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Feasibility and Acceptability of Pain Reprocessing Therapy in Racially/ Ethnically Diverse Adults With Chronic Back Pain

I. Hypotheses and Specific Aims

Clearly state the hypotheses you will test in this research project, as well as the specific aims, or major goals, of the project.

Hypotheses

1) Remotely-delivered PRT will be feasible and acceptable in a racially and ethnically diverse sample of adults with CBP.
2) PRT will significantly improve pain-related outcomes for adults with chronic back pain (CBP) compared to both a CBT treatment and a usual care control.
3) Reductions in pain-related fear and avoidance will mediate effects of PRT vs. CBT on pain intensity.

Specific Aims

Aim 1: Assess feasibility and acceptability of PRT in a racially and ethnically diverse sample of adults with CBP.

Aim 2: Generate estimates of PRT vs. CBT and PRT vs. usual care effect sizes on the primary outcome—pain intensity—and on secondary patient-reported outcomes including pain-related fear & avoidance and measures of emotional functioning.

Aim 3: Test how changes in pain beliefs, pain-related fear and avoidance, and measures of emotional functioning, collected using experience-sampling methods, lead to pain reductions in participants randomized to PRT.

II. Background and Significance

Chronic pain afflicts 20% of Americans, with an estimated annual cost of over $600 billion.[1,2] It is a leading cause of disability globally and is a major barrier to healthy aging.[3–6] Common medical treatments for CBP such as steroid injections and surgeries do not outperform sham procedures[7,8] and the population prevalence of pain continues to rise.[9–11]

In many cases of chronic pain, peripheral tissue causes cannot be identified and central nervous system processes play a prominent role.[12–16] Such pain is classified as “primary” chronic pain in the ICD-11, and is also known as “non-specific,” “nociplastic,” or “centralized” pain.[17,18] Primary pain maintenance factors include functional changes in predictive and active inference processes: Beliefs that pain indicates tissue damage can cause innocuous somatosensory input to be interpreted and experienced as painful.[19–22] Such constructed perceptions can become self-reinforcing: threat appraisals enhance pain, which is in turn threatening, creating positive feedback loops contributing to the persistence of pain after injuries have healed.[21,23–25] Disrupting **fear and avoidance of pain** can reverse this cycle and resolve primary chronic pain.[26,27]

We recently developed a novel psychological treatment, Pain Reprocessing Therapy (PRT), based on this understanding of primary pain. Using a combination of cognitive, exposure-based, and somatic psychotherapy techniques, PRT aims to promote patients' reconceptualization of pain as due to reversible, non-dangerous brain activity rather than peripheral pathology. Critically, PRT aims to reduce or eliminate pain, rather than increasing functioning. In the first trial of PRT (*N* = 151), **66% of patients randomized to PRT were pain-free or nearly so** at post-treatment, as compared to fewer than 20% of placebo and usual care controls.[26] Pain reductions were largely maintained for 1-year post-treatment, indicating durability of gains. Gains at 1-year follow-up were mediated by **reductions in fear of pain**, β_{ab} = -0.41, $p < .05$, and were correlated with **increased mind/brain attributed causes of pain,** $r(44) = .29$, $p = .05$, consistent with hypothesized treatment mechanisms.[26,30] These findings **upend traditional paradigms**, which typically view pain as a lifelong, chronic condition to be managed, and suggest that pain intensity can be substantially reduced with psychological treatments targeting fear of pain and pain attributions. While highly promising, the generalizability of these findings is limited by sample demographic characteristics: patients in this first trial were 89% White, physically active (a majority exercised 3+ hrs/week), and well educated (100% reported at least some college education).

Addressing racial and ethnic disparities in chronic pain is a priority of the U.S. DHHS National Pain Strategy and a moral imperative.[2] Major barriers to treatment engagement for ethnic minorities include **mistrust in the medical system and difficulty accessing treatments**.[31–33] Further, the central message of PRT—that the pain is a "false alarm" of injury due to neural pathways rather than bodily injury—has a heightened risk of being perceived as invalidating by patients with a history of invalidating interactions with medical providers. Psychological treatments achieve greater efficacy when they are **adapted for racial and ethnic minorities** (adapted vs. non-adapted $g = .43$, $p < .001$, meta-analysis of 30 studies),[35] indicating that adaptations promote treatment feasibility and acceptability.

