

Mindfulness and Appraisal-based Interventions for Promoting Distress Tolerance and Preventing Chronic
Illness and Persistent Psychological Distress

by

Megan Marie Lipsett

A dissertation accepted and approved in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy

in Psychology

Dissertation Committee:

Elliot Berkman, Chair

Mariah Kornbluh, Core Member

Sheila Crowell, Core Member

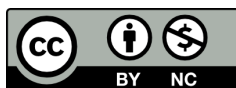
Josh Snodgrass, Institutional Representative

University of Oregon

Summer 2024

© 2024 Megan Marie Lipsett

This work is openly licensed via [CC BY-NC 4.0](https://creativecommons.org/licenses/by-nc/4.0/).



DISSERTATION ABSTRACT

Megan Marie Lipsett

Doctor of Philosophy in Psychology

Title: Mindfulness and Appraisal-based Interventions for Promoting Distress Tolerance and Preventing Chronic Illness and Persistent Psychological Distress

Addressing the psychological and emotional components of chronic physical and mental health issues is crucial for overall well-being and disease management. Psychoeducational interventions that target meta-cognitive skills and are informed by mindfulness and acceptance-based approaches show great promise in enhancing distress tolerance and fostering health-promoting skills. This dissertation explores the efficacy of interventions that pair contemplative practices with psychoeducational programs in two high-risk populations. The first study focuses on a brief, computer-delivered intervention for T2D prevention in a high-risk adult population, while the second study examines the impact of a mindful self-reflection training combined with a positive psychology and neuroscience course for college-transitioning adults at risk for chronic psychological and emotional distress.

Study 1 presents findings from a randomized controlled trial (RCT) of a brief (45-min), computer-delivered mindfulness- and acceptance-based intervention for T2D prevention in a screen-identified high-risk population, compared to conventional diabetes prevention education (DPE). Despite strong evidence that Type 2 Diabetes (T2D) can be prevented through lifestyle changes, traditional programs have limited effectiveness in altering behaviors or reducing incidence. Effective, accessible interventions targeting key psychosocial mechanisms and implementable virtually after risk assessments or primary care visits are needed. This intervention aims to enhance meta-cognitive skills (present-moment awareness, psychological flexibility, controllability awareness, experiential acceptance, cognitive defusion, and values identification) and reduce perceptions of threat and diabetes distress, a known barrier to health behavior change. The ACT + DPE group showed significantly higher controllability awareness and emotional acceptance, along with lower state anxiety, perceptions of diabetes risk-related threat, and state stress compared to the DPE-only group. Groups demonstrated equivalent readiness to change, self-management activation, or self-efficacy. This RCT is one of the first to test a brief, web-based, ACT-informed diabetes prevention program, demonstrating its potential to increase specific meta-cognitive skills and reduce anxiety, stress, and diabetes risk-related threat when engaged immediately after learning about being at high risk for diabetes.

Study 2 explores the impact of meta-cognitive skills on college-transitioning adults' well-being

through a 4-week mindful self-reflection training combined with a 10-week positive psychology and neuroscience (PPN) course for first-year undergraduate students, compared to a control group (general psychology course). The meta-cognitive skills of mindful awareness and psychological distance are valuable for reflecting on adverse life experiences and promoting emotional and psychological well-being, particularly among college-transitioning adults prone to psychological distress. We employed a multi-modal assessment that included psychological surveys, linguistic analysis, and functional magnetic resonance imaging (fMRI). Both the PPN course alone and the Mindful Self-reflection training + PPN course groups showed significant increases in self-distancing (i.e., reduced psychologically immersed speech and blame attributions) and self-transcendence. The PPN course alone led to greater increases in interpersonal perspective-taking, while the Mindful Self-reflection training + PPN course group showed greater increases in other-focus and well-being (relationship quality, self-acceptance, sense of purpose, and personal growth), as well as decreases in perceived stress, interpersonal distress, and depression. The Mindful Self-reflection training + PPN course group also had greater pre-to-post decreases in neural activity in the posterior precuneus, dmPFC, and TPJ during self-distancing tasks compared to the control group. Training in mindfulness and adaptive self-reflection on emotionally difficult events during the first year of college can alter the thought content and neural mechanisms of meta-cognitive skills, including self-referential processing, self- and other-mentalizing, self-distancing, and emotion regulation, ultimately reducing psychological and interpersonal distress and increasing multiple dimensions of well-being.

