**Loneliness predicts reduced self-reported empathy but not empathic multi-voxel neural response patterns of pain after meditation training**

Survey Measures

<https://osf.io/2sx3v>

Table of Contents

Survey Materials

Social Connectedness Scale 3

Interpersonal Reactivity Index 4

UCLA Loneliness Scale 6

Inclusion of Other in the Self 7

Cantril Ladder 8

Meditation Experience Questions 9

Perceptions and Experiences Questionnaire 10

fMRI Safety Screening Questions 12

Demographic Questions 14

Follow-Up Questions 17

Intervention Materials

Loving-Kindness Meditation 18

Progressive Muscle Relaxation 18

Attention Checks 19

Commitment Request 19

References 20

**Social Connectedness Scale** (Lee et al., 2001), administered in T1 (screener), T2 (post-intervention), and T3 (6-month follow-up) surveys

Please indicate the extent to which you disagree or agree with the following statements.

1 Strongly Disagree (1), 2 (2), 3 (3), 4 (4), 5 (5), 6 Strongly Agree (6)

\* = reverse coded

1. I feel distant from people.\*
2. I don't feel related to most people.\*
3. I feel like an outsider.\*
4. I see myself as a loner.\*
5. I feel disconnected from the world around me.\*
6. I don't feel I participate with anyone or any group.\*
7. I feel close to people.
8. Even around people I know, I don't feel that I really belong.\*
9. I am able to relate to my peers.
10. I catch myself losing a sense of connectedness with society.\*
11. I am able to connect with other people.
12. I feel understood by the people I know.
13. I see people as friendly and approachable.
14. I fit in well in new situations.
15. I have little sense of togetherness with my peers.\*
16. My friends feel like family.
17. I find myself actively involved in people's lives.
18. Even among my friends, there is no sense of brother/sisterhood.\*
19. I am in tune with the world.
20. I feel comfortable in the presence of strangers.

**Interpersonal Reactivity Index** (Davis, 1983), administered in T1, T2, scan day, and T3 surveys

The following statements inquire about your thoughts and feelings in a variety of situations. For each item, indicate how well it describes you by choosing the appropriate letter: A, B, C, D, or E. The letters are arranged in ascending order: "A" indicates "Does Not Describe Me Well" while "E" indicates "Describes Me Very Well." When you have decided on your answer, click on the letter. READ EACH ITEM CAREFULLY BEFORE RESPONDING. Answer as honestly as you can.

A Does not describe me well (1), B (2), C (3), D (4), E Describes me very well (5)

Subscales

\* = reverse coded

Subscales: Perspective Taking (PT), Fantasy (FS), Empathic Concern (EC), Personal Distress (PD)

1. I daydream and fantasize, with some regularity, about things that might happen to me. (FS)
2. I often have tender, concerned feelings for people less fortunate than me. (EC)
3. I sometimes find it difficult to see things from the "other guy's" point of view. (PT)\*
4. Sometimes I don't feel very sorry for other people when they are having problems. (EC)\*
5. I really get involved with the feelings of the characters in a novel. (FS)
6. In emergency situations, I feel apprehensive and ill-at-ease. (PD)
7. I am usually objective when I watch a movie or play, and I don't often get completely caught up in it. (FS)\*
8. I try to look at everybody's side of a disagreement before I make a decision. (PT)
9. When I see someone being taken advantage of, I feel kind of protective towards them. (EC)
10. I sometimes feel helpless when I am in the middle of a very emotional situation. (PD)
11. I sometimes try to understand my friends better by imagining how things look from their perspective. (PT)
12. Becoming extremely involved in a good book or movie is somewhat rare for me. (FS)\*
13. When I see someone get hurt, I tend to remain calm. (PD)\*
14. Other people's misfortunes do not usually disturb me a great deal. (EC)\*
15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments. (PT)\*
16. After seeing a play or movie, I have felt as though I were one of the characters. (FS)
17. Being in a tense emotional situation scares me. (PD)
18. When I see someone being treated unfairly, I sometimes don't feel very much pity for them. (EC)\*
19. I am usually pretty effective in dealing with emergencies. (PD)\*
20. I am often quite touched by things that I see happen. (EC)
21. I believe that there are two sides to every question and try to look at them both. (PT)
22. I would describe myself as a pretty soft-hearted person. (EC)
23. When I watch a good movie, I can very easily put myself in the place of a leading character. (FS)
24. I tend to lose control during emergencies. (PD)
25. When I'm upset at someone, I usually try to "put myself in his shoes" for a while. (PT)
26. When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me. (FS)
27. When I see someone who badly needs help in an emergency, I go to pieces. (PD)
28. Before criticizing somebody, I try to imagine how I would feel if I were in their place. (PT)