Innovation. Developing effective, non-pharmacological chronic pain treatments and testing their efficacy in racial/ethnic minorities is an urgent societal need and an NIH funding priority. The first aim of this proposal is to test the **feasibility (recruitment & retention) and acceptability (helpfulness, satisfaction, & impact) of PRT in a diverse, lower socioeconomic status (SES) patient population** in the context of an uncontrolled trial (Aim 1). We will include **adaptations to PRT** hypothesized to address main barriers to feasibility and acceptability in minority populations, including medical mistrust and treatment accessibility.[31,33,34] These include delivery of the intervention via telehealth, culturally inclusive recruitment materials, and a culturally diverse treatment team (around half of our treatment team are BIPOC clinicians), all of which are hypothesized to improve the patient-provider relationship, leading to greater trust.[31–33]

Aim 2 of this study is to generate preliminary estimates of PRT vs. CBT and PRT vs. usual care control effect sizes on the primary outcome—pain intensity

—and on secondary outcomes, including pain-related fear and avoidance, measures of emotional functioning.

Cognitive behavioral therapy is a widely researched psychotherapy that has shown to improve a variety of mental and behavioral conditions. CBT for chronic pain (CBT-CP) has been considered a “gold standard” for psychological therapies for chronic pain and has specifically been shown to improve functioning and quality of life for a variety of chronic pain conditions.[38] The fundamental goal of CBT-CP is to encourage participants to adopt an active, problem-solving approach to managing the challenges associated with chronic pain. CBT-CP intervention follows a standard structure of 12 sessions with the following objectives: 1) reducing the negative impact of pain on daily life 2) improving physical and emotional functioning 3) increasing effective coping skills for managing pain 4) reducing pain intensity.[38] **The CBT arm in this present study will be adapted to 9 sessions to match the length of the PRT arm, but will follow the same objectives.**

CBT when used as a stand-alone intervention and in conjunction with multi-disciplinary treatments can have positive effects on outcomes such as pain intensity, pain-related interference, health-related quality of life, and depression.[42] CBT has demonstrated effectiveness and improved patient outcomes for various chronic pain conditions including chronic lower back pain. CBT is widely recommended as a clinical treatment for patients with chronic low back pain.[39,40,41,44]. A 2010 study (N=701) involving patients with low-back pain examined the effectiveness of a group CBT intervention. The study found that CBT significantly lowered levels of disability and pain while increasing patient satisfaction with treatment.[43]

Although CBT is considered a leading psychological treatment for pain, other studies have demonstrated potential limitations to the treatment as it typically provides only small reductions in pain intensity, aiming instead to increase functioning.[28,29] As such, better psychological treatments are needed.

PRT was developed to better address pain intensity and pain-related outcomes compared to leading psychological treatments for pain such as CBT. As a result, this study aims to determine preliminary findings on the comparative efficacy of PRT vs. CBT vs. Usual care.

III. Preliminary Studies/Progress Report

PI Yoni Ashar has just started his first faculty appointment. His group at Anschutz is newly formed and has not collected any data to date. During his doctoral and post-doctoral training, PI Ashar supervised data collection for several projects closely related to the proposed work. He ran the previous clinical trial of PRT for chronic back pain, supervising a team of five research assistants and coordinating a team of five clinicians.

Study consultants Lumley and Burns have extensive experience running clinical trials testing psychological treatments for chronic pain, including CBT, and will be consulting on study design, execution, and any safety issues [46, 47, 48]. Lumley and Burns will not have access to PHI and will have no participant contact, and as such are not added to this protocol.

IV. Research Methods

A. Outcome Measure(s). List the primary and secondary (if applicable) outcome measures you will use in this study.

Measures will be collected at pre-treatment (baseline), mid-treatment, and post-treatment (primary endpoint), and at 1-, 2-, 3-, 6-, and 12-months post-treatment.

Outcome measures will include feasibility and acceptability measures:

- Enrollment rates
- Number of sessions completed
- Number of weeks required to complete treatment
- Patient-reported treatment satisfaction using a 1-item **Patients' Global Impression of Change**).