ACKNOWLEDGMENTS

I would like to express my deepest gratitude to my kind, hilarious, and astute advisor, Dr. Elliot Berkman. His unwavering support, insightful guidance, and constant encouragement have been invaluable. I am profoundly grateful for his mentorship, commitment to social justice, and humility. I would also like to thank my other committee members, Dr. Mariah Kornbluh, Dr. Sheila Crowell, and Dr. Josh Snodgrass, for their thoughtful critiques and support, which have enhanced the quality of this research.

For the diabetes prevention intervention, I am deeply indebted to my research team. Anastasia O'Hagan Browning played a crucial role in supporting study coordination. Research assistants Claire O'Connor and Noelia Duncan devoted time and effort to data collection. I am also grateful to the community advisory board: Dr. Jennifer Gregg, Dr. Lilian Dindo, Raquel Villarreal, MA, NBC-HWC, Joe Burge, MA, NBC-HWC, and Glenn Tinghitella, LPC, for their invaluable feedback on the study materials.

For the wellness mindset study, I extend my heartfelt thanks to the research team. Elizabeth Riebe, as project coordinator, your dedication and care for the study team were instrumental. Research assistants Luna Dare, Karlie Roberts, Jack Newman, Chloe Stevenson, Bethany Barnett, and Parker Rosay-Miller, your hard work in participant management, assisting with neuroimaging sessions, and coding the psychological distance qualitative data was crucial. Special thanks to co-PIs Dr. Elliot Berkman and Dr. David McCormick.

I would like to extend my gratitude to our study participants. Your contributions have been invaluable in advancing our understanding of distress in health. This work would not have been possible without your involvement, which underscores the importance of community-based research in public health.

Lastly, I am eternally grateful to my personal community, especially my supportive partner. Thank you all for your unwavering support and encouragement. This dissertation is a testament to your collective contributions.

TABLE OF CONTENTS

Chapter	Page
CHAPTER I: INTRODUCTION.....	14
1. Importance of Addressing Chronic Diseases and Stress.....	14
2. Psychological Mechanisms in Chronic Disease Prevention.....	14
3. Mindfulness and Acceptance -based Prevention Approaches.....	15
4. Overview of Studies and Aims.....	16
4.1. Study 1: Diabetes Prevention Education Informed by Acceptance and Commitment Therapy...	16
4.2. Study 2: Mindful Self-reflection Training to Promote Self-Distancing and Well-being.....	17
4.3. Research Questions.....	17
CHAPTER II: BRIEF ACCEPTANCE AND COMMITMENT THERAPY-INFORMED DIABETES PREVENTION RCT.....	18
1. Introduction.....	18
1.1. T2D Prevalence and Impact.....	18
1.2. Resource Barriers to Early Intervention in Primary Care Settings.....	19
1.3. Telehealth and Digital Health Interventions to Improve Occurrence of Self-screening and Early Intervention.....	20
1.4. The Value of Brief Interventions in Early Risk Detection.....	22
1.5. Psychological Mechanisms Driving T2D Prevention and Management.....	23
1.6. Mindfulness- and Acceptance- based Practices for Diabetes Prevention.....	24
1.7. Promoting Psychological Flexibility.....	26
1.8. Promoting Controllability Awareness.....	27
1.9. Perceptions of Threat in Diabetes Prevention.....	28
1.10. The Present Study.....	29
2. Method.....	30
2.1. Design.....	30
2.2. Ethical Considerations.....	30
2.3. Participants.....	30
2.4. Eligibility.....	31
2.5. Procedure.....	33
2.5.1. Community-engaged Intervention Development.....	33
2.5.2. Randomization.....	33
2.5.3. Pre-intervention Surveys.....	33
2.5.4. Intervention Groups.....	34
2.5.4.1. Diabetes Prevention Education Only (Active Control Condition; N =158).....	34
2.5.4.2. ACT for Diabetes Prevention + Diabetes Prevention Education (Experimental Condition; N =143).....	34
2.5.5. Post-intervention Surveys.....	35
2.5.6. Blinding.....	35

