Supplementary File 1: Enhanced education provided in Pain Science Education, including in-person sessions (Table 1) and at home activities between the in-person sessions (Table 2).

THE 'USUAL' STORY OF KNEE OA (Standard) *(From Arthritis Australia booklet)*	Session	THE 'MODERN' STORY OF KNEE OA *The 'usual' story +* <u>*current understanding of pain*</u>	Session
What is osteoarthritis? OA is a condition that affects the whole joint including bone, cartilage, ligaments and muscles.	1	OA affects the whole joint – but it is a condition that also effects the *whole of you* (- it's not just about 'wear and tear'). Wear is ok!	2, 3 & 4
OA tends to come on slowly. Joint pain or stiffness is usually worst with activity initially but can become more constant in later disease.	1	Progressive decline is <u>not</u> inevitable - even people with advanced OA can improve.	2 & 4
What causes osteoarthritis? Risk factors for OA include being overweight, having a previous knee injury or a job involving lots of kneeling or squatting, and getting older.	1	Having risk factors for OA does not mean that you can't improve with the right treatment. We all have 'wrinkles on the inside' (- aging is no excuse!)	2 & 4
Symptoms are variable but often affect your ability to do normal daily activities.	1	Bioplasticity means that being able to return to and gradually increase your daily activity is a reasonable expectation.	3 & 4
Your doctor may refer you for an x-ray of your knee (or another type of scan) to assist with the diagnosis of osteoarthritis.	2	The severity of changes shown on a knee x-ray do not have much relationship with how much pain you currently have or are likely to have in the future. Pain is complex and influenced by many things – not just what's going on in your knee.	2 & 3
There is no cure for OA, but treatments can help to reduce symptoms and maintain function.	2	It may be beneficial to review current treatments based on new knowledge. Learning about pain is an effective treatment – but learning and change takes time	1 & 4
If you are overweight, losing weight is key to managing osteoarthritis	2	Being overweight increases the load through your knee, but can also contribute to the progression of joint changes via	2, 3 & 4

		the hormones/chemicals that circulate throughout your body if you are overweight.	
Doing regular physical activity can help to reduce your pain, strengthen your muscles, maintain your joint function and improve your sleep and overall health.	**3**	Regular physical activity has countless health benefits (at any age) and enhances bioplastic change in your *whole* system. This helps make your system *less* sensitive = able to do more with less pain. There is very strong evidence that activity and exercise are safe and do not lead to further structural damage.	**3 & 4**
It is normal to feel some pain in your muscles when you start an exercise program or new activity. However, if pain feels unusual or severe, or lasts for more than 2 hours after you have stopped, it is probably best to avoid or change that activity.	**3 & 4**	Understanding what pain means can powerfully influence pain. It is often not necessary to stop an activity if it is painful. Your own brain can make powerful medications to reduce pain.	**All**

Table 1. Educational topics in the Usual care [standard education] control group and enhanced education provided in the Pain Science Education intervention group