Hypothesized moderators of engagement will be measured using:

- Revised Health Care System Distrust Scale
- Working Alliance Inventory of patient-provider relationship quality (WAI) at post-treatment only

The primary outcome measure is pain intensity:

1. Last-week average pain intensity on a numerical rating scale from 0 to 10, from the Brief Pain Inventory Short Form (BPI-SF)

Secondary clinical outcomes include:

1. Pain interference using the Brief Pain Inventory – Short Form (BPI-SF) Interference item
2. Patient Reported Outcome Measurement Information System (PROMIS) short forms for depression, anxiety, anger, social isolation, and sleep quality
3. Positive Affect Scale (PAS)

Additional measures include:

1. Tampa Scale of Kinesiophobia (TSK-11) which assess the belief that pain indicates injury and fear of movement
2. Six-item Pain Catastrophizing scale (PCS) short form
3. Survey of Pain Attitudes Emotion Subscale (SOPA-Emotion and SOPA-Control) which assess beliefs that stress and negative emotion increase pain
4. The Emotional Approach Coping Scale (EACS)
5. A novel Chronic Pain Attribution Scale (see “Additional measures” attached)

6. A checklist asking participants to identify what care/treatments they have been engaging in for their back pain in the past 6 months (see “Additional measures” attached)
7. Multidimensional Assessment of Interoceptive Awareness (MAIA v2) that measures interoceptive awareness.
8. An *ad hoc* measure asking how often back pain has been a problem over the past 6 months (see “Additional measures” attached)
9. Medication use measure (see “Additional measures” attached)
10. Chronic Pain Acceptance Questionnaire (CPAQ-8)
11. Adverse Childhood Experiences (ACEs) Questionnaire, slightly modified for the current study
12. Measure of Treatment Expectations (see “Additional Measures” document)
13. Rosenberg Self-Esteem Scale
14. Emotional Breakthrough Inventory
15. Mindful Reappraisal of Pain Scale
16. Neuroplastic Pain Screener
17. University of Michigan Image Body Map
18. International Physical Activity Questionnaire – Short Form
19. Patients’ Global Impression of Change (PGIC)
20. Surgical and Medical History (see “Additional Measures” attached)

B. Description of Population to be Enrolled. Describe the inclusion and exclusion criteria for your subject selection. [The inclusion and exclusion criteria must be the same as listed in the application form]. Discuss why this population has been chosen.

Inclusion criteria:
To be eligible, adults (aged 18 and older) must be:
Last-week average back pain of at least 4 of 10 at the two pretreatment timepoints (online pre-screening and informed consent session), back pain that is an ongoing problem for at least half the days of the last 6 months, back pain that is worse than leg pain.

Exclusion criteria aim to provide a sample able to engage with treatment and other study procedures. The exclusion criteria for this present study are as follows:

- Current litigation or compensation associated with pain or plans to apply for compensation or engage in litigation in the next 6 months.
- Active suicidal ideation with intent, recent history of suicide attempt, or recent history of suicide attempts or self-harm behaviors within the past 5 years (including non-suicidal self-harm)
- Recent history of inpatient psychiatric hospitalization within the past 5 years
- Active, current psychosis or mania
- Active, current substance abuse, or problems with substance abuse within the past 2 years
- Instability in living conditions or major interfering life events:

    - Major surgery or other major medical event planned in coming six months
    - Unsure whether will reliably have suitable conditions for telehealth appointments over the next two months, including a computer or tablet, reliable fast internet, and a quiet comfortable room that is reliably available.
    - Major, interfering changes in employment or housing anticipated over the next six months
- Failure to complete at least 85% (6 of 7) of EMA surveys in the first week of the study (post-consent, pre-randomization)

Additional criteria aim to provide a sample enriched for primary (neuroplastic) pain exclude patients with:

- Leg pain worse than back pain
- Back surgery within the last 2 years
- Difficulty controlling bladder function (to screen out cauda equina syndrome)
- Serious medical illness (e.g., current, or recent cancer diagnosis, severe cardiovascular disease)
- Recent large unexplained, unintended weight loss (20lbs or more)
- Recent vertebral fracture/ known spinal fractures or tumors
- Known sensory/motor abnormalities in the trunk or legs.
- Self-reported diagnosis of a specific inflammatory disorder: rheumatoid arthritis, polymyalgia rheumatica, scleroderma, Lupus, or polymyositis.

The sample will be enriched for racial and ethnic identities underrepresented in clinical trials, with a planned sample of 20% White/20% Black/20% non-White Hispanic/20% Asian/20% Indigenous or Other, approximately 50-60% female (consistent with CBP gender prevalence estimates)

C. Study Design and Research Methods.

Research Approach. We will conduct a randomized controlled trial comparing PRT vs. CBT vs. usual care in a racially/ethnically diverse sample of adults with primary chronic back pain (CBP). A total of approximately 200 participants will be enrolled, with 150 randomized, with 50 randomized to the PRT treatment arm, 50 randomized to the CBT treatment arm, and 50 randomized to the usual care arm.

