with regard to reasons for participating, it cannot be ascertained whether this had any influence on the behaviour observed / reported.

9.5.3 Comparison of Laboratory and Field Methodologies

As described in chapter 4, there were advantages and disadvantages to using both laboratory and field methodologies. The laboratory offered a very controlled environment and precise recording of moment-by-moment behaviour, cognitions and affect, and the need to continue exercising over a prolonged period of time and unpredictable recovery were simulated. However, how closely the behaviour observed in the laboratory mirrored that in the field could not be certain. To test whether the behaviour observed in the laboratory did mirror that in physiotherapy patients, the field study was carried out. The fact that some of the results found in the laboratory did mirror those of the field indicated that the laboratory study had simulated physiotherapy adequately. However, despite the results being similar in the laboratory and field, they did not completely map onto each other. The reasons for this may have included some of the differences between the laboratory and field studies that could not be addressed.

Firstly, if the participants left the simulation before they had recovered, they did not leave with any continuing problems. However, if the participants in the field study stopped their treatment, they may have been left with continuing problems. So motivation may have been much greater in the field. Secondly, in the laboratory the state of the injury

could not worsen, whereas in the field, worsening of the injury was possible, either due to incorrect exercising or extraneous factors.

Thirdly, the duration of the task was much shorter in the laboratory (maximum of 1½ hours) than the task which faced the physiotherapy patients (up to 38 weeks worth of periodic physiotherapy). Finally, in the laboratory study there was only one form of exercise which could either be performed or not, i.e. it was all or nothing. Response rate (including pattern of responding) was therefore the only variability in responding possible in the laboratory (beyond persistence). In the field, participants could have had numerous exercises to complete and whilst completing these exercises, they could have varied the number completed and the accuracy of following the instructions for each exercise (e.g. they could have lifted their arm half way to shoulder height rather than shoulder height). Therefore, the differences between the laboratory and field may have led to differences in the results between the two studies.

9.6 Further Research

One of the main findings of this research was that different factors were important to different aspects of adherence behaviour. Future research that measures complex adherence behaviour such as physiotherapy should assess the various different aspects of adherence behaviour. If they do not, they may miss important information about the level of adherence and those factors that predict it.

Since this research confirms findings of previous research that cognitive variables influence adherence behaviour in physiotherapy, it would be theoretically and clinically relevant to conduct studies to test whether these cognitions can be manipulated in physiotherapy. If cognitions can be successfully manipulated, further research would then be needed to ascertain whether change in cognitions resulted in increased adherence behaviour. Previous research has suggested that manipulation of outcome expectations can be achieved in smoking behaviour and that this change can influence adherence behaviour (Copeland & Brandon, 2000). Therefore, as it has been found that outcome expectations can influence some aspects of adherence behaviour in physiotherapy, further research that tests whether manipulations of outcome expectations in the physiotherapy setting is possible and may be of benefit to adherence behaviour. Similarly, manipulation of self-efficacy may be beneficial as it has also been found that manipulation of self-

efficacy in respect to exercise adherence can result in changes in self-efficacy and subsequent adherence (Resnick, 2002).

As mentioned above, baseline pain was also important to adherence behaviour. As performance of some physiotherapy can result in exacerbation of pain, it may not be possible to completely avoid pain during physiotherapy. However, it has been suggested that variables such as pain and affective state may have a direct and / or indirect influence on behaviour (Toates, 1998). If pain and affective state had an indirect impact on behaviour via cognitions, e.g. the effect of pain was mediated by cognitive variables as suggested by the results of the field study, then interventions that increased positive expectations about physiotherapy may also have the effect of diminishing the influence of pain and affective state on behaviour. Further research should therefore investigate further whether pain and affective state act only in a direct manner on behaviour, or whether they act in an indirect way, via cognitions. If it can be confirmed that pain and affective state do act via cognitions, interventions should test whether manipulation of cognitive variables can influence the effect of pain and affective state on adherence behaviour. In addition, the literature would suggest that interventions that address the psychological aspects of pain, such as pain expectations, or pain-related fear, may also be beneficial to adherence behaviour (Poulton et al., 2002; Seligman & Johnston, 1973). Similarly, it has been suggested that affective state may have an effect on adherence via self-efficacy and outcome expectations, i.e. affective state influences the level of self-efficacy (Salovey & Birnbaum, 1989), which may in turn influence adherence behaviour. Further research could test whether the influence of affective state is a direct or indirect one.

Since it has been found that variables other than cognitive ones can influence adherence in physiotherapy, other variables may be important to other behaviours. For example, pain and affective state may also influence initiation and maintenance of exercise for fitness. If pain and affective state were also important to the performance of exercise, this could have potential implications for health professionals who aim to influence health via exercise behaviour.

The findings of this programme of research suggest that aversive feedback may have an influence on behaviour on a relatively short time scale. It would be theoretically important to investigate whether the influence of these other variables strengthens when behaviour is carried out over longer time periods. This would have implications for

whether a complex behaviour such as physiotherapy can be governed effectively using more reliance on other resources, thereby reducing the need for cognitive control of the behaviour, and indeed whether cognitive variables continue to be important. Through an understanding of which factors increase and decrease adherence at particular points through treatment, appropriate interventions can be employed to increase adherence throughout treatment.

In the field study, general pain was found to be related to some aspects of adherence. However, the findings regarding pain were not found in all cases where they were expected. One of the potential reasons for this may be that specific pain caused by physiotherapy was not assessed. It may be that where physiotherapy does increase pain, participants would learn to avoid their physiotherapy. One of the possible mechanisms for this may be that suggested by Seligman and Johnston (1973). The cognitive component of this theory suggests that a participant develops an expectancy that physiotherapy will result in pain but a preference for not experiencing this pain, and the secondary mechanism dictates that pain-related fear is classically conditioned to physiotherapy. Performance of physiotherapy therefore becomes less likely. Assessing specific pain and pain-related fear may therefore clarify the role of pain further. The literature suggests that pain-related fear can be important to the performance of behaviours. For example, a recent study investigated whether fear-avoidance beliefs were evident and had an impact on outcome measures in acute injury (Fritz, George, & Delitto, 2001). Fear-avoidance beliefs were defined in this study as the individual's beliefs about how activity might affect the level of pain they experience and how the activity might affect their injury. The findings of this study revealed that fear-avoidance beliefs were, in fact, evident in acute lower back pain. Whilst the fear-avoidance beliefs were not able to account for initial levels of disability, the work subscale of the fear-avoidance beliefs state (items relating to how their work contributed/s to their pain and how their pain may affect their work) was able to add significantly to the variance in disability explained at 4 weeks, after pain intensity, impairment and initial disability had been controlled for. The results of an investigation in patients with chronic back pain also showed that pain-related fear had a higher association with disability ratings than actual pain (Crombez, Vlaeyen, Heuts, & Lysens, 1999). This investigation also showed that pain-related fear was a significant predictor of behavioural performance of physical tasks. Ascertaining whether it is pain and / or pain-related fear that is important to the performance of physiotherapy would have theoretical and clinical implications. If pain was the important factor, addressing the pain itself would be most beneficial to adherence behaviour. However, if pain-related fear

was also/more important, this would suggest that pain was having an influence on adherence in a manner consistent with Seligman and Johnston's theory and that addressing the psychological impact of pain would be important for increasing adherence.

Learning principles have been successfully employed to decrease pain reports in previous research (Flor, Knost, & Birbaumer, 2002). Since pain has been found to influence certain aspects of adherence, future research could use similar techniques to decrease the pain reports of patients undergoing physiotherapy with the goal of testing whether this firstly, could be achieved, and secondly, if pain reports could be reduced, these could negate some of the negative influence of pain on adherence.

Finally, the systematic review reported in chapter 2 revealed a need for the design and validation of a measure that captures adherence during sessions for home-based treatment programmes. This measure is potentially a very important instrument for health professionals who need to monitor and predict adherence to home-based exercise treatment programmes.

9.7 Conclusion

The overall conclusions for this programme of research were that firstly, both cognitive and additional factors influenced performance at simulated and real world physiotherapy. Secondly, it was clear that different factors were important to different aspects of adherence. In particular, cognitive variables predicted how long participants persisted at their task, but that both cognitive and other variables predicted adherence to instructions beyond persistence. Therefore, it seemed that both cognitive and other mechanisms shared control of behaviour from an early point in the task. As different factors were important to different aspects of adherence, it is important that future studies assess dropout, attendance at sessions and adherence during these sessions.

APPENDICES

Appendix A: Systematic review study code to reference key

Study code	Citation
1	Alexandre, N. M. C., Nordin, M., Hiebert, R., & Campello, M. (2002). Predictors of compliance with short-term treatment among patients with back pain. *Pan American Journal of Public Health, 12,* 86-94.
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individualized rehabilitation programme: A clinical follow-up. *Scandinavian Journal of Public Health, 33,* 11-18.