2.6. Measures.....	35
2.6.1. Cognitive Measures.....	35
2.6.1.1. Personalized Psychological Flexibility Index-Diabetes Prevention.....	35
2.6.1.2. Diabetes Prevention-Related Controllability Awareness.....	36
2.6.1.3. Perceptions of Diabetes Risk-related Threat.....	36
2.6.2. Affective Measures.....	37
2.6.2.1. Diabetes Risk-related Distress.....	37
2.6.2.2. State Anxiety.....	37
2.6.2.3. Affective Stress.....	37
2.6.3. Secondary Measures.....	37
2.6.3.1. Self-management Activation.....	37
2.6.3.2. Treatment Expectations and Intentions to Engage (TEIE).....	38
2.6.3.3. Readiness for Change.....	38
3. Statistical Analysis.....	39
3.1. Analysis of Covariates.....	39
3.2. Analysis of Survey Measures.....	39
4. Results.....	40
4.1. Preliminary Analyses.....	40
4.2. Primary Analyses.....	40
4.2.1. Results of Cognitive Measures.....	40
4.2.1.1. Personalized Psychological Flexibility Index-Diabetes Prevention.....	40
4.2.1.2. Expected Diabetes Prevention-Related Controllability Awareness.....	41
4.2.1.3. Perceptions of Diabetes Risk-related Threat.....	41
4.2.2. Results of Affective Measures.....	42
4.2.2.1. Diabetes Risk-related Distress.....	42
4.2.2.2. Affective Stress.....	42
4.2.2.3. State Anxiety.....	43
4.2.3. Secondary Measures.....	43
4.2.3.1. Confidence in Treatment.....	44
4.2.3.2. Self-management.....	44
5. Discussion.....	45
5.1. Implications of Findings.....	45
5.2. Limitations and Potential Biases.....	48
5.3. Future Research Directions.....	49
6. Conclusion.....	52

CHAPTER III: TRAINING MINDFUL SELF-REFLECTION AND PSYCHOLOGICAL DISTANCE REDUCES EVALUATIVE MENTALIZING, EMOTIONAL REACTIVITY, AND PSYCHOSOCIAL DISTRESS..... 53

1. Introduction.....	53
1.1. Mental Health Risk in Young Adults.....	53

1.2. Evaluative Self- and Other- Mentalizing during Following Distressing Interpersonal Experiences..	54
1.3. Training Attention Regulation through Mindfulness-based Practices.....	55
1.4. Targeting Self-immersion following Distressing Interpersonal Events to Improve Emotion Regulation and Stress Resilience.....	56
1.5. Neural Mechanisms Mindfulness and Self-distanced Reflection Techniques.....	57
1.6. Potential Impacts on Psychosocial Well-being.....	57
1.7. Mindfulness and Self-distancing Interventions.....	59
1.7. The Present Study.....	59
1.7.1. Hypothesis 1: Improvements in Evaluative Mentalizing and Psychological Immersion.....	60
1.7.2. Hypothesis 2: Improvements in Emotion Regulation and Stress Resilience.....	61
1.7.3. Hypothesis 3: Improvements in Psychosocial Well-being.....	61
2. Method.....	61
2.1. Participants.....	61
2.1.1. Consort flow and participant payment.....	62
2.1.1.1. Neuroimaging subgroups.....	62
2.1.1.2. Survey only groups.....	63
2.2. Eligibility.....	63
2.3. Procedure.....	65
2.3.1. Baseline Neuroimaging session.....	66
2.3.1.1. Pre-Scanning Preparation.....	66
2.3.1.2. Order of reflection task runs and blocks.....	66
2.3.1.2. Post-reflection emotional reactivity ratings.....	67
2.3.1.3. Overall Engagement Rating.....	67
2.3.2. Intervention Groups.....	67
2.3.2.1. PPN Course Alone (Experimental Group 1).....	67
2.3.2.2. Mindful Self-Reflection Training and PPN Course (Experimental Group 2).....	68
2.3.2.3. Introductory Psychology Course (Active Control Group).....	68
2.3.3. Post-intervention Surveys and Neuroimaging Session.....	68
2.3.4. Blinding.....	68
2.4. Measures.....	69
2.4.1. Self-report Measures.....	69
2.4.1.1. Self- and Other- Mentalizing and Psychological Immersion.....	69
2.4.1.2. Emotional Reactivity and Stress Resilience.....	69
2.4.1.3. Psychosocial Well-being.....	69
2.4.2. Measures of Immersed and Distanced Speech (MIDS) and Blame Attributions.....	70
2.4.3. Linguistic Signatures of Psychological Distance and Well-being.....	71
2.4.4. Neuroimaging Data Acquisition.....	72
3. Statistical Analysis.....	72
3.1. Analysis of Covariates.....	73
3.2. Analysis of Survey Measures.....	73