The full sample size of N = 150 is determined by feasibility considerations, including study budget and timeframe. Study procedures will be fully remote, with data collection through REDCap and interventions delivered via telehealth, allowing nationwide recruitment.

Recruitment. Patients will be recruited by provider referral from primary care and pain medicine clinics affiliated with academic medical centers and from community and religious centers serving diverse communities, targeting a diverse sample. If a clinic provider wishes to refer a potentially eligible patient for the study, they will have the

patient complete a HIPAA A Form (see attachment, “HIPAA A Form”), and then provide the patient’s name and contact information to the study team. This may be augmented by online recruitment (e.g., BuildClinical, ResearchMatch, Facebook) of participants as needed to target recruitment of a diverse sample (see attachment “Recruitment Flyer”)

Eligibility Screening and Informed Consent. Recruitment materials will direct potential participants to an initial online self-report pre-screening measure on REDCap. The data will be stored in REDCap managed by CU Anschutz Medical Campus.

Potentially eligible people who pass the pre-screening measure will be contacted by a member of the research team to confirm eligibility through a telephone interview.

Once eligibility has been confirmed, participants will complete remote electronic informed consent (eConsent).

Consent will be obtained using eConsent over HIPAA-compliant zoom or through a telephone call and will be conducted by trained members of the research staff. Participants will be advised to find a quiet, comfortable room for the informed consent process. A member of the research staff will send the participant a link to a REDCap survey that represents our informed eConsent. An inline image of our COMIRB stamped informed consent document will be included in the REDCap survey and the research staff will explain the informed consent document to the participant and answer any questions they may have. The research staff will then direct them to complete a series of questions on the REDCap survey as a part of the E-consent process. They will then provide their electronic signature which REDCap will save automatically as a PDF using the auto-archive and E-consent framework feature on REDCap. Participants will then be given an opportunity to download or print a copy of the signed eConsent form for themselves. The research staff conducted the informed consent will instruct the participant on how to do so.

In a separate REDCap survey, the Research staff administering the eConsent will also provide their signature to confirm that informed consent was delivered according to study protocol and that all questions from the participant were answered. Two signed copies of the informed consent document (one signed by the participant and one signed by the research staff administering the informed consent) will be stored as PDFs using REDCaps file repository.

Participants who refuse eConsent will not be permitted to join the study as this study is a national telehealth study. All procedures will be conducted virtually/digitally.

Baseline Assessment and Randomization. Once consented, eligible participants will complete a baseline assessment battery. Then, participants will be asked to complete a short daily survey for the next 7 days. Participants must complete pre-treatment assessments before randomization. Participants who are unable to complete at least

85% of the surveys in the first week (6 of 7 surveys) will be withdrawn from the study due to inability to comply with study protocols. Participants who complete at least 85% of the surveys in the first week (6 of 7 surveys) will be contacted by a research assistant, who will remind them of study procedures and confirm their continued interest in participating in the study (continuing informed consent) [45].

Participants who confirm interest and consent will be assigned at a 1:1:1 ratio to PRT or usual care or CBT using a minimization algorithm balancing on pain intensity, race/ethnicity, age, and opioid use.

Treatment, Pain reprocessing therapy (4.1 Research Design). PRT will follow the model used in our previous trial and conform to published protocols [26, 49] with adaptations described below. Pain Reprocessing Therapy has 5 components: 1) education about the origin of pain in the brain, how it can reverse, and the pain-fear cycle; 2) reinforcing the education using personal biography; 3) "somatic tracking" of pain through mindfulness and reappraisal of pain sensations as non-dangerous; 4) lowering the level of personal threat that may trigger pain sensation; and 5) inducing positive affect in periods of pain. Patients will engage in a brief phone call with a PRT clinician prior to attending one assessment and education telehealth session with a physician. Following this, participants will attend eight therapist-led sessions. Pacing will be flexible, ranging from 5-12 weeks, to increase accessibility. Treatment will be provided by experienced PRT clinicians.

Adaptations to PRT for this population include: 1) remote (telehealth) delivery of treatment and all study measures, 2) a focus on humble, empathic listening to patients' previous medical experiences in early sessions, an intervention hypothesized to build trust in treatment contexts, [50] and 3) flexible pacing of treatment sessions.