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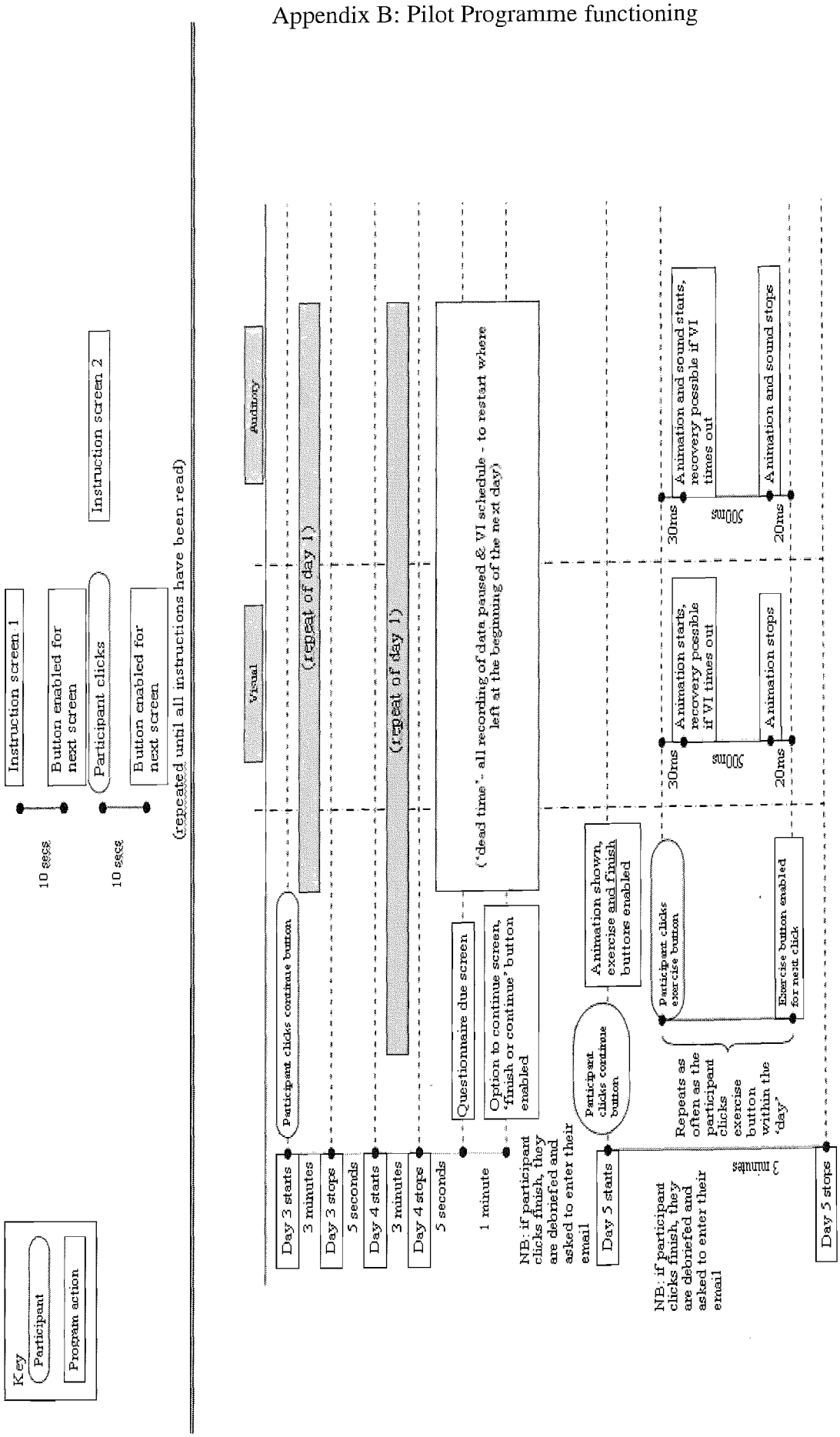
Appendix B: Pilot Programme functioning



Appendix C: Self-efficacy questionnaire preparation

Imagine you are about to take part in a simulation experiment. Your aim is to make the simulated person recover from a shoulder injury by determining when they exercise (one exercise = one mouse click). However, as with 'real' physiotherapy, recovery will be non-uniform and will not be achieved if you exercise too fast, too slow or inconsistently.

Some of the questions are similar, but please answer each question as quickly and honestly as you can, without looking at the answers you gave previously.

Thank-you very much for your time, it is greatly appreciated!

Self-efficacy

(please circle one number for each question)

How strongly do you believe that you will be able to complete the simulation even if…:

1. …it was harder than you thought it would be?						
0 I definitely will NOT complete it	1	2	3 neutral	4	5	6 I definitely WILL complete it
2. …you didn't like doing it?						
0 I definitely will NOT complete it	1	2	3 neutral	4	5	6 I definitely WILL complete it
3. …you found it boring?						
0 I definitely will NOT complete it	1	2	3 neutral	4	5	6 I definitely WILL complete it
4. …you were tired?						
0 I definitely will NOT complete it	1	2	3 neutral	4	5	6 I definitely WILL complete it
5. …you found it unpleasant?						
0 I definitely will NOT complete it	1	2	3 neutral	4	5	6 I definitely WILL complete it

Appendix D: Self-efficacy questionnaire

Self-efficacy

(please circle one number for each question)

How strongly do you believe that you will be able to complete the simulation even if…:

0= I definitely *will NOT* complete it; 6= I definitely *WILL* complete it

6. …it was harder than you thought it would be?						
0 I definitely will NOT complete it	1	2	3 neutral	4	5	6 I definitely WILL complete it
7. …you didn't like doing it?						
0 I definitely will NOT complete it	1	2	3 neutral	4	5	6 I definitely WILL complete it
8. …you found it boring?						
0 I definitely will NOT complete it	1	2	3 neutral	4	5	6 I definitely WILL complete it
9. …you were tired?						
0 I definitely will NOT complete it	1	2	3 neutral	4	5	6 I definitely WILL complete it
10. …you found it unpleasant?						
0 I definitely will NOT complete it	1	2	3 neutral	4	5	6 I definitely WILL complete it

Appendix E: Outcome expectations questionnaire preparation

Imagine you are about to take part in a simulation experiment. Your aim is to make the simulated person recover from a shoulder injury by determining when they exercise (one exercise = one mouse click). However, as with 'real' physiotherapy, recovery will be non-uniform and will not be achieved if you exercise too fast, too slow or inconsistently.

Some of the questions are similar, but please answer each question as quickly and honestly as you can, without looking at the answers you gave previously.

Thank-you very much for your time, it is greatly appreciated!

Outcome expectations
Please rate the following on a scale of 1-7.

1= strongly agree; 7= strongly disagree

Question	Score
1. I expect that the simulation will be boring to complete	
2. I expect the experimenter will be unconcerned if I complete the simulation	
3. I expect I will be disinterested if I complete the simulation	
4. I expect that the simulation will be pleasurable to complete	
5. I expect the experimenter will be indifferent if I complete the simulation	
6. I expect that the simulation will be dull to complete	
7. I expect I will be impressed with myself if I complete the simulation	
8. I expect the experimenter will be impressed if I complete the simulation	
9. I expect that the simulation will be enjoyable to complete	
10. I expect I will be indifferent if I complete the simulation	
11. I expect the experimenter will be disinterested if I complete the simulation	
12. I expect I will be impressed with myself if I complete the simulation	
13. I expect that the simulation will be fun to complete	
14. I expect the experimenter will be pleased with me if I complete the simulation	
15. I expect the experimenter will be glad if I complete the simulation	
16. I expect that the simulation will be unpleasant to complete	
17. I expect I will be dissatisfied if I don't complete the simulation	
18. I expect that the simulation will be awful to complete	
19. I expect I will be pleased if I complete the simulation	
20. I expect that the simulation will be horrible to complete	
21. I expect I will be satisfied if I complete the simulation	
22. I expect I will be upset if I do not complete the simulation	

Appendix F: Laboratory outcome expectations questionnaire

Please complete the following questionnaires with reference to how you think about the simulation *now*.

Remember, there are no right or wrong answers.

Please try to record your first reactions as these are the most helpful.

Outcome expectations

(please circle one number for each question)

0= strongly disagree; 6= strongly agree

1. I expect the experimenter will be unconcerned if I complete the simulation						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
2. I expect the experimenter will be glad if I complete the simulation						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
3. I expect the experimenter will be pleased with me if I complete the simulation						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
4. I expect I will be impressed with myself if I complete the simulation						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
5. I expect I will be indifferent if I complete the simulation						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
6. I expect I will be dissatisfied if I don't complete the simulation						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
7. I expect that the simulation will be fun to complete						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
8. I expect that the simulation will be dull to complete						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
9. I expect that the simulation will be pleasurable to complete						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree

Appendix G: Mood questionnaire

Mood

(please tick one box on each line)

0= not at all; 6= extremely

How much do you currently feel:	0 not at all	1	2	3	4	5	6 extremely
Happy							
Pleased							
Joyful							
Enjoyment/ fun							

How much do you currently feel:	0 not at all	1	2	3	4	5	6 extremely
Depressed/ blue							
Worried/ anxious							
Frustrated							
Unhappy							
Angry/ hostile							

(adapted from Diener, E., Larsen, R. J., Levine, S., & Emmons, R. A. (1984). Intensity and frequency: Dimensions underlying positive and negative affect. *Journal of Personality and Social Psychology, 48,* 1253-1265)

Appendix H: Laboratory demographics

Participant number _____

Age _____

Gender

Male ☐
Female ☐

Have you ever had physiotherapy?