3.3 Human-coded Analysis of Psychological Immersion and Blame Attributions in Writing Prompts...	73
3.4. Analysis of Writing Prompts Using LIWC.....	74
3.5. Analysis of Neuroimaging Data.....	74
3.5.1. Neuroimaging Preprocessing.....	75
3.5.1.1. Preprocessing of B0 Inhomogeneity Mappings.....	75
3.5.1.2. Anatomical Data Preprocessing.....	75
3.5.1.3. Functional Data Preprocessing.....	76
3.5.4. Motion Artifacts.....	77
3.5.5. First-level Modeling.....	77
3.5.6. ROI Definition and Parameter Extraction.....	78
3.5.7. Analyzing Differences Between Task Conditions and Effects of the Intervention.....	78
4. Results.....	78
4.1. Preliminary Analyses.....	78
4.2. Primary Analyses.....	80
4.2.1. Human-Coded Analysis of Psychological Immersed and Distanced Speech in Writing Prompts.....	81
4.2.1.1. PPN course alone.....	81
4.2.1.1. Mindful Self-reflection + PPN course.....	82
Participants in the mindfulness + PPN condition (vs controls) had significantly buffered the increase in frequency of psychologically immersed speech ($\beta = -33.43$, $SE = 11.14$, $t = -3.00$, $p < .01$) ¹ from baseline to post-intervention, controlling for baseline psychological distance, expression length, memory recency, and significant covariates (see Table S.B.2 and Figure 9).....	
4.2.2.1. PPN course alone.....	82
4.2.2.1. Mindful Self-reflection + PPN course.....	82
4.2.3. LIWC-derived Analysis of Writing Prompts.....	83
4.2.3.1. PPN course alone.....	83
4.2.3.2. Mindful Self-reflection Training + PPN course.....	84
4.2.4. Results of Neuroimaging Analysis.....	86
4.2.4.1. Baseline Neural Activity Differences by Reflection Task.....	86
4.2.4.2. Changes in Neural Activation in Self-distanced > Self-immersed for the Mindful Self-reflection Training + PPN Course.....	87
4.2.5. Results for Analysis of Emotional Reactivity Post-memory Reflection Task.....	87
4.2.6. Self-report Measures.....	89
4.2.6.1. Analysis of Self-report Data for PPN Course Alone.....	90
4.2.6.2. Analysis of Self-report Data for Mindful Self-reflection Training + PPN course.....	93
5. Discussion.....	94
5.1. Increased Self-distancing and Reduced Blame Attribution following Mindful Self-reflection Training and PPN Course.....	94
5.2. Emotional Regulation, Stress Resilience, and Psychosocial Well-being.....	95
5.3. Intervention-driven Changes in Neural Substrates for Self-Referential Processing, Evaluative Mentalizing, Emotion Regulation, and Perspective-Taking.....	96

5.3.1. Posterior Precuneus.....	96
5.3.2. Temporoparietal Junction (TPJ).....	96
5.3.3. Dorsomedial Prefrontal Cortex (dmPFC).....	97
5.4. Dynamic Nature of Self-reflection.....	97
5.5. Benefit of Pairing Positive Psychology Courses with Mindful Self-reflection Trainings.....	99
5.6. Limitations and Future Directions.....	99
6. Conclusion.....	101
CHAPTER IV: GENERAL DISCUSSION.....	103
1. Overview of Research and Goals.....	103
2. Integrative Summary of Findings.....	103
2.1. Psychological Distress in Diabetes Prevention and Transition to College.....	103
2.2. Enhancing Meta-Cognitive Skills.....	104
2.3. Mindfulness- and Acceptance- based Practices.....	104
2.4. Novel Assessment of Neural Impact of Intervention for Promoting Psychological Distance....	105
3. General Summary of Results and Implications.....	105
3.1. Impact on Psychological and Emotional Experiences of Positive Diabetes Risk Assessment and Prevention Education.....	105
3.2. Impact on Psychological Immersion, Emotional Regulation, and Psychosocial Well-being in the Transition to College.....	106
4. Summary of Insights and Integration.....	110
4.1. The Gap between Knowing and Doing.....	111
5. Conclusion.....	111
APPENDICES.....	113
APPENDIX A. STUDY 1 SUPPLEMENTARY MATERIAL.....	113
APPENDIX B. STUDY 2 SUPPLEMENTARY MATERIAL.....	137
REFERENCES CITED.....	153