CBT Treatment Group: Cognitive behavioral therapy (CBT). CBT is considered the leading psychological treatment for chronic pain. In contrast to PRT, it views all chronic pain as due to a complex interaction of biopsychosocial etiology and central sensitization, and it aims primarily to reduce pain interference, rather than to eliminate pain.[50, 37, 26] Studies conducted by the VA (U.S. Department of Veteran Affairs) have offered strong support for the CBT for chronic pain (CBT-CP) protocol as an effective, safe treatment for chronic pain [38, 49].

CBT-CP is a structured, time-limited intervention that aims to teach patients how to better manage chronic pain and improve their quality of life.

Participants will receive 9 sessions of CBT-CP over 5 – 12 weeks, parallel to the PRT structure and adapted from the widely used 12-session CBT-CP protocol outlined in the VA's CBT-CP Therapist Manual [38].

The CBT-CP protocol contains an initial orientation involving education and familiarization with the CBT-CP approach to chronic pain. The protocol then includes

sessions that focus on topics such as exercise, relaxation, pleasant activities, cognitive coping, and sleep.

The 12-session CBT-CP protocol includes an initial pain evaluation and baseline assessment which will be omitted in our 9-session adapted protocol, since this data will be collected before randomization. Additional adaptations include omitting the booster session at the end and condensing two behavioral activation sessions into one session. Finally, the original CBT-CP protocol requires that participants have a walking plan approved by their medical providers. In the current study, participants will be assigned the walking program, but rather than getting medical clearance, participants will be advised that they can reach out to their doctors if they have concerns about doing the exercises, and that they should listen to their bodies and do the exercises that feel appropriate. Treatment will be provided by experienced CBT-CP clinicians.

Usual care control. Participants will be asked to continue whatever they are already doing to care for their back pain. Length of the usual care condition will be 9weeks, the expected mean completion time of the PRT and CBT arms and may be adjusted at mid-enrollment to match treatment arm length more closely.

Electronic Momentary Assessment (EMA). Participants will be asked to answer a brief set of questions daily, assessing pain and pain beliefs, from the informed consent session through the post-treatment assessment timepoint. The questions included in the EMA are attached.

Numerical Pain Ratings: Study therapists will collect participants' numerical pain rating (assessed via the Pain Rating Scale; NRS) at the beginning and end of every therapy session. This will be done via the Before and After Treatment Session Form on REDCAP

Post-Treatment Assessment. Upon completion of the treatment, all participants (PRT, CBT, and usual care) will complete a second assessment battery of self-reported questionnaires, similar to the baseline assessment.

Follow-up Assessments. All participants will also complete five follow up assessments at the following time points: mid-treatment, 1 months, 2 months, 3 months, 6 months, and 12 months.

Both primary and secondary outcome data will be measured during baseline, mid-treatment, post-treatment, and during follow-up assessments at 1-month, 2-month, 3-month, 6-month, and 12-months.

Feasibility and acceptability will be measured by enrollment rates, number of sessions completed, number of weeks required to complete the intervention, and participant-reported treatment satisfaction at post-treatment.

Participant questionnaires taken at baseline, mid-treatment, post-treatment, and at 1-month, 2-month, 3-month, 6-month, and 12-months follow-up will include: PROMIS, PAS, BPI-SF, the Tampa Scale of Kinesiophobia measuring fear of pain, Six-item Pain Catastrophizing scale (PCS) short form, Survey of Pain Attitudes Emotion Subscale (SOPA-Emotion) that assess beliefs that stress and negative emotion increase pain, a novel Chronic Pain Attribution Scale (see attached measure "Chronic Pain Attribution Scale"), Rosenberg Self-Esteem Scale, Neuroplastic Pain Screener, Chronic Pain Acceptance Questionnaire (CPAQ-8), Adverse Childhood Experiences (ACEs) Questionnaire, slightly modified for the current study, Emotional Breakthrough Inventory, Mindful Reappraisal of Pain Scale, International Physical Activity Questionnaire – Short Form, a checklist asking participants to identify what care/treatments they have been engaging in for their back pain in the past 6 months, multidimensional Assessment of Interoceptive Awareness (MAIA v2) that measures interoceptive awareness, an *ad hoc* measure regarding participant experience with back pain over the past 6 months (see attached measure "ad hoc back pain measure"). Additionally, covariate measures include but are not limited to emotional functioning (e.g., PHQ-9), demographics, childhood experiences, medical distrust, intervention feedback, pain medication use, Quality of life, and PRT-skills use. Additionally, at the 1-month follow up we will ask for their consent to use clips from their session recordings for training and educational purposes, outside the study team.