Yes ☐
No ☐

Appendix I: Laboratory post participation

Post-Participation Questionnaire

1 a) What did you do to try and recover from your shoulder injury?

b) Do you think you were successfully recovering?

2 What aspect(s) of your exercising do you think controlled changes in your recovery?

Appendix J: Laboratory information sheet

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Information Sheet

My name is Imogen Tijou and I am a PhD student. I am conducting research into variables that affect adherence behaviour.

The study will take up to an hour and a half, during which time your aim will be to get a computer simulated person to carry out shoulder exercises in order that they recover from a shoulder injury.

One mouse click on an on screen 'button' will make the simulated person raise their arms once. In order to recover, you will have to choose the rate at which you exercise.

As the simulated person raises their arms, you will get feedback on the injury. This will either be in the form of a loud scream through headphones, that will decrease in volume as the simulated person recovers. The second form of feedback you may receive will be given visually in the form of a vertical red bar which will move from one end marked 'no recovery', to 'full recovery' as recovery occurs. Lastly, you may receive both forms of feedback at the same time.

You will receive participation credits for your first 15 minutes of participation. If you manage to recover from the injury, you will be entered into a draw to win £20. Those entered into the draw will have a 25% chance of winning £20.

Participation in the study is voluntary and you may withdraw at any time without giving a reason. If you do choose to withdraw, this will not affect you as a student in any way. All information given will be treated with strict confidentiality.

If you have any questions about the study you can ask them now, or you can email me at it201@soton.ac.uk.

If you have any concerns about the study you may contact the Chair of the Ethics Committee, Department of Psychology, University of Southampton, Southampton, SO17 1BJ, or telephone 02380 593995.

Appendix K: Laboratory consent form

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Consent form

Please complete the following:

- ❑ I have read and understood the information sheet and have been given the opportunity to ask questions
- ❑ I understand that my participation in this study is voluntary and I can withdraw at any time without giving a reason. This will not affect me as a student
- ❑ I agree to take part in this study

Please print your name_____

Signed_____

Date_____

Appendix L: Auditory Instructions

Auditory Instructions

In this study, YOU will play the part of this computer-simulated student. Imagine that you have been knocked off your bike and have injured your shoulder badly.

It hurts so much that you cannot ride your bike to get to the university, you can't write, you can't work, you can't sleep, and you certainly can't have any fun!

In order to recover from your shoulder injury you must carry out repeated arm movements. To carry out a single arm movement you simply click on the button labelled 'Exercise'.

For this study you must carry out these movements for a minimum of four days (in this simulation a 'day' actually lasts 3 minutes). But to achieve recovery, you may need to carry out the movements for many more 'days' - up to a maximum of 20 (about an hour in real time).

Before you begin exercising and every few 'days', you will be asked to complete questionnaires that include questions about what you think about your recovery and about your mood.

You must decide how many arm exercises to carry out each day. You may exercise at any time of day.

If you exercise too much you may injure yourself, but if you do not exercise enough you will not recover.

You will be able to tell if you are exercising at the right pace from the volume of the scream - the volume will remain the same if you are exercising too fast or too slow, but the volume will decrease when you are recovering!

You will have up to a maximum of 20 days (about 1 hour) in which to try to achieve full recovery.

You will be entered into a draw to win £20 if you carry out the exercise successfully and recover. If you successfully recover, you will have a one in four chance of winning the bonus. Of course, if you can work out how to exercise correctly early on, you are more likely to win the bonus!

If you have any questions, please ask the experimenter now.

If you are sure that you understand these instructions (you have been given a paper copy of them in case you forget them), please complete the questionnaires infront of you.

When you have finished the questionnaires, click the button to start your first day of exercising.

Appendix M: Visual Instructions

Visual Instructions

In this study, YOU will play the part of this computer-simulated student. Imagine that you have been knocked off your bike and have injured your shoulder badly.

It hurts so much that you cannot ride your bike to get to the university, you can't write, you can't work, you can't sleep, and you certainly can't have any fun!

In order to recover from your shoulder injury you must carry out repeated arm movements. To carry out a single arm movement you simply click on the button labelled 'Exercise'.

For this study you must carry out these movements for a minimum of four days (in this simulation a 'day' actually lasts 3 minutes). But to achieve recovery, you may need to carry out the movements for many more 'days' - up to a maximum of 20 (about an hour in real time).

Before you begin exercising and every few 'days', you will be asked to complete questionnaires that include questions about what you think about your recovery and about your mood.

You must decide how many arm exercises to carry out each day. You may exercise at any time of day.

If you exercise too much you may injure yourself, but if you do not exercise enough you will not recover.

You will be able to tell if you are exercising at the right pace from the bar at the side of the screen - the bar will remain the same if you are exercising too fast or too slow, but the bar will decrease when you are recovering!

You will have up to a maximum of 20 days (about 1 hour) in which to try to achieve full recovery.

You will be entered into a draw to win £20 if you carry out the exercise successfully and recover. If you successfully recover, you will have a one in four chance of winning the bonus. Of course, if you can work out how to exercise correctly early on, you are more likely to win the bonus!

If you are sure that you understand these instructions (you have been given a paper copy of them in case you forget them), please complete the questionnaires infront of you.

When you have finished the questionnaires, click the button to start your first day of exercising.

Appendix N: Laboratory debrief

University of Southampton

School of Psychology

University of Southampton
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Telephone: 023 8059 2581
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Email: it201@soton.ac.uk

Debrief

Thank you for your participation in this study.

It has already been established that self-efficacy and outcome expectations can have an influence on adherence behaviour (e.g. Resnick, B., Palmer, M. H., Jenkins, L. S., & Spellbring, A. M., 2000; Brady, B. A., Tucker, C. M., Alfino, P. A., Tarrant, D. G., & Finlayson, G. C., 1997). As well as these variables that an individual is aware of, researchers have suggested that there might be processes that affect adherence behaviour without an individual being aware of them (e.g. Kirsch, I. & Lynn, S. J., 1999). These might include the effect of mood (e.g. Armitage, C. J., Conner, M., & Norman, P., 1999) and of pain (Rejeski, W. J., Ettinger, W., Martin, K., & Morgan, T., 1998), which is simulated in this study with the scream.

This study aims to see if the effects of the self-efficacy and outcome expectations (that the individual is aware of) and the effects of mood and pain (the influence of which the individual is unaware of) act independently of one another, or whether, for example, changes in self-efficacy can affect pain assessments and vice versa.

Reference List

Armitage, C. J., Conner, M., & Norman, P. (1999). Differential effects of mood on information processing: evidence from the thoeries of reasoned action and planned behaviour. *European Journal of Social Psychology, 29,* 419-433.

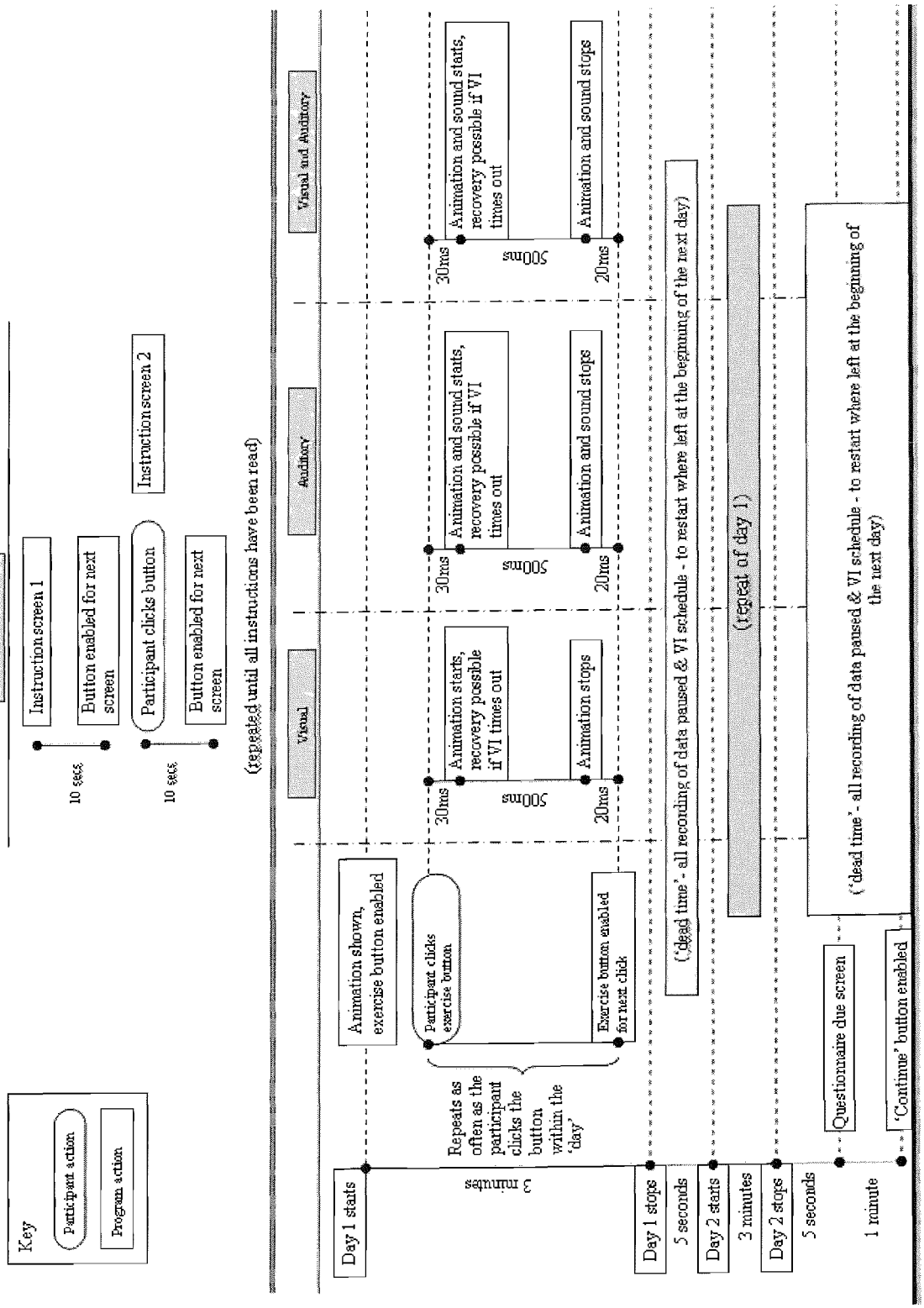
Brady, B. A., Tucker, C. M., Alfino, P. A., Tarrant, D. G., & Finlayson, G. C. (1997). An investigation of factors associated with fluid adherence among hemodialysis patients: a self- efficacy theory based approach. *Annals of Behavioural Medicine, 19,* 339-343.