MESSAGE		
Target Concept (Linked to Objectives)	**Content** (Syllabus)	**Delivery & Resources** (Homework tasks in ***bolded italics***)
Introduction to Pain Education (beginning of <u>session 1</u>): • <u>Holistic confrontation</u>: pain mechanisms model (educationally sound) – a 'big picture' overview (visual model/drawing). • Link to what is to follow…. talk about 4 visits… What will I do?/What will you do? (provide general overview, discuss goals and expectations)		
1. Learning about pain can help reduce pain and enhance physical activity	• There is evidence that PSE is beneficial for in other conditions - and the evidence also suggests that it will work for people with knee OA • Knowledge itself can be analgesic • Knowledge can open the 'drug cabinet in the brain' • Pain education is relevant for *all* pain • Knowledge changes the way you think about movement • The right knowledge can allow you to move very differently	• EP p. 8-11 • EP evidence (EPS Ch. 4; other relevant studies) • Knowledge is analgesic (EPS Nugget 54, p.190) • ***Homework:*** • ***EPH 112-113: 'Tool 1: Education and understanding'*** • ***EPH 5***
2. Pain is always real	• You are not alone (e.g. 1 in 2 people >65yrs and 4m adults of working age have painful OA) • Emotional and physical pain are intertwined • There is no test for pain or love • You are the expert on your pain • Pain is a 'gift' and is necessary for survival	• Statistics for OA/OA Knee – including OA pain epidemiology • Congenital analgesia example. • Picture of a fMRI image of pain in the brain (orient participants to brain areas) • EPS Nugget 2 p.175 (Pain is a defender not an offender)
3. There are danger detectors, not pain detectors	• There are no pain endings, pain fibres, pain pathways or pain signals • The danger alarm system • Danger detectors: there are lots of them and they can change • Danger messages can be altered in many places (in the tissues, the spinal cord and in the brain) • Danger detectors can be active all the time – but we are not necessarily in pain all the time (give non-knee example – and then link to knee via discussion of low grade inflammation). • 'Danger' signals from your knee are represented in your brain (re-visit: the knee in the brain)	• EPH 7 (no hunger signals), 8-9 (info to fill in on their own, pain not relating to damage) • EP 28-39 • Draw the danger pathway and discuss input types (chemical, mechanical, temp) • EPS Nugget 19, p.178 (Lucky us – no pain endings); <u>video clip</u> for this one. • EPS Nugget 18, p.177 (Danger detectors – the great givers of life) •
Session 1 re-cap: • Knowledge is power – the more you understand the more helpful it will be. It will help future-proof you…		

- Your pain is mostly invisible but we know for sure that it's real
- We also know that impulses from your knee tell you about danger – but those messages on their own are not enough to make pain.
- Let's go back to the drawing… the key thing to understand is that humans are completely adaptable! There are so many places that your system can change (your knee can get healthier, with healthy movement and less stress the brain can change…and then what the brain produces can further change things in the knee….
- You are starting to understand these things so you are on your way….

Revision (beginning of <u>session 2</u>): What did you take from last week? Could you describe what you learned to someone else?
Reflection on readings, re-cap on 'danger' detector/messages/pathways

4. Radiographic changes usually do not relate to pain or to prognosis **&** **What else is going on in the tissues and how does it relate to pain?**	• Identifiable changes on x-ray are *not* pain and many people without pain have these changes too • Amazing pain stories • Pain is an unreliable indicator of tissue damage • We don't treat x-rays or scans • When *are* scans important? • 'Phew, it's only arthritis! - We will offer an alternative (more complete) explanation for your OA pain. (- promise!)	• EP p. 12-15 (Amazing pain stories) • Stages of OA and % without pain (stats/graph) • Positive scans in pain-free people (x-rays) • News story of the runner with 'terrible' knees • Scans are often important in the case of suspected # (following a fall) or suspicion of serious pathology (rare) • EPS Nugget 16 p.177 (We stop feeling it way before we stop healing it) • EPS Nugget 67 p. 194 (We grow like trees) • *If participants bring up MRI findings, have resources/explanation ready
5. Pain is completely dependent on context	• What is distributed brain activity? • Thoughts and beliefs are nerve impulses too (linked to distributed brain activity) • What is context? (The current situation you are in; your temporary state that is informed by everything going on *in and around* you: the things you hear, see, smell, taste and touch; the things you do and things you believe…). • Context, like your pain experience, is individual and unique • Usually you are not fully aware of context and its effect • Knowledge is context too • Short mirror neuron explanation/example/story.	• Complete the previous danger pathway drawing to include the brain • EPH 11 (why do I hurt) • EP 18-21 • EPS Nugget 46 p.188 (Plumbers and poos, electricians and zaps) • EP 38-41 (distributed processing) • Images which depict complex, interconnected dynamic networks (e.g., airline flight paths, the brain as an orchestra) • EPS Nugget 5 p. 174 (Grandma is distributed in the brain) • Mirror neuron activity: imagine a past experience of being active; moving easily and pain free….or reflect on how your knee might hurt if you even think about moving in a certain way.