Participants in all groups will be asked to make no major changes to any ongoing back pain treatments, unless deemed medically necessary by their provider, until after the post-treatment assessment timepoint.

Video testimonials: We will select a sub-sample of participants who experience particularly notable improvements in pain and functioning in both groups and ask if they are interested in providing a video recording testimonial about their experience with the treatment and how the treatment has impacted their lives. In order to be eligible to provide a video testimonial, participants will be required to provide written consent in which it is made clear that these videos may be shown at scientific conferences and presentations. Consent to record and share videos will be recorded and stored in RedCap. We will ask the same questions of all participants, which are listed below.

- What did you first think of treatment?
- How has your back pain changed since finishing treatment?
- How have other aspects of your life changed since finishing treatment?
- What do you think is causing your back pain? Did your beliefs about your back pain change as you went through treatment?
- Did therapy change your awareness of your emotions?
- How does your back feel right now?
- Did participation in the study made you more aware of yourself?

Large language model (LLM) fidelity assessments. To assess both treatment fidelity and treatment differences between CBT and PRT we will randomly select therapy session transcripts that have previously undergone human fidelity assessments and ask the LLM Claude to also perform a fidelity assessment on the same transcript, following

the same guidelines. We will then compare the results of the human fidelity assessment to the LLM fidelity assessment, to determine the accuracy of LLMs in performing fidelity assessments. Additionally, we will ask the LLM to identify conceptual differences between the two therapies and determine if those conceptual differences correlate with within session treatment effects. For example, we will feed the LLM one randomly selected CBT transcript and one randomly selected PRT transcript and ask the LLM to compare instances of the different therapists discussing the brain's ability to generate pain. This data will then be correlated with after session pain data to determine if there is a mechanistic connection between specific therapeutic actions and subsequent reduction in pain intensity. Transcripts will be deidentified using the HIPAA compliant National Library of Medicine (NLM) scrubber, followed by manual verification of deidentification by a research assistant. Only fully deidentified transcripts will be fed into the Claude LLM.

Compensation. Participants will receive $25 for the Baseline Questionnaire and $20 for the Midtreatment, Post-treatment and Follow-up questionnaires they complete. Participants randomized to the treatment or control groups will receive the same compensation. Participants will be compensated through gift cards to a store of their choosing. Participants will also be entered into a lottery system, with each survey completion functioning as a lottery ticket. At the end of the study, 12 participants (10% of the study) from the lottery will win $100 in additional compensation. Additionally, if a participant is selected and agrees to provide a video testimonial, they will receive an additional $20 in compensation.

D. Description, Risks, and Justification of Procedures and Data Collection Tools.

Research material collected for this study will include:

a. **Questionnaire data and demographics** will be collected and stored in REDCap, a widely used HIPAA-compliant digital data management system. REDCap will be accessible only to IRB-approved study staff with individualized access granted by the PI. These data will include PHI such as participant names and ages.
b. **Telehealth session recordings (audio/video)** will be recorded via Zoom, a HIPAA-compliant platform, and then transferred to secure servers for longer-term storage. These will be submitted to later analyses of audio/visual features hypothesized to support pain recovery (e.g., patient-provider bodily synchrony; natural language processing analyses of session transcripts) in planned future research.
c. **Treatment engagement** measures—the number of sessions completed and the date of each session—will be recorded by the study team in REDCap.
d. **Pre-existing radiological imaging reports** of the spine that participants *already have available* will be collected to aid the physician diagnosis and assessment session (no imaging will be conducted as part of this study). Participants randomized to treatment will be asked to share any reports they are able to locate using a personalized REDCap link that stores the files securely with their

REDCap record, accessible to the study physician. Provision of these records is optional.

Study Measures

Feasibility and acceptability will be measured by enrollment rates, number of sessions completed, number of weeks required to complete the intervention, and participant-reported treatment satisfaction. Participant questionnaires will include: PROMIS, PAS, Owestry disability index, the Tampa Scale of Kinesiophobia measuring fear of pain, Six-item Pain Catastrophizing scale (PCS) short form, Survey of Pain Attitudes Emotion Subscale (SOPA-Emotion) that assess beliefs that stress and negative emotion increase pain, a novel Chronic Pain Attribution Scale (see attached measure "Chronic Pain Attribution Scale"), Rosenberg Self-Esteem Scale, Neuroplastic Pain Screener, Chronic Pain Acceptance Questionnaire (CPAQ-8), Adverse Childhood Experiences (ACEs) Questionnaire (slightly modified for the current study), International Physical Activity Questionnaire – Short Form, a checklist asking participants to identify what care/treatments they have been engaging in for their back pain in the past 6 months, multidimensional Assessment of Interoceptive Awareness (MAIA v2) that measures interoceptive awareness, an *ad hoc* measure regarding participant experience with back pain over the past 6 months (see attached measure "ad hoc back pain measure").