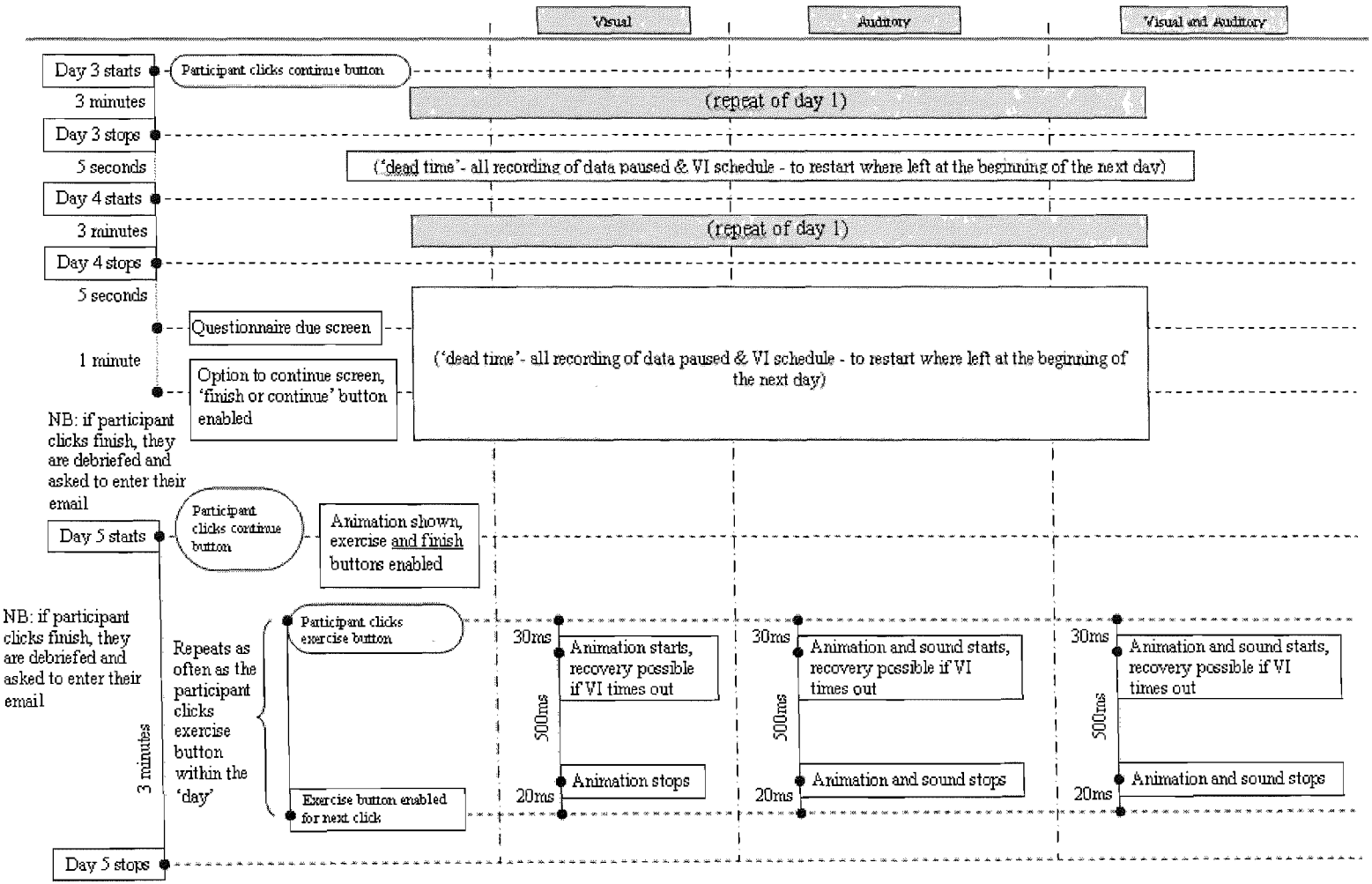
Kirsch, I. & Lynn, S. J. (1999). Automaticity in Clinical Psychology. *American Psychologist, 54,* 504-515.

Rejeski, W. J., Ettinger, W., Martin, K., & Morgan, T. (1998). Treating disability in knee osteoarthritis with exercise therapy: a central role for self-efficacy and pain. *Arthritis Care and Research, 11,* 94-101.

Resnick, B., Palmer, M. H., Jenkins, L. S., & Spellbring, A. M. (2000). Path analysis of efficacy expectations and exercise behaviour in older adults. *Journal of Advanced Nursing, 31,* 1309-1315.

Appendix O: Laboratory study programme functioning




Visual
Auditory
Visual and Auditory
Day 3 starts
Participant clicks continue button
3 minutes
(repeat of day 1)
Day 3 stops
5 seconds
('dead time'- all recording of data paused & VI schedule - to restart where left at the beginning of the next day)
Day 4 starts
3 minutes
(repeat of day 1)
Day 4 stops
5 seconds
Questionnaire due screen
1 minute
Option to continue screen, 'finish or continue' button enabled
('dead time'- all recording of data paused & VI schedule - to restart where left at the beginning of the next day)
NB: if participant clicks finish, they are debriefed and asked to enter their email
Day 5 starts
Participant clicks continue button
Animation shown, exercise and finish buttons enabled
NB: if participant clicks finish, they are debriefed and asked to enter their email
3 minutes
Repeats as often as the participant clicks exercise button within the 'day'
Participant clicks exercise button
30ms
Animation starts, recovery possible if VI times out
500ms
Animation stops
20ms
Exercise button enabled for next click
30ms
Animation and sound starts, recovery possible if VI times out
500ms
Animation and sound stops
20ms
30ms
Animation and sound starts, recovery possible if VI times out
500ms
Animation and sound stops
20ms
Day 5 stops

Appendix P: Verbal instructions for laboratory study

There is another thing I can tell you, and that is that you should respond between once every 2, 3 and 4 seconds.

Do you have any questions?

Please complete the three pages of the questionnaire, leave them on the desk when you have completed them (put the head phones on – *if in the auditory or combined condition*) and start the programme by clicking on the 'exercise' button.

Appendix Q: Final follow-up Physiotherapy Questionnaire

Version 2 27.1.2005 LREC No: 04/Q1704/77

Date Today_____

We would like to know how easy or difficult it was for you to carry out the therapy which was recommended for you. If it was difficult in any way for you to carry out, we want to know what the problems were and how often they prevented you from carrying out the therapy.