LIST OF FIGURES

CHAPTER II Figures.....	31
Figure 1 Consort Flow Diagram (Study 1).....	31
Figure 2 Cognitive Measures (Post-intervention) by Study Group.....	41
Figure 3 Affective Measures (Post-intervention) by Study Group.....	42
Figure 4 Secondary Outcomes Measures (Post-intervention) by Study Group	44
Figure 5 Readiness to Change Scores Depicted as Related to Corresponding Stage of Behavior Change.....	51
CHAPTER III Figures.....	53
Figure 6 Consort Flow Diagram: Study 2.....	64
Figure 7 Visualization of Runs and Blocks	66
Figure 8 Description of Reflection Task by Block.....	67
Figure 9 Line Graphs of Pre-to-post Change Scores for Self-Distancing and Blame Attribution within Written Reflections by Condition.....	81
Figure 10. Line Graphs of Pre-To-Post Change Scores for LIWC-Derived Other-Focus versus Self-Focus, Psychological Distance, and Positive Emotional Tone within Written Reflections by Condition.....	83
Figure 11. Line Graphs of Pre-to-post Change Scores for LIWC-Derived Personal Pronouns, First Person Singular, Emotional Anxiety Terms, and Negative Emotional Tone within Written Reflections by Condition	85
Figure 12. Visual depiction of neural regions that showed greater reductions in activity post-intervention for the Mindful Self-reflection training group (compared to the control group) for the contrasts for distanced > immersed.....	88
Figure 13. Line Graphs of Pre-to-post Change Scores for Emotional Reactivity Following the Memory Reflection Tasks by Condition.....	89
Figure 14. Line Graphs of Pre-to-post Change Scores for Perceived Stress, Interpersonal Distress, and Depression by Condition.....	90
Figure 15. Line Graphs of Pre-to-post Change Scores for Self-Transcendence, Well-Being (Overall), Interpersonal Perspective-Taking, and Community Connectedness by Condition	91
APPENDIX A FIGURES.....	114
Figure S.A.1. Correlation Heatmap for the Items of the Modified Diabetes-related Controllability Awareness Inventory.....	119
Figure S.A.2. Confidence in Treatment and Self-management (Post-intervention) by Study Group and Gender.....	120
Figure S.A.3. Psychological and Emotional Distress (Post-intervention) by Study Group and Gender..	121
Figure S.A.4. Correlation Heatmap for the PPFi Items.....	122
Figure S.A.5. Thematic Map of Focus Group Feedback.....	132
APPENDIX B FIGURES.....	139
Figure S.B.1. Histograms of Variables at Pre and Post that Displayed Zero-inflation.....	147
Figure S.B.2. Baseline Neural Activity Comparison (Collapsed across Groups): Self-Distanced + Empathy + Resilience > Self-Immersed.....	148

LIST OF TABLES

Table	Page
CHAPTER II Tables.....	32
Table 1. Baseline Demographic Characteristics for Enrolled Participants: Study 1.....	32
Table 2. Summary of Means and Primary Outcomes for Regression Models with Significant Covariates by Group: Study 1.....	43
CHAPTER III Tables.....	53
Table 3. Baseline Characteristics of Enrolled Participants: Study 2.....	65
Table 4. Summary of Measures Collected via Writing Prompt, Neuroimaging, and Self-Report by Construct.....	70
Table 5. General Summary of Findings: Comparing Change Scores of Measures Collected at Baseline and Post-Intervention for Experimental Groups versus Control Group	79
Table 6. Results of t-tests for Activation for Self-Distanced Composite > Rest vs. Self-Immersed > Rest	86
APPENDIX A. STUDY 1 SUPPLEMENTARY MATERIAL.....	114
Table S.A.1. Sample of Questions Posed to Focus Group and Participant Responses.....	130
Table S.A.2. Regression Model Results for Group Predicting Controllability Awareness.....	133
Table S.A.3. Regression Model Results for Group Predicting Emotional Non-Avoidance.....	133
Table S.A.4. Regression Model Results for Group Predicting Emotional Acceptance.....	134
Table S.A.5. Regression Model Results for Group Predicting Emotional Harnessing.....	134
Table S.A.6. Regression Model Results for Group Predicting Diabetes-Risk Distress.....	135
Table S.A.7. Regression Model Results for Group Predicting Perceptions Of Threat.....	135
Table S.A.8. Regression Model Results for Group Predicting Affective Stress.....	136
Table S.A.9. Regression Model Results for Group Predicting State Anxiety.....	136
Appendix B. STUDY 2 SUPPLEMENTARY MATERIAL.....	139
Table S.B.1. Tailored Coding Rubric for Measures of Immersed and Distance Speech.....	149
Table S.B.2. All Models of Human-Coded Analysis of Psychological Immersion and Blame Attributions in Writing Prompts.....	151
Table S.B.3. All Models for Human-Coded Analysis of Writing Prompts Using LIWC.....	152
Table S.B.4. All Models for Baseline Differences in Neural Activity between the Composite of the Self-Distanced Reflection Task and the Self-Immersed Reflection Task (Collapsed across Intervention Group) for our Regions of Interest.....	152
Table S.B.5. All Models for Self-Report Measures	152