6. Pain depends on the balance of danger and safety - PART 1	- Modern pain definitions - Introduce DIMs, SIMs and DIM/SIM balance - Introduce DIM/SIM part of the Protectometer - The 'on alert' zone (between 0 and 1 on the protectometer – have I got a headache or not?) - DIMs and SIMs hide in hard to find places - Danger and safety 'patterns of brain activity' - Link to patterns of brain activity related to danger signals from your knee (unity of systems)	- EPH 13-23 (DIMs/SIMs & Protectometer) - Lorimer Moseley's TED talk: snake story - EPS Nugget 50 p.189 Bilby in the bath – - Work through DIMs and SIMs relevant to walking - Exercise – danger/safety wheel (EPH p. 15); links to individualised context - Danger/safety specific to physical activity ***Homework: Personal Protectometer at home - consider DIMs and SIMs more broadly***
Introduction to bioplasticity (Target concept 9.)	Reflect on the power of healing	

Session 2 re-cap:
- Scans are only one part of the story. What's going on in your knee may be responsible for danger signals but these can be modified by everything else that is going on in your system and your brain. X-rays usually don't relate to the pain that you feel or how much pain you will have in your future – because the changes in your knee are only a tiny part of you and are a normal adaptation to life.
- We are bioplastic: pain can be modified by anything – even changing the way you think about what's going on in your knee can change the pain that you feel. But the pain you experience with your osteoarthritis is about so much more than your knee…

Revision (beginning of <u>session 3</u>): Work through DIMs/SIMs identified in homework task.

6. Pain depends on the balance of danger and safety – PART 2	- Explore DIMs and SIMs at play more broadly - DIMs and SIMs often hide in hard to find places - SIMS open up the drug cabinet in the brain, DIMS close the door. - There is a neuroscience rationale for increasing SIMs to reduce pain - Return to the OVERVIEW DIAGRAM and add anything new that comes up from review of DIMs and SIMs - Discuss changes in/at the synapse	- Consider context in walking program: boosting SIMs - Identify super-DIMs and break them down? - Some DIMs can't be changed, but acknowledging them and understanding that they have impact can change them or alter their impact - Identify super-SIMS - Give them a DIM/SIM challenge(s)
	The pain protective system can become "turned up and edgy"	EP 70-79, 82-83 (The sensitised central alarm system)

7(a). The pain system can become overprotective	• Overprotection is understandable; it makes you super safe (the brain is actually trying to help!) • Increased protective, safety buffer. • The "orchestra" repeats the pain and only plays the pain tune • Flare-ups are inevitable, common and understandable; understanding about them helps them resolve quicker • You are able to 'wind down' this overprotection (movement and knowledge are highly important)	• Refer to DIAGRAM and add to it to show enhanced sensitivity in the dorsal horn and the brain • *Homework:* • *Kangaroo tracks in the brain* • *Twin peaks model EP p. 119*
7(b). Pain is only one of many protective outputs that can also become over-protective	• Introduction to other protective systems including endocrine, immune, motor, cognitive, respiratory, sympathetic. • The increased sensitivity of the protective system also involves body systems apart from pain (immune, endocrine, etc.) • Inflammation, movement and stiffness are protective outputs too, e.g. knee giving way • Protective systems have an adaptive purpose – but they can become unhelpful when they are overprotective • Your thoughts and emotions are protective outputs too • ? Focus on endocrine system as an example	• EPH p. 24: blue brain; • EPH p. 27: pink brain • EPS Nugget 35 p. 184 (Stress and swelling) • EPS Nugget 38 p. 185 (rest and digest) • EPS Nugget 42 p. 186 (fingernails grow faster on holidays) • EPS Novella 10 p. 213 (Protectometer for stress, fatigue and anxiety) – if relevant • *Homework: Turned up, edgy systems' exercise (EPH 27)*

Re-cap session 3:
- When the DIM SIM balance isn't ideal, body systems can become overprotective.
- The pain system can become overprotective at many levels of the system – but you are capable of 'winding down' the protective system. You have your own personal drug cabinet in your brain and the DIM/SIM balance determines whether the door is open or closed. There are many ways to start to change this balance….
- There is a good and a bad side to bioplasticity – new pathways can be formed in the brain

Revision (beginning of <u>session 4</u>): Check in – how are they going? Seek self-explanation. Revise list of target concepts and what they mean for the individual. Further discuss the importance of context in making progress with activity/exercise goals