Please circle a number to show how much you agree that the problems listed below interfered with carrying out the therapy:

1 Agree Strongly	2 Agree	3 Not sure	4 Disagree	5 Disagree strongly

Problems due to symptoms:

1. I had to skip the therapy because it made my symptoms worse	1	2	3	4	5
2. I was prevented from carrying out the therapy by severe symptoms	1	2	3	4	5
3. I could not carry out the therapy because it caused more symptoms	1	2	3	4	5

Problems due to uncertainty or doubts about the therapy:

4. I could not carry out the therapy because I was unsure how to do it properly	1	2	3	4	5
5. I was unable to carry out the therapy because it was difficult to know what to do	1	2	3	4	5
6. I skipped the therapy because I was not sure if it was helping	1	2	3	4	5
7. I skipped the therapy because it did not seem relevant to my symptoms and problems	1	2	3	4	5
8. I did not carry out the therapy because I was not convinced it was right for me	1	2	3	4	5

Practical problems:

9. Lack of time prevented me from carrying out the therapy	1	2	3	4	5
10. It was not possible to find suitable opportunities to carry out the therapy	1	2	3	4	5
11. I was too busy or tired to carry out the therapy	1	2	3	4	5

12. Please circle an answer to show for how long you tried to carry out the therapy **at the gym:**

Never started	1-6 days	1-2 weeks	3-7 weeks	Still carrying out therapy

13. Please circle an answer to show for how long you tried to carry out the therapy **at home:**

Never started	1-6 days	1-2 weeks	3-7 weeks	Still carrying out therapy

Please turn over…

14. How often did you have to skip the therapy **at the gym**, on average?

Very often (daily, or most days)	Quite often (more than once a week)	Several times (most weeks)	A few times	Never

15. How often did you have to skip the therapy **at home**, on average?

Very often (daily, or most days)	Quite often (more than once a week)	Several times (most weeks)	A few times	Never

16. For how long did you carry out the therapy each time you did it **at the gym?**

1-5 minutes	6-20 minutes	21-45 minutes	Over 45 minutes

17. For how long did you carry out the therapy each time you did it **at home?**

1-5 minutes	6-20 minutes	21-45 minutes	Over 45 minutes

18. Overall, how well do you think you have been able to follow the recommended therapy?

Not at all	Not very well	Quite well	Very well

19. How close to recovery did you feel when you stopped carrying out the therapy? (If you are still carrying out the therapy, please indicate how close to recovery you feel now.)

No progress towards recovery	Some progress towards recovery	Substantial progress towards recovery	Almost fully recovered	Totally recovered

Thank you for your time, it is greatly appreciated.

Appendix R: Self-efficacy for exercise scale

(please circle one number for each question)

0= Not very confident; 10= Very confident

How confident are you right now that you could complete your physiotherapy if…:

1. You were bored by the programme or activity									
0 not very confident	1	2	3	4	5	6	7	8	9	10 very confident
2. You felt pain when doing your physiotherapy									
0 not very confident	1	2	3	4	5	6	7	8	9	10 very confident
3. You had to do your physiotherapy alone									
0 not very confident	1	2	3	4	5	6	7	8	9	10 very confident
4. You did not enjoy it									
0 not very confident	1	2	3	4	5	6	7	8	9	10 very confident
5. You were too busy with other activities									
0 not very confident	1	2	3	4	5	6	7	8	9	10 very confident
6. You felt tired									
0 not very confident	1	2	3	4	5	6	7	8	9	10 very confident
7. You felt stressed									
0 not very confident	1	2	3	4	5	6	7	8	9	10 very confident
8. You felt depressed									
0 not very confident	1	2	3	4	5	6	7	8	9	10 very confident

Appendix S: Field study outcome expectations scale

Please complete the following questionnaires with reference to how you think about your physiotherapy *now*.

Remember, there are no right or wrong answers.

Please try to record your first reactions as these are the most helpful.

Expectations

(please circle one number for each question)

0= strongly disagree; 6= strongly agree

1. I expect the physiotherapist will be unconcerned if I complete my physiotherapy						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
2. I expect the physiotherapist will be glad if I complete my physiotherapy						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
3. I expect the physiotherapist will be pleased with me if I complete my physiotherapy						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
4. I expect I will be impressed with myself if I complete my physiotherapy						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
5. I expect I will be indifferent if I complete my physiotherapy						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
6. I expect I will be dissatisfied if I don't complete my physiotherapy						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
7. I expect that my physiotherapy will be fun to complete						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
8. I expect that my physiotherapy will be dull to complete						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree
9. I expect that my physiotherapy will be pleasurable to complete						
0 strongly disagree	1	2	3 neutral	4	5	6 strongly agree

Appendix T: Anticipated Problematic Experiences of Therapy Scale

Date Today_____

We would like to know what you think carrying out the therapy will be like.

Please circle a number to show how much you expect that the experiences listed below :

1 Agree Strongly	2 Agree	3 Not sure	4 Disagree	5 Disagree strongly

Expectations for symptoms:

1. I expect the therapy will make my symptoms better	1	2	3	4	5
2. I expect I will have severe symptoms during the therapy	1	2	3	4	5
3. I expect the therapy will cause more symptoms	1	2	3	4	5

Expectations about the therapy:

4. I expect I will know how to carry out the therapy properly	1	2	3	4	5
5. I expect it will be difficult to know what to do	1	2	3	4	5
6. I expect it will be obvious that the therapy is helping	1	2	3	4	5
7. I expect the therapy will be relevant to my symptoms and problems	1	2	3	4	5
8. I expect that the therapy will be right for me	1	2	3	4	5

Practical expectations:

9. I expect that the therapy will take a lot of time	1	2	3	4	5
10. I expect it will be possible to find suitable opportunities to carry out the therapy	1	2	3	4	5
11. I expect that the therapy will take a lot of effort	1	2	3	4	5

Thank you for your time, it is greatly appreciated.

Appendix U: Brief pain inventory

STUDY ID# _____ HOSPITAL # _____

DO NOT WRITE ABOVE THIS LINE

Brief Pain Inventory (Short Form)

Date: ____/____/____ **Time:** ____

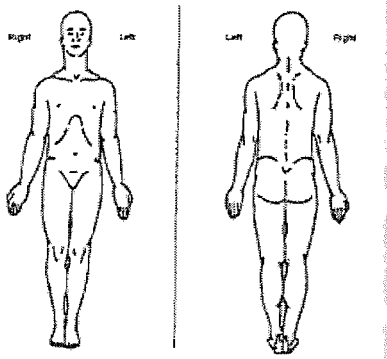
Name: _____ _____ _____

Last First Middle Initial

1. Throughout our lives, most of us have had pain from time to time (such as minor headaches, sprains, and toothaches). Have you had pain other than these every-day kinds of pain today?

1. Yes 2. No

2. On the diagram, shade in the areas where you feel pain. Put an X on the area that hurts the most.



3. Please rate your pain by circling the one number that best describes your pain at its worst in the last 24 hours.

0 1 2 3 4 5 6 7 8 9 10

No Pain — Pain as bad as you can imagine

4. Please rate your pain by circling the one number that best describes your pain at its least in the last 24 hours.

0 1 2 3 4 5 6 7 8 9 10

No Pain — Pain as bad as you can imagine

5. Please rate your pain by circling the one number that best describes your pain on the average.

0 1 2 3 4 5 6 7 8 9 10

No Pain — Pain as bad as you can imagine

6. Please rate your pain by circling the one number that tells how much pain you have right now.

0 1 2 3 4 5 6 7 8 9 10

No Pain — Pain as bad as you can imagine

7. What treatments or medications are you receiving for your pain?

_____

8. In the last 24 hours, how much relief have pain treatments or medications provided? Please circle the one percentage that most shows how much relief you have received.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
No Relief										Complete Relief

9. Circle the one number that describes how, during the past 24 hours, pain has interfered with your:

A. General Activity

0	1	2	3	4	5	6	7	8	9	10
Does not Interfere										Completely Interferes

B. Mood

0	1	2	3	4	5	6	7	8	9	10
Does not Interfere										Completely Interferes

C. Walking Ability

0	1	2	3	4	5	6	7	8	9	10
Does not Interfere										Completely Interferes

D. Normal Work (includes both work outside the home and housework)

0	1	2	3	4	5	6	7	8	9	10
Does not Interfere										Completely Interferes

E. Relations with other people

0	1	2	3	4	5	6	7	8	9	10
Does not Interfere										Completely Interferes

F. Sleep

0	1	2	3	4	5	6	7	8	9	10
Does not Interfere										Completely Interferes

G. Enjoyment of life

0	1	2	3	4	5	6	7	8	9	10
Does not Interfere										Completely Interferes

Appendix V: Baseline physiotherapy questionnaire

About you

1. How old are you? _____

2. Sex: Male Female *(please circle the appropriate answer)*

About your injury

3. Date of your first physiotherapy appointment_____

4. Date today _____

5. Have you ever carried out this type of physiotherapy exercise before? Yes / No *(please circle the appropriate answer)*

6. What type of injury do you have?

---

7. How long have you had this injury?

_____ years _____ months _____ weeks

8. Have you ever had this injury before? Yes/ No

Please circle one answer:

9. How long have you been recommended to carry out physiotherapy exercises **at the gym?**:

1-6 days	1-2 weeks	3-7 weeks	8-15 weeks	4-12 months	not sure

10. How long have you been recommended to carry out physiotherapy exercises **at home?**:

1-6 days	1-2 weeks	3-7 weeks	8-15 weeks	4-12 months	not sure

11. How many times each day or week have you been recommended to carry out physiotherapy exercises **at the gym** on average?

More than once a day	Daily	Several times a week	Once or twice a week

12. How many times each day or week have you been recommended to carry out physiotherapy exercises **at home** on average?