**UCLA Loneliness Scale** (Russell, 1996), administered in T1, T2, and T3 surveys

Indicate how often each of the statements below is descriptive of you.

Never 1 (1), Rarely 2 (2), Sometimes 3 (3), Often 4 (4)

\* = reverse coded

1. How often do you feel that you are "in tune" with the people around you?\*
2. How often do you feel that you lack companionship?
3. How often do you feel that there is no one you can turn to?
4. How often do you feel alone?
5. How often do you feel part of a group of friends?\*
6. How often do you feel that you have a lot in common with the people around you?\*
7. How often do you feel that you are no longer close to anyone?
8. How often do you feel that your interests and ideas are not shared by those around you?
9. How often do you feel outgoing and friendly?\*
10. How often do you feel close to people?\*
11. How often do you feel left out?
12. How often do you feel that your relationships with others are not meaningful?
13. How often do you feel that no one really knows you well?
14. How often do you feel isolated from others?
15. How often do you feel you can find companionship when you want it?\*
16. How often do you feel that there are people who really understand you?\*
17. How often do you feel shy?
18. How often do you feel that people are around you but not with you?
19. How often do you feel that there are people you can talk to?\*
20. How often do you feel that there are people you can turn to?\*

**Inclusion of Other in the Self** (Aron et al., 1992), administered in T1, T2, scan day (only about study partner), and T3 surveys

In the following section, you will be asked to describe your closeness to various individuals.

Please pick ONE specific immediate family member (for example, your parent, sibling, child, or spouse) and briefly describe their relationship to you (that is, is this person your parent, sibling, child, or spouse):

Please select the picture that best describes your closeness to the specific immediate family member you indicated above.

A diagram of circles with words

Description automatically generatedFrom left to right: (1), (2), (3), (4), (5), (6), (7)

Questions repeated for “ONE specific extended family member (for example, your cousin, aunt, uncle, niece, nephew, grandparent, or grandchild) and briefly describe their relationship to you (that is, is this person your cousin, aunt, uncle, etc.):”, “ONE specific friend and briefly describe their relationship to you (that is, is this person your childhood friend, coworker, etc.)”, “ONE specific acquaintance and briefly describe their relationship to you (that is, is this person your neighbor, cashier in a local store, etc.)”, and finally “Please imagine a stranger you have never met before. Please select the picture that best describes your closeness to the stranger.”

**Cantril Ladder** (Cantril, 1965), administered in T1, T2, and T3 surveys

Please imagine a ladder with steps numbered from 0 at the bottom to 10 at the top. The top of the ladder represents the best possible life for you and the bottom of the ladder represents the worst possible life for you. On which step of the ladder would you say you personally feel you stand at this time?

Please imagine a ladder with steps numbered from 0 at the bottom to 10 at the top. The top of the ladder represents the best possible life for you and the bottom of the ladder represents the worst possible life for you. On which step do you think you will stand about five years from now?

10 Best Possible Life (10), 9 (9), 8 (8), 7 (7), 6 (6), 5 (5), 4 (4), 3 (3), 2 (2), 1 (1), 0 Worst Possible Life (0)

**Meditation Experience Questions**, included in T1 survey

1. Do you have previous formal meditation training, or do you currently practice meditation?

Yes (1), No (2)

1. Please describe your past or current meditation practice. What kind of meditation practice have you done and for how long? Meditation practices can include loving-kindness meditation, compassion meditation, apps such as Calm or Headspace, yoga, transcendental meditation, etc.
2. Approximately how many hours per week do you practice meditation?