Additionally, covariate measures include but are not limited to emotional functioning (e.g., PHQ-9), demographics, childhood experiences, medical distrust, intervention feedback, pain medication use, and PRT-skills use.

All study team members will use best practices in human research, will complete CITI Human Subjects Training and Responsible Conduct of Research training, and will be trained on how to handle personally identifiable information. All data will remain confidential, stay within the confines of the study, and protected under the purview of the institutional IRB. Any results published will not be linked to any identifying information.

Potential risks.

Psychological Distress. Psychological treatments pose some risk of psychological discomfort. Participants may find that discussing their pain is distressing, and some exposures may lead to temporary increases in pain intensity. Chronic pain is naturally fluctuating in intensity and naturally psychologically distressing, and the levels of distress and pain associated with treatment are not expected to exceed the normal range already part of participants' chronic pain experience.

Loss of Confidentiality. A potential risk from this study is the unplanned violation of the participant's privacy since PHI will be collected. There are no known long-term risks from any study activities.

Protection Against Risks

Recruitment and informed consent. The recruitment protocol and consent process will be approved by the institutional IRB. The consent process and consent form will be in language that persons with an 5th grade education can understand. At the consent session, research personnel will provide a complete description of the study procedures, risks, benefits, and compensation. Research personnel will answer any questions that subjects have after receiving this information. In particular, during informed consent prior to enrollment, research personnel will ensure that prospective participants have a good understanding of the risks and benefits of participation, and of what study involvement will entail in terms of randomization, attending treatment sessions, and answering questionnaires. Each patient will have an opportunity to ask questions and will be encouraged to discuss participation with friends and family members if he or she desires. If the patient has any reservations, they will be encouraged to think about enrolling and sign the consent form only if and when they feel comfortable. Patients will be assured that they can decide at any point to discontinue participation with absolutely no consequences for their care.

Consent will be obtained by video session or (if participant prefers) by phone, using trained research personnel (**See attached "Informed consent")**. After thorough description and discussion of study procedures, a REDCap link to an unsigned consent form will be sent to the participant for their review. Those who choose to participate will sign and date the consent form using the REDCap interface, and the staff member will countersign and date the form in REDCap. A signed PDF of the consent form will then be sent to participants for their own records.

All study staff have completed and passed CITI RCR Human Subjects, Good Clinical Practice, and HIPAA training and will have been provided with materials and instruction in the proper and ethical manner in which consent should be obtained.

Vulnerable participants (e.g., prisoners, those who cannot provide fully informed consent) will not be enrolled in the study. Socially and economically disadvantaged persons are not discriminated against entering the study. There will be no covert or overt coercion to participate.

Questionnaires and Treatment. Participants will be told that all participation is voluntary, and they can withdraw from the study at any time or choose not to answer any question. They will be told that the care they receive from their treating providers will in no way be affected by their participation or decision not to participate in this study.

The risks associated with treatment will be minimized by emphasizing to participants that treatment participation is optional, and they can always choose not to attend sessions while still completing all other aspects of the study. All study therapists conducting the assessments and treatment sessions are trained clinicians experienced in the treatment protocol. Study therapists will be supervised weekly by an expert in the

protocol and will have access to the study physician as needed. Additional training will be provided as needed to study therapists on the Columbia Suicidality Rating Scale by a licensed clinical psychologist (PI Ashar). Further, should the subject express suicidal ideation at any time during the interview, the therapists will be instructed to contact both their supervisor and the PI immediately to determine the appropriate course of action. This study is not equipped with the resources for crisis management, and participants in crisis will be referred to national or local crisis hotlines for help. In case of emergencies, study staff will attempt to obtain participants' current location and will contact the most relevant local authority to share this information.