More than once a day	Daily	Several times a week	Once or twice a week

13. For how long have you been recommended to carry out the therapy each time you do it **at the gym?**:

1-5 minutes	6-20 minutes	21-45 minutes	Over 45 minutes

Please turn over…

14. For how long have you been recommended to carry out the therapy each time you do it **at home?**:

1-5 minutes	6-20 minutes	21-45 minutes	Over 45 minutes

15. How simple or complicated are the exercises you have to carry out **at the gym?**:

Very simple	Quite simple	Rather complicated	Very complicated

16. How simple or complicated are the exercises you have to carry out **at home?**:

Very simple	Quite simple	Rather complicated	Very complicated

We would like to know what you think carrying out the therapy will be like.

Please circle a number to show how much you expect that the experiences listed below :

1 Agree Strongly	2 Agree	3 Not sure	4 Disagree	5 Disagree strongly

Expectations for symptoms:

1. I expect the therapy will make my symptoms better	1	2	3	4	5
2. I expect I will have severe symptoms during the therapy	1	2	3	4	5
3. I expect the therapy will cause more symptoms	1	2	3	4	5

Expectations about the therapy:

4. I expect I will know how to carry out the therapy properly	1	2	3	4	5
5. I expect it will be difficult to know what to do	1	2	3	4	5
6. I expect it will be obvious that the therapy is helping	1	2	3	4	5
7. I expect the therapy will be relevant to my symptoms and problems	1	2	3	4	5
8. I expect that the therapy will be right for me	1	2	3	4	5

Practical expectations:

9. I expect that the therapy will take a lot of time	1	2	3	4	5
10. I expect it will be possible to find suitable opportunities to carry out the therapy	1	2	3	4	5
11. I expect that the therapy will take a lot of effort	1	2	3	4	5

Thank you for your time, it is greatly appreciated.
Please return your completed questionnaires in the prepaid envelope provided.

Appendix W: Information sheet & consent form1st appointment booked by letter

University of Southampton

School of Psychology

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Telephone: 023 8059 2581
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Adherence to Physiotherapy
Information sheet for potential research participants
LREC No: 04/Q1704/77

You are being invited to take part in a research study. Before you decide whether you would like to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Thank you for reading this.

What is the purpose of the study?
I am requesting your participation in a study that looks at what is important to people when they are carrying out physiotherapy. If you choose to take part, the study will involve completing questionnaires that will ask you about the treatment you are carrying out, some of your beliefs about the treatment, your mood and any pain you might experience. You will be asked to complete these questionnaires within 2 days of your first physiotherapy appointment, 2 weeks after starting and 8 weeks into treatment.

Why have I been chosen?
I am inviting you to take part as you have recently been referred to the physiotherapy department at Southampton General Hospital for treatment. I hope to recruit around 200 people to take part in my study.

Do I have to take part?
It is up to you to decide whether or not you would like to take part. If you do decide to take part, I will need you to return the consent form included in the pack, a copy of which will be sent to you. If you decide to take part you are still free to withdraw at any time and without giving a reason. However, I am interested in your views on physiotherapy no matter how you get on with your physiotherapy. A decision to withdraw from the study at any time, or a decision not to take part will in no way affect the care that you receive from the physiotherapy department.

What will happen to me if I take part?
If you choose to take part, the study will involve completing questionnaires that will ask you about the treatment you are carrying out, some of your beliefs about the treatment, your mood and any pain you might experience. Each batch of questionnaires should take about half an hour to complete. You will be asked to complete these questionnaires before you start your treatment, 2 weeks after starting and 8 weeks into treatment. If you forget to return your questionnaires once you have agreed to take part in the study, I will

send you one reminder letter with another copy of the questionnaire in case you have misplaced them. If I do not receive your questionnaires after this reminder, I will contact you once by telephone to ask whether you would still like to take part in the study. I would like to check with the physiotherapy department at the hospital, how many inpatient sessions you attend. I will also send a letter to your GP informing them that you will be taking part in this study, for professional courtesy. Your GP will not see any of the information that you give whilst in this study. Personal information will not be released to or viewed by anyone other than researchers involved in this project. Results of this study will not include your name or any other identifying characteristics.

What do I have to do?

The questionnaires will be sent to you by post with a prepaid reply envelope. The first of these will be sent to you once you have returned your consent form to me. I would like you to complete the first set of questionnaires within two days of your first physiotherapy appointment once you have been told about the treatment you will receive. 2 weeks and 8 weeks after this first physiotherapy appointment later you will be sent another batch of questionnaires. You will be asked to complete the questionnaires and return them.

What are the possible disadvantages and risks of taking part?

As this study simply involves completing questionnaires, you are not likely to experience any disadvantages or risks from taking part. The care you receive will not be influenced by whether or not you take part or if you drop out of the study as the researcher is not connected with the physiotherapy department.

What are the potential benefits of taking part?

It is unlikely that you will benefit personally from taking part in the study, however, this research is important to understanding what is important to people who are taking part in physiotherapy. I am interested in your experiences of physiotherapy no matter what they are. It is hoped that the information that we get from this study will be able to help future physiotherapy patients.

What if new information becomes available?

If information becomes available during the course of the study, you will be sent a letter detailing this new information. You will be given the opportunity to reconsider whether you want to continue with the study.

What happens when the research study stops?

If the study is stopped before you have completed all your questionnaires, you will be sent a letter informing you why the study has stopped.

What if something goes wrong?

If you are harmed by taking part in this study as a result of a breach of professional duty or negligent acts by the researcher, you will be able to claim compensation from the University of Southampton. Please note that this includes only taking part in this questionnaire study, and does not cover your physiotherapy treatment.

Will my taking part in this study be kept confidential?

All information with is collected about you during the course of the study will be kept strictly confidential. Any information about you which leaves the university will have your name and address removed so that you cannot be recognised from it.

What will happen to the results of the research study?

The results of this study will form part of my PhD research and it is hoped that the results of the study will be published as a journal paper. It is hoped that the results of the study

will be ready for publication by October 2006. If you would like to receive a copy of the final results, please let me know by stating you would like a copy of the results on any of your questionnaires. You will not be identified in any report or publication.

Who is organising and funding the research?

I, Imogen Tijou, am organising the study as part of my PhD research. I am funded by the Economic and Social Research Council. None of the clinicians involved in your treatment will receive any payment as a result of this study.

Who has reviewed the study?

This study has been reviewed by my PhD supervisors, the School of Psychology University of Southampton Ethics committee and by South and South West Hampshire Local Research Ethics Committee.

Contact for further information

Should you want any further information about this study, please do not hesitate to contact me.

Imogen Tijou
School of Psychology
University of Southampton
Highfield
Southampton
SO17 1BJ.

Tel: 02380 592581
Email: it201@soton.ac.uk

If you have any concerns about the study you may contact the Chair of the Ethics Committee, School of Psychology, University of Southampton, Highfield, Southampton, SO17 1BJ, or telephone 02380 593995.

Thank-you for taking the time to read this and I hope you will consider taking part,
Sincerely,

Imogen Tijou

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Consent Form for Research Participants

LREC No: 04/Q1704/77

Patient Identification number for this trial:_____
Title of Project: Adherence to Physiotherapy
Name of Researcher: Imogen Tijou

	Please initial box
1. I confirm that I have read and understood the information sheet dated 3.11.04 (version 2) for the above study and have had the opportunity to ask questions	☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected	☐
3. I understand that sections of any of my medical notes may be looked at by responsible individuals from the University of Southampton or from regulatory authorities where it is relevant to my taking part in research. I give permission for these individuals to have access to my records.	☐
4. I agree to take part in the above study	☐

_____	_____	_____
Name of patient	Date	Signature
_____	_____	_____
Name of person taking consent (if different from researcher)	Date	Signature
_____	_____	_____
Researcher	Date	Signature

If you would like to take part in this study, please supply contact details so that I can send you questionnaires

Please turn over...

Continued...

(please circle)
Mr Mrs Miss Other:_____

Forename *(please print)*:

_____

Surname:

_____

Address:

_____

_____

_____

_____

_____

_____

Postcode:_____

Telephone:_____

I give consent for my GP to be informed I am taking part in this study: Yes No

GP name and address:

GP Name: _____

Address:_____

_____

_____

_____

_____

Postcode:_____

Thank-you. Please send your completed screening questionnaire with this form to me in the prepaid envelope

Appendix X: Screening questionnaire 1st appointment booked by letter

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Adherence to Physiotherapy Screening Questionnaire

LREC No: 04/Q1704/77

If you would like to be involved in this study, please complete the following brief questionnaire to check that you are eligible to take part.

Name:_____

Age:

Do you have any chronic medical conditions that require you to have physiotherapy (e.g. arthritis, chronic pain)?

*Please give details*_____

_____

Are you taking part in any other research at the moment or have you recently taken part in research?

Yes ☐
No ☐

Thank you.
Please return your consent form and this questionnaire to me in the prepaid envelope.
I will be in contact with you shortly.

Appendix Y: Cover letter for participants with 1st appointment booked by letter

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Questionnaire Pack 1

LREC No: 04/Q1704/77

Dear Participant,

Thank-you very much for agreeing to take part in my study, I really appreciate it.