**Perceptions and Experiences Questionnaire** (adapted Visual Analogue Scale) (Crichton, 2001), administered in scan day survey

This questionnaire asks about your thoughts and feelings during the brain imaging task, in which you and your study partner were receiving pressure stimulation. Please select one answer for each question. Please answer the following questions about your own experiences:

Not at all 1 (1), 2 (2), 3 (3), 4 (4), 5 (5), 6 (6), Extremely 7 (7)

1. How fearful or anxious did you feel when you heard the cue indicating that you might be about to receive pressure stimulation?
2. How fearful or anxious did you feel when you heard the cue indicating that you would not receive pressure stimulation?
3. How unpleasant did you find the trials in which you received pressure stimulation?
4. How unpleasant were the trials in which you did not receive pressure stimulation?

Please answer the following questions about your beliefs about your study partner’s experiences:

1. How fearful or anxious did your partner feel when she heard the cue indicating that she might receive pressure stimulation?
2. How fearful or anxious did your partner feel when she heard the cue indicating that she would not receive pressure stimulation?
3. How unpleasant did your partner find the trials in which she received pressure stimulation?
4. How unpleasant did your partner find the trials in which she did not receive pressure stimulation?

Please indicate how much you agree with the following statements about your study partner.

Strongly Disagree (1), Disagree (2), Somewhat Disagree (3), Neutral (4), Somewhat Agree (5), Agree (6), Strongly Agree (7)

1. I liked my study partner.
2. I thought that my study partner was real (i.e., the live stream).

**fMRI Safety Screening Questions** (Center for Functional and Molecular Imaging, Georgetown University Medical Center), included in T1 survey

The following questions pertain to whether you can be safely scanned using functional magnetic resonance imaging (fMRI). An fMRI scan uses strong magnetic fields and radio waves to measure activity in your brain and to take pictures of your brain. fMRI is safe to use with some kinds of metallic implants but not others.

1. Have you had a prior surgery or an operation (arthroscopy, endoscopy, wisdom teeth removal, etc.) of any kind?

Yes (1), No (2)

Please indicate the date and the type of surgery and be sure to include all prior surgeries.

1. Have you experienced any problems related to a previous MRI examination or MR procedure?

Yes (1), No (2)

Please describe the problems related to a previous MRI examination or MR procedure.

1. Do you have any implants (cardiac pacemaker, stent, IUD, joint replacement, bone screw/nail, insulin pump, wire mesh or clamp, etc.)?

Yes (1), No (2)

For each implant, please describe the type of implant (IUD, pacemaker, surgical clip, etc).

1. Do you have any dental implants (braces, permanent retainer, dentures, etc.)?

Yes (1), No (2)

For each dental implant, please describe the type of dental implant (braces, permanent retainer, dentures, etc.).

1. Have you ever been injured by a metallic object or foreign body (BB, bullet, shrapnel, etc.)?

Yes (1), No (2)

Please describe the injury by a metallic object or foreign body (BB, bullet, shrapnel, etc.)

6. What is your height (in feet/inches)?

7. What is your weight (in pounds)?

8. Are you or could you be pregnant?

Yes (1), No (2)

9. Do you have any tattoos, body piercings, or permanent makeup (eyeliner, eyebrows, etc.)? Please select all that apply.

Tattoo(s) (1), Body piercing(s) (2), Permanent makeup (eyeliner, eyebrows, etc.) (3), I do not have any tattoos. Body piercings, or permanent makeup. (4)

Where is the tattoo located? (Please list all locations.)

Where is the body piercing located? (Please list all locations.)

Where is the permanent makeup located? (Please list all locations.)

10. Do you have claustrophobia, a motion disorder (vertigo, etc.), or asthma?

Yes (1), No (2)

11. Are you able to comfortably lie on your back in the MRI machine for the duration of the scan (60 minutes)?

Yes (1), No (2)

**Demographic Questions** (included in T1 survey)

The following questions will ask for brief demographic and biographical information. Please try to answer these questions as accurately as possible. Please note that this information will only be used for statistical purposes.