ABBREVIATIONS

ACT = Acceptance and Commitment Therapy
ACT + DPE = Acceptance and Commitment Therapy + Diabetes Prevention Education
ADA = American Diabetes Association
aIns = Anterior Insula
ANOVA = Analysis of Variance
B-IPQ = Brief Illness Perceptions Questionnaire
BMI = Body Mass Index
BOLD = Blood Oxygenation Level Dependent
CAI-DP = Diabetes Prevention-Related Controllability Awareness Inventory
CDC = Centers for Disease Control and Prevention
CES-D = Center for Epidemiologic Studies Depression Scale
CMS = Cortical Midline Structures
COVID-19 = Coronavirus Disease 19
CSM = Common-Sense Model
dmPFC = Dorsomedial Prefrontal Cortex
DPE = Diabetes Prevention Education
DRDS = Modified Diabetes Risk-related Distress Scale
fACT = Focused Acceptance and Commitment Therapy
fMRI = Functional Magnetic Resonance Imaging
HbA1c = Hemoglobin A1c
IRI = Interpersonal Reactivity Index
IOS = Inclusion of Other in the Self
IIFG = Left Inferior Frontal Gyrus
LIWC = Linguistic Inquiry Word Count
MBSR = Mindfulness-based Stress Reduction
MIDS = Measures of Immersed and Distanced Speech
NCDs = Non-communicable Diseases
NPED = Nutrient-poor, Energy-dense
OFC = Orbitofrontal Cortex
PPN = Positive Psychology and Neuroscience
PPFI = Personalized Psychological Flexibility Index
pPrecun = Posterior Precuneus
PSS = Perceived Stress Scale
RCT = Randomized Controlled Trial
ROIs = Regions of Interest
SDOH = Social Determinants of Health
STAI: Y-6 item = Spielberger State-Trait Anxiety Inventory (6-item)
STS = Self-Transcendence Scale
T2D = Type 2 Diabetes
TEIE = Treatment Expectations and Intentions to Engage
TPJ = Temporoparietal Junction
WHO = World Health Organization

CHAPTER I: INTRODUCTION

1. Importance of Addressing Chronic Diseases and Stress

Chronic diseases and persistent stress represent major public health concerns. Chronic health conditions are consistently among the top 10 leading causes of death in the United States (Centers for Disease Control and Prevention, 2024) and account for almost 75% of healthcare expenditures (Raghupathi & Raghupathi, 2018). Nearly one-third of US adults, and half of young adults, report chronic stress that impacts their mental health, eating habits, physical health, and interest in activities (American Psychological Association, 2022). Empirical studies have demonstrated that both chronic diseases and persistent psychological distress can be prevented or mitigated with psychological and behavioral health interventions (Azami et al., 2018; Sin & Lyubomirsky, 2009).

Despite being preventable, strategies to mitigate these conditions have not consistently achieved enduring results. Over the past century, the United States has undergone a significant epidemiologic transition from infectious diseases to chronic non-communicable diseases (NCDs), with rates continuing to steadily increase. Similarly, the prevalence of mental health problems, such as depression, anxiety, and stress, continues to rise, including disproportionately high rates in populations experiencing chronic health conditions (Bener et al., 2011).