Please complete the questionnaires in this pack within two days after your first physiotherapy appointment. It is important that you fill these in within two days so that I can get your views of your physiotherapy right at the start.

Once you have completed the questionnaires, please return them in the pre-paid envelope provided. If I have not heard from you within a week, I will telephone you to check that you have received the questionnaires and that you are not having any problems with them.

Many thanks for your time,

Imogen Tijou

Appendix Z: Sample letter explaining ineligibility

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

LREC No: 04/Q1704/77

27th April 2005

Dear Mr XXXX,

Re: Adherence to Physiotherapy study

Thank-you very much for expressing an interest in my study. However, I am unable to accept people under the age of 18; so unfortunately you are not eligible to take part. I have included a copy of your consent form and screening questionnaire with this letter.

Many thanks for your time,

Imogen Tijou

Appendix AA: Cover letter for participants who booked 1st appointment by telephone

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Questionnaire Pack 1

LREC No: 04/Q1704/77

Dear Participant,

Thank-you for taking the time to read this information. If you would like to take part, please read on and I will explain how you can take part.

Please complete the questionnaires in this pack within two days after your first physiotherapy appointment. It is important that you fill these in within two days so that I can get you views of your physiotherapy right at the start.

Once you have completed the questionnaires, please return them in the pre-paid envelope provided.

Many thanks for your time and thank-you very much for agreeing to take part in my study, I really appreciate it,

Imogen Tijou

Appendix AB: Information sheet and consent form for participants who booked 1st appointment by telephone

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Adherence to Physiotherapy
Information sheet for potential research participants
LREC No: 04/Q1704/77

You are being invited to take part in a research study. Before you decide whether you would like to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Thank you for reading this.

What is the purpose of the study?
I am requesting your participation in a study that looks at what is important to people when they are carrying out physiotherapy. If you choose to take part, the study will involve completing questionnaires that will ask you about the treatment you are carrying out, some of your beliefs about the treatment, your mood and any pain you might experience. You will be asked to complete these questionnaires within 2 days of your first physiotherapy appointment, 2 weeks after starting and 8 weeks into treatment.

Why have I been chosen?
I am inviting you to take part as you have recently been referred to the physiotherapy department at Southampton General Hospital for treatment. I hope to recruit around 200 people to take part in my study.

Do I have to take part?
It is up to you to decide whether or not you would like to take part. If you do decide to take part, I will need you to return the consent form included in the pack, a copy of which will be sent to you. If you decide to take part you are still free to withdraw at any time and without giving a reason. However, I am interested in your views on physiotherapy no matter how you get on with your physiotherapy. A decision to withdraw from the study at any time, or a decision not to take part will in no way affect the care that you receive from the physiotherapy department.

What will happen to me if I take part?
If you choose to take part, the study will involve completing questionnaires that will ask you about the treatment you are carrying out, some of your beliefs about the treatment, your mood and any pain you might experience. Each batch of questionnaires should take about half an hour to complete. You will be asked to complete these questionnaires before you start your treatment, 2 weeks after starting and 8 weeks into treatment. If you

forget to return your questionnaires once you have agreed to take part in the study, I will send you one reminder letter with another copy of the questionnaire in case you have misplaced them. If I do not receive your questionnaires after this reminder, I will contact you once by telephone to ask whether you would still like to take part in the study. I would like to check with the physiotherapy department at the hospital, how many inpatient sessions you attend. I will also send a letter to your GP informing them that you will be taking part in this study, for professional courtesy. Your GP will not see any of the information that you give whilst in this study. Personal information will not be released to or viewed by anyone other than researchers involved in this project. Results of this study will not include your name or any other identifying characteristics.

What do I have to do?

The questionnaires will be sent to you by post with a prepaid reply envelope. The first of these is included in this pack and I would like you to complete it once you have been told about the treatment you will receive. 2 weeks and 8 weeks after this first physiotherapy appointment, you will be sent another batch of questionnaires. You will be asked to complete the questionnaires and return them.

What are the possible disadvantages and risks of taking part?

As this study simply involves completing questionnaires, you are not likely to experience any disadvantages or risks from taking part. The care you receive will not be influenced by whether or not you take part or if you drop out of the study as the researcher is not connected with the physiotherapy department.

What are the potential benefits of taking part?

It is unlikely that you will benefit personally from taking part in the study, however, this research is important to understanding what is important to people who are taking part in physiotherapy. I am interested in your experiences of physiotherapy no matter what they are. It is hoped that the information that we get from this study will be able to help future physiotherapy patients.

What if new information becomes available?

If information becomes available during the course of the study, you will be sent a letter detailing this new information. You will be given the opportunity to reconsider whether you want to continue with the study.

What happens when the research study stops?

If the study is stopped before you have completed all your questionnaires, you will be sent a letter informing you why the study has stopped.

What if something goes wrong?

If you are harmed by taking part in this study as a result of a breach of professional duty or negligent acts by the researcher, you will be able to claim compensation from the University of Southampton. Please note that this includes only taking part in this questionnaire study, and does not cover your physiotherapy treatment.

Will my taking part in this study be kept confidential?

All information with is collected about you during the course of the study will be kept strictly confidential. Any information about you which leaves the university will have your name and address removed so that you cannot be recognised from it.

What will happen to the results of the research study?

The results of this study will form part of my PhD research and it is hoped that the results of the study will be published as a journal paper. It is hoped that the results of the study

will be ready for publication by October 2006. If you would like to receive a copy of the final results, please let me know by stating you would like a copy of the results on any of your questionnaires. You will not be identified in any report or publication.

Who is organising and funding the research?
I, Imogen Tijou, am organising the study as part of my PhD research. I am funded by the Economic and Social Research Council. None of the clinicians involved in your treatment will receive any payment as a result of this study.

Who has reviewed the study?
This study has been reviewed by my PhD supervisors, the School of Psychology University of Southampton Ethics committee and by South and South West Hampshire Local Research Ethics Committee.

Contact for further information
Should you want any further information about this study, please do not hesitate to contact me.
Imogen Tijou
School of Psychology
University of Southampton
Highfield
Southampton
SO17 1BJ.

Tel: 02380 592581
Email: it201@soton.ac.uk

If you have any concerns about the study you may contact the Chair of the Ethics Committee, School of Psychology, University of Southampton, Highfield, Southampton, SO17 1BJ, or telephone 02380 593995.

Thank-you for taking the time to read this and I hope you will consider taking part,
Sincerely,

Imogen Tijou

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Consent Form for Research Participants

LREC No: 04/Q1704/77

Patient Identification number for this trial:_____
Title of Project: Adherence to Physiotherapy
Name of Researcher: Imogen Tijou

	Please initial box
5. I confirm that I have read and understood the information sheet dated 3.11.04 (version 2) for the above study and have had the opportunity to ask questions	☐
6. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected	☐
7. I understand that sections of any of my medical notes may be looked at by responsible individuals from the University of Southampton or from regulatory authorities where it is relevant to my taking part in research. I give permission for these individuals to have access to my records.	☐
8. I agree to take part in the above study	☐

_____	_____	_____
Name of patient	Date	Signature
_____	_____	_____
Name of person taking consent (if different from researcher)	Date	Signature
_____	_____	_____
Researcher	Date	Signature

If you would like to take part in this study, please supply contact details so that I can send you questionnaires

Please turn over...

Continued...

(please circle)
Mr Mrs Miss Other:_____

Forename *(please print)*:

_____

Surname:

_____

Address:

_____

_____

_____

_____

_____

_____

Postcode:_____

Telephone:_____

I give consent for my GP to be informed I am taking part in this study: Yes No
GP name and address:

GP Name: _____

Address:_____

_____

_____

_____

_____

Postcode:_____

Thank-you. Please send your completed screening questionnaire and the questionnaire pack with this form to me in the prepaid envelope.

Appendix AC: Screening questionnaire for participants who booked 1st appointment by telephone

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: jt201@soton.ac.uk

Adherence to Physiotherapy
Screening Questionnaire
LREC No: 04/Q1704/77

If you would like to be involved in this study, please complete the following brief questionnaire to check that you are eligible to take part.

Name:_____

Age:

Do you have any chronic medical conditions that require you to have physiotherapy (e.g. arthritis, chronic pain)?

*Please give details*_____
_____

Are you taking part in any other research at the moment or have you recently taken part in research?

Yes ☐
No ☐

Thank you.
Please return your consent form and this questionnaire and the questionnaire pack to me in the prepaid envelope.
I will be in contact with you shortly.

Appendix AD: Cover letter for week 2 questionnaires

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Questionnaire Pack 2
LREC No: 04/Q1704/77

Dear Participant,

Thank-you very much for taking part in my study, I really appreciate it. Enclosed is your second pack of questionnaires.

Please complete the questionnaires in this pack within two days after receiving them. I ask you to complete these within two days as it is important for me to get your views of your physiotherapy at this point in your treatment.

I would like to hear from you no matter how you have got on with your physiotherapy. The views of those who did not get on with their treatment are just as important to me as of those who did get on with their treatment.