9. We are bioplastic throughout our lifespan **INTRODUCED IN PREVIOUS**	• What is bioplasticity? • Bioplasticity occurs in the brain's representation of the knee and in the knee structure itself (link to 'wear') • Bioplasticity occurs in all body systems, throughout the lifespan • There is a dark and a bright side to bioplasticity • Why understanding bioplasticity increases hope • The number of danger detectors (and their sensitivity) can change; DRH can change (# of receptor and sensitivity); brain can change (structural and functional changes; DIMs/SIMs)	• EPH 30-32 • EPS Novella 14 p.218 (Your ever changing brain) • Example of an older person taken up sport (or learning new skills) • Dealing with DIMs

SESSIONS: Emphasis is now on activity-focussed bioplasticity	• Virtual body and homunculus – the knee in the brain (link to changes in motor function and activity).	
10. Active treatment strategies promote recovery	• Evidence-based treatment options for OA. • Contrasting active and passive treatments • Move smart (pacing and not overdoing it, moving is learning) • Goal setting • Use your own drug cabinet (endogenous versus exogenous medication) • Have optimal linguistic expression in relation to OA and activity (e.g. avoid "wear and tear") • The place of pills • Exercise and activity enhance bioplastic change and have an important impact on your safety buffer • Flare-ups are common (and may enhance bioplastic change). Discuss strategies for what to do in the case of a flare up.	• Example of what active and passive means • EP 80-81, 94-107 • EPH 34-48 • *Homework: YouTube: 'Brainman stops his opioids' and 'Drug cabinet in the brain'* • EPS Novella 9 p. 212 (Movement, the SIM-fest!) • Re-visit twin peaks model • *Homework: EP 116-119: pacing and graded exposure*
SUMMARY: The modern story of osteoarthritis	i. OA affects the whole joint – but it is a condition that also effects the whole of you (- it's not just about 'wear and tear'). Some wear is ok! ii. Progressive decline is not inevitable - even people with advanced OA can improve. iii. Having risk factors for OA does not mean that you can't improve with the right treatment. We all have 'wrinkles on the inside' (- aging is no excuse!) iv. Bioplasticity means that being able to return to and gradually increase your daily activity is a reasonable expectation. v. The severity of changes shown on a knee X-Ray do not have much relationship with how much pain you currently have or are likely to have in the future. Pain is complex and influenced by LOTS of things – not just what's going on in your knee. vi. It may be beneficial to review current treatments based on new knowledge. Learning about pain is an effective treatment – but learning and change takes time…. vii. Being overweight increases the load through your knee, but can also contribute to the progression of joint changes and via the hormones/chemicals that circulate throughout your body if you are overweight. These also influence your sensitivity. viii. Regular physical activity has countless health benefits (at any age) and enhances bioplastic change in your whole system. There is very strong evidence that activity and exercise is safe and does not lead to further structural damage. ix. Understanding what pain means can powerfully influence pain. It is often not necessary to stop an activity if it is painful. Your own brain has powerful mechanisms of reducing pain.	

Table 2. In-depth session specific Pain Science Education intervention, including homework. OA, Osteoarthritis; EP, Explain Pain; EPS, Explain Pain Supercharged; EPH, Explain Pain Handbook.

Supplementary File 2: In-person treatment session by session breakdown for each group.

Treatment component	Interventions - Graded walking program combined with:		Timing Considerations
	Standard Education + Sham US (Control)	*Enhanced education (PSE)*	
Session 1			To more closely match treatment duration and therapist time between groups, the Control group will have:
Baseline assessment	Standard physical examination Standard subjective examination	Standard physical examination Enhanced subjective examination ('standard' + identification of participants' education targets for PSE).	
Education	General education Provide inactive ultrasound to 4 locations on the most painful knee (~5 mins each). Introduce participants to the AA handbook (to take home)	Enhanced education Introduce participants to 'Explain Pain Handbook' and the 'The Protectometer' (to take home)	1. Increased time taken for the Standard physiotherapy assessment (go slow!) 2. Inactive ultrasound application
Graded walking program	Instructions for following week re: Establish baseline walking tolerance that does not result in sustained, increased pain following walking (for next session)		
Session 2			For Sessions 2-4: To more closely match treatment duration and therapist time between groups, the Control group will have:
Assessment	Standard subjective and physical re-assessment	Brief subjective evaluation and re-cap of session 1	
Education	General education Discussion of x-ray findings (read interpretation section) Provide inactive ultrasound to 4 locations on the most painful knee (~5 mins each).	Enhanced education Discussion of x-ray findings (focus on normal age-related changes; positive reframing of structural findings)	1. A longer re-assessment at the beginning of the session
Graded walking program, goal-setting	Use baseline walking tolerance to calculate a 'start' walking level and set a walking program for the week ahead. Set activity goals (short and long term)		
Session 3			2. Inactive ultrasound application
Assessment	Standard subjective and physical re-assessment	Brief subjective evaluation and re-cap of sessions 1&2	