2. Psychological Mechanisms in Chronic Disease Prevention

Interventions that are informed by a thorough consideration of the upstream psychological mechanisms (e.g. condition-related distress, psychological inflexibility, and rumination) driving chronic diseases and mental health outcomes are needed to mitigate this sustained rise in incidence rates. Prevention-oriented psychoeducational approaches seek to move beyond the focus of conventional approaches on eradicating downstream symptoms, like prescribing hemoglobin A1c (HbA1C--lowering medications for Type 2 Diabetes. Instead, these interventions target upstream psychological mechanisms that influence well-being (e.g. diabetes distress) and health behaviors (e.g., ongoing dietary choices) that in turn impact chronic illness progression (e.g. HbA1C levels).

Chronic conditions ultimately develop following recurrent physiological dysregulation, which is generated in part by the cumulative effects of heightened and prolonged stress reactivity on cognitions, behaviors, and physiology. Stress reactivity includes psychological and physiological (i.e. neuroendocrine, cardiovascular, and inflammatory responses) responses to real or imagined life demands. Once developed, these chronic conditions in turn amplify stress reactivity. For individuals with psychological distress,

demanding situations like managing complex and comprehensive prevention regimens or transitioning to college elicit differences in stress-relevant physiological processes (e.g. parasympathetic nervous system activity) that are not apparent in neutral situations (Kiecolt-Glaser et al., 2020).

Heightened and prolonged stress reactivity is significantly associated with chronic inflammation, which characterizes multiple chronic conditions (e.g. metabolic syndrome, cardiovascular disease, and diabetes) and depression (Kiecolt-Glaser et al., 2015). Targeting psychological processes that are relevant in stress reactivity is therefore a promising approach to the prevention of chronic physical and mental health conditions. Many dynamic processes underpin the psychophysiological responses collectively described as “stress”, including low cognitive reappraisal ability (Troy, 2012), experiential avoidance (Brown, 2018; Choi et al., 2014), psychological self-immersion (Ayduk & Kross, 2008), psychological inflexibility (Cyniak-Cieciura, 2021; Madison, 2021), anticipatory stress and rumination (LeMoult et al., 2013; Ottaviani et al., 2016), and stigma internalization (Jung et al., 2020). Integrative intervention approaches that dynamically address both psychological and behavioral components are needed to effectively mitigate these processes and promote overall health and well-being.

3. Mindfulness and Acceptance -based Prevention Approaches

Broadly, mindfulness and acceptance -based approaches target these upstream psychological mechanisms to reduce stress and support health and well-being, with the potential to mitigate the onset of chronic conditions and persistent psychological distress. The impact of these interventions can be understood through theories that explain how psychosocial factors can alleviate the negative effects of stress on an individual's health and well-being. For instance, applying the Stress Buffering Account (Cohen & Wills, 1985) to mindfulness and acceptance -based approaches, protective psychological factors enhanced in these approaches (e.g., psychological flexibility, experiential awareness, self-distance) mitigate stress appraisals and reduce stress reactivity, and the resultant stress reduction explains how these approaches impact health behaviors and outcomes.

In addition to psychological protective factors, health behavior modification is key to the prevention or management of chronic health conditions. Yet, health behavior change remains elusive for many people. The stress that arises due to the day-to-day experience of managing one's health is considerable, especially for individuals working to maintain complex prevention or management regimens. Prevention regimens invariably include dietary components and physical activity because Westernized diets, characterized by the consumption of nutrient-poor, energy-dense (NPED) foods, along with a sedentary lifestyle, are closely associated with obesity (Oggioni et al., 2014; Dagfinn et al., 2017). Obesity, in turn, is a risk factor for several chronic conditions, including T2D and various forms of cancer (Benetou et al., 2008; Renehan et al., 2015;

Wolin et al., 2010). Chronic stress, including regimen distress, impedes the adoption of health behaviors. For instance, overeating (especially of high fat foods) is used as a method of ameliorating stress and is associated with obesity (Davis et al., 2004; Laitinen & Sovio, 2002). Psychological distress is linked to various health risk behaviors, including reduced frequency of exercise and cigarette smoking (Ng & Jeffery, 2003), as well as poor self-care and outcomes in both T2D and cancer risk (Winchester et al., 2016; Chida et al., 2008).