1. What is your age?

2. What is your date of birth?

3. Would you describe yourself as:

Female (1), Male (2), Nonbinary (3), Not listed (Please specify): (4)

4. How do you prefer to be addressed?

She/Her (1), He/Him (2), They/Them (3)

5. Would you describe yourself as (select all that apply):

Hispanic, Latino, or Spanish (1), White (2), Black or African American (3), American Indian or Alaska Native (4), Asian (5), Native Hawaiian or Other Pacific Islander (6), Not listed (Please specify): (7)

6. In what country were you born?

7. How many years have you lived in the United States?

8. What is the ZIP code of your current residence?

9. Is English the primary language that you read and speak?

Yes (1), No (2)

10. How many years have you been speaking and reading English?

11. What is your proficiency in English?

Very profiecient (1), Proficient (2), Somewhat proficient (3), Slightly proficient (4), Not at all proficient (5)

12. Are you primarily right-handed or left-handed, or do you use both hands?

Right (1), Left (2), Both (3)

13. What is the highest level of education you have completed?

Less than high school (1), High school graduate or G.E.D. (2), Some college (3), Two-year college degree (A.A., A.S.) (4), Four-year college degree (B.A., B.S.) (5), Master’s degree (for example, M.B.A., M.A., M.S.) (6), Doctoral or professional degree (for example, Ph.D., M.D., J.D., D.V.M., D.D.M.) (7)

14. What is your current occupational status?

Employed full-time for pay (1), Employed part-time for pay (2), Homemaker (3), Retired (4), Full-time student (5), Part-time student (6), Leave of absence for medical reasons (holding job, plans to return to work) (7), Unemployed less than 6 months, do not expect to work (8), Unemployed more than 6 months, do not expect to work (9), Unemployed less than 6 months, expects to work (10), Unemployed more than 6 months, expects to work (11), Laid off (12), Other (describe) (13)

15. What is your current job title? Please give a brief description of your duties. If RETIRED, please describe your job prior to retirement.

16. Can you estimate your current household’s gross income? This includes all sources of income, including public assistance and social security benefits.

Under $5,000 (1), $5,000-9,999 (2), $10,000-14,999 (3), $15,000-24,999 (4), $25,000-39,999 (5), $40,000-59,999 (6), $60,000-89,999 (7), $90,000-179,999 (8), Over $180,000 (9), Don’t know (10)

17. Are you currently receiving public assistance?

Yes (1), No (2)

18. How many people live in your household including yourself?

19. How many of each ot the following do you live with?

0 (1), 1 (2), 2 (3), 3 (4), 4 (5), 5+ (6)

Parents, parents-in-law, or step-parents (1), children, children-in-law, or step-children (2), Other family members (grandparents, aunts, uncles, cousins, etc.) (3), Friends/roommates that are not related to you (4)

20. How would you describe yourself poltically?

Very Liberal (1), Liberal (2), Slightly Liberal (3), Moderate (4), Slightly Conservative (5), Conservative (6), Very Conservative (7)

21. When it comes to social issues, how would you describe yourself politically?

Very Liberal (1), Liberal (2), Slightly Liberal (3), Moderate (4), Slightly Conservative (5), Conservative (6), Very Conservative (7)

22. When it comes to economic issues, how would you describe yourself politically?

Very Liberal (1), Liberal (2), Slightly Liberal (3), Moderate (4), Slightly Conservative (5), Conservative (6), Very Conservative (7)

23. What is your present religion, if any?

Protestant (such as Baptist, Methodist, Lutheran, Presbyterian, Pentecostal, Episcopalian or Anglican, United Church of Christ) (1), Roman Catholic (2), Mormon (3), Orthodox (such as Greek or Russian Orthodox) (4), Jewish (5), Muslim (6), Buddhist (7), Hindu (8), Atheist (9), Agnostic (10), Something else (please specify): (11), Nothing in particular (12)

24. Would you describe yourself as a born-again or evangelical Christian, or not?

Yes (1), No (2)

25. How religious do you consider yourself to be?

Not At All Religious 1 (1), 2 (2), 3 (3), 4 (4), 5 (5), 6 (6), Very Religious 7 (7)

26. How spiritual do you consider yourself to be?

Not At All Spiritual 1 (1), 2 (2), 3 (3), 4 (4), 5 (5), 6 (6), Very Spiritual 7 (7)

**Follow-Up Questions** (included in T3 survey)

1. Over the past six months, have you listened to the meditations from the training (i.e., after the training was over, have you continued to listen to the meditations)?