Education	General education Provide inactive ultrasound to 4 locations on the most painful knee (~5 mins each).	Enhanced education	
Graded walking program	Check in. Increase activity by 10% during the next week. Discuss general principles of activity pacing. Provide the Practical considerations of activity handout		
	N/A	Discuss and consider context when planning walking/activity this week	
Session 4			
Assessment	Standard subjective and physical re-assessment	Brief subjective evaluation and re-cap of sessions 1-3	
Education	General education Provide inactive ultrasound to 4 locations on the most painful knee (~5 mins each).	Enhanced education	
Graded walking program, goal-setting	Check in. Increase activity by 10% during the next week. Set-up walking and general activity plan over the next 4 weeks.		
	Discuss flare-ups and how to reduce activity.	Review flare-ups – what they mean (pain science) and the activity plan.	

US, Ultrasound; PSE, Pain Science Education; AA, Arthritis Australia.

Supplementary File 3: Questionnaires to gather participant and clinician perceptions on intervention acceptability

Participant Experience Questionnaire

(Credibility – 1, 2, 3; Acceptability – 4, 5, 6; Perceived usefulness – 7, 8, 9, 10)

Consider the following statements and place a tick in the box that best describes your response:

	Strongly disagree	Disagree	Unsure	Agree	Strongly agree
1. I would recommend this treatment to other people with knee osteoarthritis					
2. I had confidence in the expertise of the Physiotherapist who treated me					
3. It was easy to believe what the Physiotherapist told me					
4. I enjoyed attending the treatment sessions					
5. The treatment sessions were relevant to me					
6. It was worthwhile attending the treatment sessions					
7. The treatment sessions have increased my knowledge and understanding					

8. As a result of the treatment sessions I am likely to increase my activity level in the **short** term (the next 3-6 months)					
9. As a result of the treatment sessions I am likely to increase my activity level in the **long** term (beyond 3-6 months)					
10. The treatment sessions have changed the way I think about my knee pain					

Participant short answer questions

Please provide a short answer to the following questions:

1. What did you like most about the treatment that you received?

_____

_____

_____

2. What did you like least about the treatment that you received?

_____

_____

_____

3. Do you have any suggestions for how the CONTENT of the treatment sessions could be improved?

_____

_____

_____

4. Do you have any suggestions for how the FORMAT of the treatment sessions could be improved? (e.g. number of sessions, duration of sessions)

_____

_____

_____

Clinician Short Answer Questions

<u>After each participant:</u>

1. Do you think the participant considered the intervention to be an acceptable treatment?

    Yes   /   No (circle). If 'No': please describe any aspects that were not well accepted.

_____

_____

_____

At the end of the study:

Please provide a short answer to the following questions:

1. Briefly describe your experience as the therapist delivering the Pain Science Education/Control intervention in this study:

_____

_____

_____

2. Do you have any suggestions for how the CONTENT of the treatment sessions could be improved?

_____

_____

_____

3. Do you have any suggestions for how the FORMAT of the treatment sessions could be improved? (e.g. number of sessions, duration of sessions)

_____

_____

_____

4. Do you have any other suggestions?

_____

_____

_____

Supplementary File 4: Content analysis of the participant short questionnaires at 4 weeks, 8 weeks and 6 months.