SAE Reporting. Any SAEs will be reported to the IRB within 24 hours after they are reported to the PI (and reported to the Roybal Center investigators and the NIA Program Officer). SAEs will be collected and reported from screening to 30 days after the end of the study follow-up period for an individual participant. SAEs will be followed until resolution, stabilization, or until it is determined that study participation is not the cause. **The risks of this study are considered minimal risk and no SAEs are expected.**

Privacy Protections

The information obtained during this research (Research Record) will be kept confidential to the extent permitted by law. All data will be stored on secure, HIPAA compliant servers accessible only to members of the study team. Only de-identified data will be made available (e.g., sharing of de-identified raw outcomes data upon publication, consistent with the principles of open science). To minimize the risk to confidentiality, participant information will be assigned a unique code for use in all analyses. The table linking participant ID to identifying information will be stored in REDCap and available only to study personnel requiring access to that information (e.g., to contact participants).

Although every reasonable effort will be made to protect the confidentiality of records, such protection cannot be guaranteed, and this will be explained in the study consent form. By law, representatives of the sponsoring organization, the Institutional Review Board (IRB), and other regulatory authorities may inspect these records.
All personal information made available for inspection will be handled in strictest confidence and in accordance with data protection laws. All data will be used specifically for research purposes. Only authorized personnel, those who have official status as part of the authorized research team, will have access to any records containing identifiable participant data.

No incidental findings are anticipated as no diagnostic studies will be conducted.

Potential Benefits of the Proposed Research to Human Subjects and Others

Improved pain and functioning: Participants may benefit from receiving an intervention in terms of pain reduction and reduced pain interference. Usual care participants may receive benefits from increased awareness of emotional state in completing the weekly

reports. The potential treatment benefits of lasting pain relief outweigh the potential risks delineated above.

Contributions to knowledge: While participants in this study may not directly benefit from their participation, we anticipate results from this study to benefit future research that seeks to relieve chronic pain.

E. Potential Scientific Problems.

This study's primary aim is to determine the feasibility and acceptability of a novel PRT intervention in a patient population that is enriched for racial and ethnic minorities underrepresented in scientific research. As such, this study's ability to produce meaningful generalizable knowledge may be limited by our ability to recruit a chronic back pain population that is enriched for underrepresented minority group.

The study's secondary aim is to compare the effectiveness of PRT versus CBT versus usual care for addressing pain-related outcomes in participants with chronic back pain. Participants in the PRT and CBT treatment arms will be asked to complete nine total treatments. Thus, this data may be limited by adherence to the treatment arms and the total number of treatment sessions attended by participants in each group.

Analyses of how changes in pain beliefs support pain reduction may be limited if rates of missing data in the EMA are overly high.

F. Data Analysis Plan.

The primary endpoint of the trial is the post-treatment assessment session, approximately 1 or 1.5 months after the baseline assessment and randomization. Follow up measures are collected for one year following the post-treatment assessment and may be included in the main analysis or presented in a separate manuscript.

Mixed models will be used to estimate group differences on primary and secondary outcomes. These models are unbiased and relatively robust to missing data. Secondary outcomes are considered exploratory and correction for multiple comparisons will not be conducted.

Clinical significance will be determined by calculating the percentage of patients in each condition who meet the following criteria regarding pain reduction from baseline: at least 30% reduction in pain intensity, at least 50% reduction in pain intensity, and "pain free or nearly pain free"—defined as average pain intensity of 0 or 1 over the past week (on the single BPI-SF item measuring average pain over the last week).

Primary analyses will be conducted on an intent-to-treat (ITT) sample, and if necessary, the ITT sample will be modified by excluding any randomized patients who are found not to meet study criteria (e.g., patients unable or unwilling to initiate the

treatment or control group they are randomized to). Secondary analyses will be conducted on a per protocol ("completer") sample.

Analyses will focus on the PRT vs. CBT and the PRT vs. usual care group differences, as the scientific focus of this study is on the PRT intervention. CBT vs. usual care group differences may be reported for archival purposes and to confirm the efficacy of CBT in this sample.

Sample size is determined primarily by simulation-based power analysis. Analysis found that with N = 50 arm provided 80% power to detect a 1.2-point PRT vs. CBT difference on a 0-10 pain scale.

G. Summarize Knowledge to be Gained.

The knowledge gained will increase the understanding of the feasibility and promise of PRT for diverse patients and to increase the understanding of factors moderate treatment engagement. This study will also generate knowledge about new treatments for CBP that are potentially more effective than established treatments such as CBT. Furthermore, we may learn whether this treatment protocol engages the hypothesized fear-based mechanisms for pain relief in this population and treatment context. These potential contributions to knowledge outweigh the potential risks delineated above.

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