It is very important that you complete this second pack of questionnaires otherwise I will not be able to use the information that you have already given me.

Once you have completed the questionnaires, please return them in the pre-paid envelope provided. If I have not heard from you within a week, I will send you another questionnaire pack.

Many thanks for your time,

Imogen Tijou

Appendix AE: Cover letter for week 8 questionnaires

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Questionnaire Pack 3

LREC No: 04/Q1704/77

Dear Participant,

Thank-you very much for taking part in my study, I really appreciate it. Enclosed is your final pack of questionnaires.

Please complete the questionnaires in this pack within two days after receiving them. I ask you to complete these within two days as it is important for me to get your views of your physiotherapy at this point in your treatment.

I would like to hear from you no matter how you have got on with your physiotherapy. The views of those who did not get on with their treatment are just as important to me as of those who did get on with their treatment.

It is very important that you complete this last pack of questionnaires otherwise I will not be able to use the information that you have already given me.

Once you have completed the questionnaires, please return them in the pre-paid envelope provided. If I have not heard from you within a week I will send you another questionnaire pack.

Many thanks for your time,

Imogen Tijou

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Questionnaire Pack 1
Reminder
LREC No: 04/Q1704/77

Dear Participant,

Thank-you very much for taking part in my study, I really appreciate it. Enclosed is your first pack of questionnaires. If you have already returned the questionnaires to me, please ignore this reminder which was sent before I received them.

Please complete the questionnaires in this pack within two days after receiving them. I ask you to complete these within two days as it is important for me to get your views of your physiotherapy right at the start.

Once you have completed the questionnaires, please return them in the pre-paid envelope provided. If I have not heard from you within a week, I will telephone you to check that you have received the questionnaires and that you are not having any problems with them.

If you have decided that you do not want to fill out any more questionnaires, simply return your unanswered questionnaire in the pre-paid envelope, and I will not contact you again.

Many thanks for your time,

Imogen Tijou

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Questionnaire Pack 2
Reminder
LREC No: 04/Q1704/77

Dear Participant,

Thank-you very much for taking part in my study, I really appreciate it. Enclosed is your second pack of questionnaires. If you have already returned the questionnaires to me, please ignore this reminder which was sent before I received them.

Please complete the questionnaires in this pack within two days after receiving them. I ask you to complete these within two days as it is important for me to get your views of your physiotherapy at this point in your treatment.

I would like to hear from you no matter how you have got on with your physiotherapy. The views of those who did not get on with their treatment are just as important to me as of those who did get on with their treatment.

It is very important that you complete this pack of questionnaires otherwise I will not be able to use the information that you have already given me.

Once you have completed the questionnaires, please return them in the pre-paid envelope provided. If I have not heard from you within a week, I will telephone you to check that you have received the questionnaires and that you are not having any problems with them.

If you have decided that you do not want to fill out any more questionnaires, simply return your unanswered questionnaire in the pre-paid envelope, and I will not contact you again.

Many thanks for your time,

Imogen Tijou

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

Questionnaire Pack 3
Reminder
LREC No: 04/Q1704/77

Dear Participant,

Thank-you very much for taking part in my study, I really appreciate it. Enclosed is your final pack of questionnaires. If you have already returned the questionnaires to me, please ignore this reminder which was sent before I received them.

Please complete the questionnaires in this pack within two days after receiving them. I ask you to complete these within two days as it is important for me to get your views of your physiotherapy at this point in your treatment.

I would like to hear from you no matter how you have got on with your physiotherapy. The views of those who did not get on with their treatment are just as important to me as of those who did get on with their treatment.

It is very important that you complete this last pack of questionnaires otherwise I will not be able to use the information that you have already given me.

Once you have completed the questionnaires, please return them in the pre-paid envelope provided. If I have not heard from you within a week, I will telephone you to check that you have received the questionnaires and that you are not having any problems with them.

If you have decided that you do not want to fill out any more questionnaires, simply return your unanswered questionnaire in the pre-paid envelope, and I will not contact you again.

Many thanks for your time,

Imogen Tijou

Appendix AG: Field debriefing statement

University of Southampton

School of Psychology

University of Southampton
Highfield
Southampton
SO17 1BJ
United Kingdom

Telephone: 023 8059 2581
Fax: 023 8059 4597
Email: it201@soton.ac.uk

LREC No: 04/Q1704/77

Debriefing statement

Dear Participant,

Re: Adherence to Physiotherapy study

Thank-you for participating in my study. The aim of the study was to look at what was important to people when they were carrying out their physiotherapy. The study is now complete and the results have been analysed. These results showed that three main sets of beliefs were important to people whilst they were carrying out their physiotherapy. The first of these was whether people believed the physiotherapy would be pleasurable to complete. The second was how strongly people believed they would be able to complete the physiotherapy despite encountering problems. The last was the level of pain experienced.

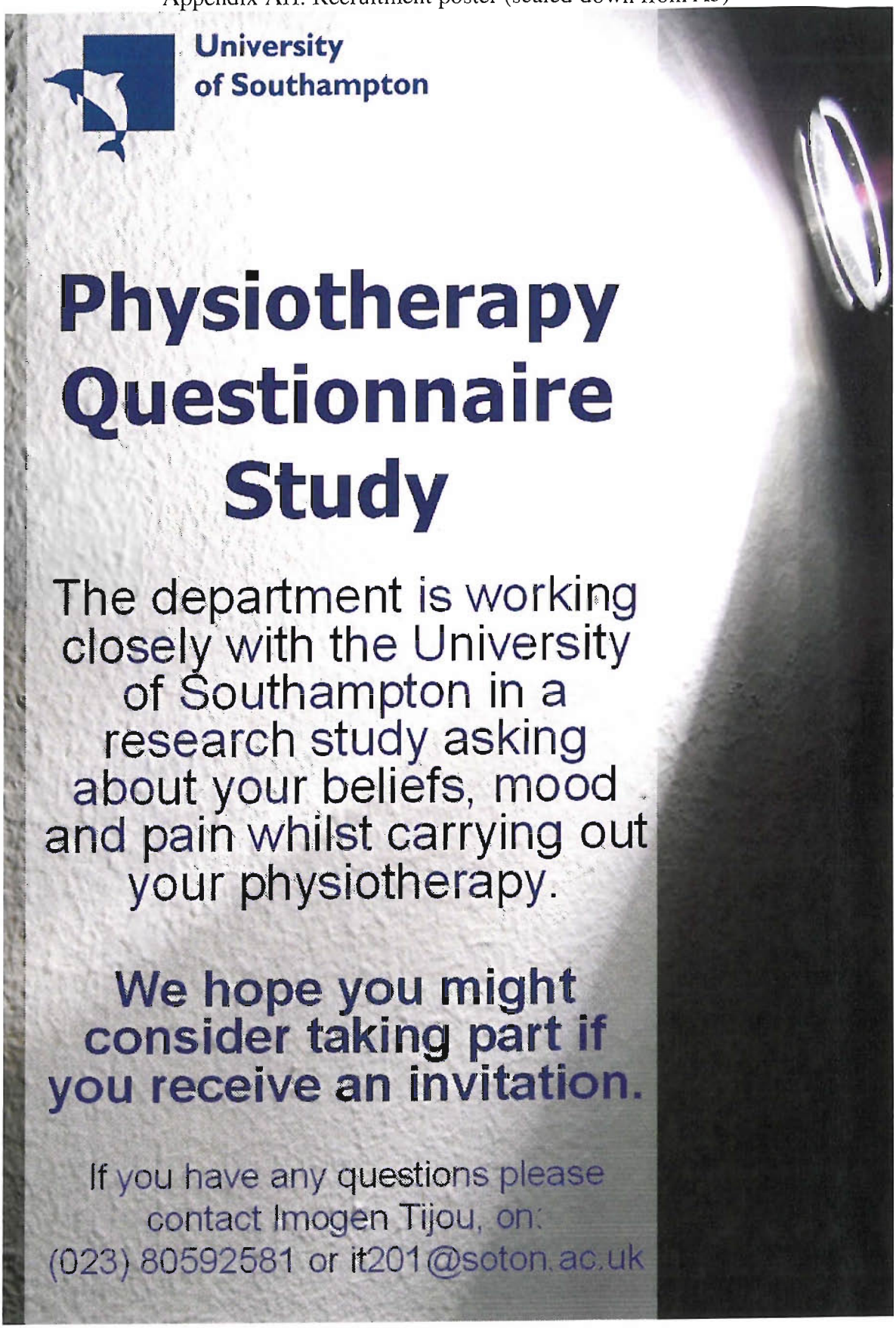
I am aiming to publish the results in an academic journal. It is hoped that the information that we get from this study will be able to help future physiotherapy patients. Please be reassured that you will not be identified in any report or publication.

If you have any further questions, please do not hesitate to contact me using the details given above.

Many thanks for your time,

Imogen Tijou

Appendix AH: Recruitment poster (scaled down from A3)



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Belza, B., Topolski, T., Kinne, S., Patrick, D. L., & Ramsey, S. D. (2002). Does adherence make a difference? Results from a community-based aquatic exercise program. *Nursing Research, 51,* 285-291.

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