FEEDBACK FORMS	PAIN SCIENCE EDUCATION			CONTROL		
	Week 4	**Week 8**	**6 month**	**Week 4**	**Week 8**	**6 month**
Likes	3 x friendly staff 3 x increasing knowledge of pain 2 x personal interaction 2 x teaching of content 1 x Non-invasive 1 x set goals 1 x importance of keeping active 1 x confidence	2 x at home 2 x Focused goals 1 x motivation 1 x DIM/SIM daily 1 x awareness 1 x Flexible schedule 1 x importance of home tasks	4x Knowledge of pain 3 x benefits 2 x not considered 'treatment' 1 x importance of keeping active 1 x teaching style	5 x knowledge-exercise is safe 4 x Confidence 3 x professional staff 2 x Friendly 2 x ultrasound 1 x gait improvements 1 x benefits (hope)	3 x goals specific & manageable 3 x consistent walking 2 x Encouragement 2 x Confidence 1 x at home (easier) 1 x make time for activity	2 x Confidence 2 x benefits (hopeful) 1 x thankful for opportunity 1 x decrease pain
Dislikes	7 x nothing 1 x takes time to see change	3 x None 2 x time (similar questions each week) 1 x heavy concepts (struggled to understand) 1 x Missed call (disappointed)	4 x None 1 x travel to uni 1 x time required for follow up	4 x Nothing 3 x no answer 2 x repetition 1 x squats	3 x nothing 2 x no answer 1 x paperwork 1 x repetition 1 x missed face to face contact 1 x ongoing time commitment	1 x minimal improvement 1 x getting to sessions 1 x pushing through pain 1 x time required 1 x lost confidence 1 x nothing
Content	3 x No changes needed 2 x No response 1 x too early to say (want whole program 1st) 1 x exercises with physio 1 x use a powerpoint or display	5 x no changes 1 x use medical drawings 1 x manageable currently 1 x simplify (wording)	3 x No changes needed 1 x Explain plain book good 1 x increased pain medication/surgery discussion 1 x simplify book	6 x No changes needed 1 x repetition 1 x testimonies of similar patients	3 x no changes needed 2 x No response 1 x sufficient currently 1 x specify self motivation needed for at home tasks 1 x more research summaries (study links)	5 x no changes needed 1 x increased ultrasound 1 x more phone calls 1 x research summaries

Improvement	2 x reasonable currently 1 x Probe questions- check patient understands 1 x structured appt times (limit to length) 1 x condense sessions	1 x more calls 1 x folder/booklet to hold all worksheets 1 x wish it continued 1 x general discussion of weather impacting OA	3 x no changes 1 x include pain log sheet to track improvements 1 x group session instead of individual 1 x more follow up	5 x no changes needed 3 x no response 1 x walking group rather than individual 1 x condense content 1 x consistent time of appointments	4 x no changes needed 1 x No response 1 x space appointments fortnightly 1 x reformat diary (more user friendly) 1 x consider impact of co-morbidities on participation	5 x No changes needed 1 x increased contact in follow up period

Supplementary File 5: Content analysis of participant verbal interviews at 4 and 8 weeks.

PHONE CALLS	PAIN SCIENCE EDUCATION		CONTROL	
	Week 4	**Week 8**	**Week 4**	**Week 8**
General comments	6 x learning new information 5 x informative 5 x friendly/professional staff 4 x unexpected or non-traditional approach 3 x books excellent	5 x happy 4 x homework 4 x more movement 2 x learning 2 x opportunity (thankful) 2 x walking 1 x bad pain 1 x okay 1 x weather effects 1 x sore at times	7 x physio 6 x excellent experience 6 x increased confidence 5 x increased awareness 4 x ultrasound 3 x mindset shift 3 x professional 1 x unexpected 1 x frightened to move	5 x positive 4 x pain limiting movement 4 x motivation 4 x physio 3 x good 3 x overdid it (+ new injury) 2 x mindset 2 x easy to follow 2 x informative
Likes	5 x physio staff 3 x education component 2 x well-spaced content (small bites info) 2 x got me out of house 1 x Explain Pain concept (Pain Science Education) 1 x forced action 1 x increased motivation	4 x at home flexibility (scheduling) 4 x self-motivating 3 x all good 1 x phone calls to clarify	6 x increasing exercise (see improvement) 4 x no jargon (in books) 3 x all of it 3 x ultrasound 3 x having opportunity 1 x no use-by-date for knee	6 x easy to follow 3 x reinforcing 3 x accountability 2 x checking workbook 1 x on-time
Dislikes	5 x nothing 1 x building temperature (unclear but likely too cold)	3 x none 2 x time to complete all tasks	7 x nothing 2 x repetition	4 x repetitive 4 x miss ultrasound 2 x miss face to face