Yes (1), No (2)

1. How many hours total did you listen to the meditations from the training in the past six months (i.e., after the training was over)?
2. Over the past six months, have you practiced any forms of meditation besides the meditations from the meditation training (i.e., have you done any other type of meditation after the meditation training was over)?

Yes (1), No (2)

1. Please describe your meditation practice over the past six months (i.e., after the meditation training was over). What kind of meditation practice have you been doing and for how long?
2. Over the past six months, have you had any major life change or major life event occur?

Yes (1), No (2)

1. Please describe your major life change or event.
2. Is there anything else that you would like to tell us about the past six months?
3. Do you have any questions or comments about the study? Feel free to share anything else you would like us to know.

**Loving-Kindness Meditation Intervention**\*

Today's 27-minute introduction meditation will begin when you click the arrow. Please make sure that your device is not muted, and that the volume is turned up on your device before you click the arrow. Please make sure that you are able to listen to the entire meditation at once. An arrow will pop up in the bottom right corner once the meditation is complete. Please answer the question after the meditation to let us know that you did today's meditation.

Please listen to the meditation. You will be able to advance to the next page after the meditation is complete.

Did you listen to the entire meditation?

Yes (1), No (2)

\*Audio materials from <https://sharonsalzberg.com>.

**Progressive Muscle Relaxation Intervention**\*

Today's 19-minute introduction meditation will automatically begin when you click the arrow. Please make sure that your device is not muted, and that the volume is turned up on your device before you click the arrow. Please make sure that you are able to listen to the entire meditation at once. The meditation contains long periods of silence. An arrow will pop up in the bottom right corner once the meditation is complete. Please answer the question after the meditation to let us know that you did today's meditation.

Please listen to the meditation. You will be able to advance to the next page after the meditation is complete.

Did you listen to the entire meditation?

Yes (1), No (2)

\*Audio materials shared on <https://osf.io/2sx3v/>.

**Commitment Request** (included in each survey and both intervention materials)

We care about the quality of our survey data. For us to get the most accurate measures

of your opinions, it is important that you provide thoughtful answers to each question in this

survey. Do you commit to providing thoughtful answers to the questions in this survey?

I can’t promise either way (1)

Yes, I will (2)

No, I will not (3)

**Attention Checks**

T1, T2, Scan Day Survey, and T3 Surveys:

During Interpersonal Reactivity Index:

It is important that you pay attention. Please select "A - Does Not Describe Me Well".

T1, T2, and T3 Surveys:

During UCLA Loneliness Scale:

It is important that you pay attention. Please select "Rarely".

**References**

Aron, A., Aron, E. N., & Smollan, D. (1992). Inclusion of Other in the Self Scale and the structure of interpersonal closeness. Journal of Personality and Social Psychology, 63(4), 596–612. <https://doi.org/10.1037/0022-3514.63.4.596>

Cantril, H. (1965). The pattern of human concern. Rutgers University Press.

Crichton, N. (2001). Visual analogue scale (VAS). Journal of Clinical Nursing, 10(5), 706–706.

Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. Journal of Personality and Social Psychology, 44(1), 113–126. <https://doi.org/10.1037/0022-3514.44.1.113>

Lee, R. M., Draper, M., & Lee, S. (2001). Social connectedness, dysfunctional interpersonal behaviors, and psychological distress: Testing a mediator model. Journal of Counseling Psychology, 48(3), 310–318. <https://doi.org/10.1037/0022-0167.48.3.310>

Russell, D. (1996). UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. Journal of Personality Assessment, 66, 20–40.