	1 x detailed information	1 x books wordy on own 1 x easier with physio for Qs	1 x missing goals that had been set	1 x paperwork
Content	7 x very happy with current set up 1 x used to doing homework so no problem 1 x understand purpose now 1 x consider using a screen/computer display 1 x straightforward 1 x clearly presented	4 x happy (no changes) 4 x straightforward 1 x clarify meaning 'pacing- other activities' when goal setting by self 1 x full on (level/amt of reading) 1 x needed self-discipline to complete	7 x positive messaging is good 7x liked positive messaging 6 x no changes needed 5 x ultrasound good 2 x liked face to face	4 x workbook good/clear 1 x exercises with physio (traditional model) 2 x easy to forget
Improvement	2 x no changes 2 x face to face works to discuss Qs as come up 1 x shorter time period 1 x tell medical doctors about this 1 x exercises to do with physio (as supplement)	8 x no changes	6 x no changes needed 2 x parking 2 x more ultrasound 1 x repetition	7 x no changes needed 1 x group activity 1 x consider mental health impacts of missing goals
Travel/practicalities	6 x No issues 1 x sick-rescheduled no probs 1 x very professionally handled 1 x appointment rescheduled (preferred time not available) 1 x parking	8 x no problems 1 x missed call-rescheduled easily	4 x sessions too long 3 x used public transport 2 x credible because UniSA 1 x weekend call (good flexibility)	5 x no problems 2 x phone good 1 x on-time 1 x flexibility of scheduling

Supplementary File 6: Sensitivity analysis for clinical and physical activity outcomes (baseline data carried forward)

	Pain Science Education			Control		
	Baseline - 4 wks	Baseline – 8 wks	Baseline – 26 wks	Baseline – 4 wks	Baseline – 8 wks	Baseline – 26wks
Avg pain (rest) most painful knee	**-1.5 (-2.6 to -0.4)***	-0.3 (-1.7 to 1.1)	-0.6 (-1.8 to 0.6)	-1.7 (-3.9 to 0.4)	**-1.9 (-4.0 to -0.0)***	-1.6 (-3.9 to 0.7)
Avg pain (walking) most painful knee	**-1.4 (-2.7 to -0.1)***	**-1.4 (-2.7 to -0.1)***	-0.5 (-1.6 to 0.6)	**-1.9 (-3.2 to -0.5)***	**-2.4 (-4.0 to -0.8)***	-1.9 (-3.9 to 0.1)
Avg pain (rest) least painful knee	-1.5 (-3.1 to 0.1)	-0.7 (-3.0 to 1.6)	-0.8 (-3.0 to 1.3)	**-2.1 (-4.1 to -0.1)***	-1.3 (-3.2 to 0.7)	-1.2 (-3.7 to 1.4)
Avg pain (walking) least painful knee	-0.9 (-3.6 to 1.8)	-2.1 (-4.3 to 0.1)	-0.7 (-2.4 to 0.9)	-0.8 (-3.9 to 2.3)	-0.6 (-2.8 to 1.6)	-1.6 (-6.0 to 2.9)
WOMAC overall	**-12.3 (-20.5 to -4.0)***	**-10.3 (-18.7 to -1.9)***	**-**7.7 (-16.0 to 0.6)	-8.4 (-18.3 to 1.6)	-10.1 (-21.4 to 1.2)	**-**3.6 (-12.8 to 5.6)
WOMAC Pain	**-3.1 (-5.5 to -0.7)***	**-2.5 (-4.1 to -0.9)***	-1.4 (-3.0 to 0.2)	-2.4 (-5.0 to 0.3)	-2.8 (-5.7 to 0.2)	-1.9 (-4.6 to 0.8)
WOMAC Function	**-9.2 (-15.7 to -2.6)***	**-7.8 (-15.1 to -0.5)***	-6.3 (-13.8 to 1.2)	-6.0 (-13.8 to 1.8)	-7.4 (-16.7 to 2.0)	-1.7 (-8.4 to 5.0)
PSFS Activity 1	0.6 (-0.2 to 1.4)	1.2 (-0.0 to 2.4)	0.5 (-1.1 to 2.1)	0.8 (-0.8 to 2.4)	0.7 (-1.8 to 3.2)	0.5 (-1.2 to 2.1)
PSFS Activity 2	0.6 (-0.0 to 1.2)	**0.9 (0.2 to 1.6)***	0.6 (-0.4 to 1.6)	1.5 (-0.5 to 3.5)	1.0 (-1.3 to 3.3)	0.9 (-0.0 to 1.8)
PSFS Activity 3	0.6 (-0.0 to 1.2)	**0.9 (0.1 to 1.7)***	0.3 (-1.0 to 1.6)	0.8 (-1.6 to 3.1)	1.1 (-2.0 to 4.2)	1.4 (-0.1 to 2.9)
PSEQ	**10.2 (2.9 to 17.5)***	**7.9 (2.7 to 13.1)***	6.1 (-0.1 to 12.3)	2.9 (-1.1 to 6.8)	**3.7 (0.4 to 7.0)***	-1.0 (-5.4 to 3.5)
Brief FoM	0.0 (-2.7 to 2.7)	-1.2 (-3.8 to 1.4)	1.7 (-0.7 to 4.1)	**-2.2 (-4.0 to -0.4)***	-2.2 (-4.8 to 0.4)	-2.1 (-4.6 to 0.4)
PCS	2.1 (-2.4 to 6.5)	-0.9 (-5.6 to 3.9)	0.9 (-3.8 to 5.6)	-3.4 (-7.5 to 0.7)	-4.3 (-9.3 to 0.7)	-4.4 (-11.5 to 2.7)
PBQ – Organic	**6.7 (1.0 to 12.4)***	**7.2 (2.2 to 12.2)***	**4.3 (0.4 to 8.2)***	2.6 (-0.5 to 5.6)	1.7 (-1.3 to 4.7)	**3.1 (0.6 to 5.6)***
PBQ – Psych	-0.7 (-3.7 to 2.3)	0.3 (-2.1 to 2.7)	0.2 (-2.9 to 3.3)	-1.9 (-5.1 to 1.4)	-1.2 (-4.0 to 1.6)	-0.2 (-2.5 to 2.2)
rNPQ	**2.2 (0.4 to 4.0)***	**2.4 (0.7 to 4.1)***	**2.1 (0.2 to 4.0)***	0.7 (-0.3 to 1.7)	0.8 (-0.1 to 1.7)	0.5 (-0.7 to 1.7)
Avg daily step count (steps/day)	N/A	**1313 (254 to 2372)***	368 (-301 to 1038)	N/A	77 (-1323 to 1478)	766 (-642 to 2175)
Avg daily sedentary time (mins/day)	N/A	**1313 (254 to 2372)***	368 (-301 to 1038)	N/A	77 (-1323 to 1478)	766 (-642 to 2175)
Avg daily light time (mins/day)	N/A	-17 (-95 to 61)	**-73 (-136 to -9)***	N/A	-15 (-76 to 46)	**-52 (-98 to -6)***
Avg daily mod time (mins/day)	N/A	**38 (0.3 to 76)***	6 (-59 to 71)	N/A	26 (-14 to 65)	33 (-6 to 73)

Table 1. Baseline data carried forward for clinical and physical activity outcome within group change scores and 95% confidence intervals. Bolded entries represent significant within group change. * Statistically significant within group change (confidence intervals do not include zero). Pain Science Education, Baseline – 4 weeks (n=10, except least painful knee n=8); 8 weeks (n=10, except least painful knee n=8); 26 weeks (n=10, except least painful knee n=8).

Control, Baseline – 4 weeks (n=10, except least painful knee n=5; PSFS Activity 3 n=8); 8 weeks (n=10, except least painful knee n=5; PSFS Activity 3 n=8); 26 weeks (n=10, except least painful knee n=5; PSFS Activity 3 n=8). WOMAC, Western Ontario McMaster Universities OA Index; PSFS, Patient-Specific Functional Scale; PSEQ, Pain Self Efficacy Questionnaire; Brief FoM, Brief Fear of Movement scale; PCS, Pain Catastrophizing Scale; PBQ, Pain Beliefs Questionnaire; rNPQ, Revised Neurophysiology of Pain Questionnaire.