Cognitive appraisals of social and interpersonal experiences, along with resultant coping mechanisms, are central to developing distress tolerance and maintaining psychological well-being. Mindfulness and acceptance-based approaches are particularly well-suited to address the impact of psychosocial stressors on health and well-being, especially in demanding situations. Equipping individuals with effective distress tolerance practices is crucial for addressing various public health issues, particularly in preventing chronic physical and mental health conditions. Interventions informed by mindfulness and acceptance practices can enhance adaptive cognitive appraisals through non-judgmental awareness, psychological flexibility, self-acceptance, and insight. By targeting meta-cognitive tendencies related to psychosocial stressors, these approaches can buffer against the adverse effects of stress, reducing the likelihood of health-risk behaviors and psychological distress

4. Overview of Studies and Aims

This dissertation explores the efficacy of interventions targeting meta-cognitive tendencies through two controlled studies, including a randomized controlled trial (RCT) and a non-randomized controlled study. The studies are designed to examine the efficacy of psychoeducational interventions aimed at bolstering prevention behaviors through targeting psychological mechanisms that increase distress tolerance in the context of potentially demanding situations (i.e. learning about diabetes risk management and reflecting on emotionally difficult life experiences) as a method of preventing chronic disease and persistent psychological distress. Together, these interventions examine multiple “upstream” psychological and neural mechanisms that promote distress tolerance and, ultimately, psychological and behavioral health.

4.1. Study 1: Diabetes Prevention Education Informed by Acceptance and Commitment Therapy

Study 1 is a randomized controlled trial (RCT) of a brief (45-min), computer-delivered mindfulness- and acceptance-based intervention for the prevention of T2D in a high risk population (compared to conventional diabetes education). This intervention is designed to enhance present-moment awareness, psychological flexibility, controllability awareness, experiential acceptance, cognitive defusion, and values identification in a population of individuals who are at high risk for developing diabetes. The intervention is

further designed to reduce perceptions of threat and, ultimately, diabetes distress – a known barrier to health behavior change.

4.2. Study 2: Mindful Self-reflection Training to Promote Self-Distancing and Well-being

Study 2 is an RCT of a 4-week mindfulness-based wellness mindset training along with a positive psychology and neuroscience course in a population of first-year undergraduate students (compared to an introductory psychology course). The training is designed to increase present-moment awareness and foster psychological distance towards emotionally difficult memories in order to decrease emotional reactivity and increase meaning making and, ultimately, psychological well-being. Changes to linguistic and neural correlates of these constructs are also explored.

4.3. Research Questions

The overarching aim of this dissertation was to examine the efficacy of mindfulness and acceptance-based psychoeducational interventions in promoting health and well-being in high-risk populations. Specifically, it investigates: How does psychological distress impact the prevention of chronic illnesses such as Type 2 Diabetes (T2D) and overall well-being in college-transitioning adults? Does the development of psychological skills that foster distress tolerance support chronic illness prevention by reducing diabetes distress and facilitating better management of prevention regimens? Does a brief computer-delivered mindfulness and acceptance-based T2D prevention program improve diabetes distress, threat perceptions, affect, anxiety, controllability awareness, and psychological flexibility compared to conventional diabetes education? Can mindfulness and psychological distance enhance adaptive self-reflection on challenging life experiences, thereby improving psychological well-being? What are the psychological and neural mechanisms that reduce reactivity during self-reflection on demanding life experiences? Does a 4-week mindfulness-based wellness mindset training, combined with a positive psychology and neuroscience course, enhance psychological distance and overall well-being in young adults?

CHAPTER II: BRIEF ACCEPTANCE AND COMMITMENT THERAPY-INFORMED DIABETES PREVENTION RCT

Trial registration: ClinicalTrials.gov Identifier NCT05260983

Open Science Framework link: <https://osf.io/zpna4>

As the PI for this study, I designed and delivered the intervention (with input from the community and expert advisory boards named below), conducted the focus group sessions, preprocessed and analyzed the data, and compiled this dissertation document. Study activities were also supported by the research team (see acknowledgments). Study 1 was supported by the small grant program at the Center for Science Communication Research within the University of Oregon. The content is solely the responsibility of the authors and does not necessarily represent the official views of these funders.

1. Introduction

1.1. T2D Prevalence and Impact

Type 2 diabetes (T2D) is among the most widespread chronic diseases globally. T2D is often preceded by ‘prediabetes,’ a prodromal stage characterized by hyperglycemia, when changes in behavior can mitigate the risk for progression to clinical T2D. Both prediabetes and clinical T2D affect millions worldwide, with estimates that 11.3% of the global population will have T2D by 2030 (Magliano et al, 2021). These conditions carry significant health implications, including diabetic retinopathy, neuropathy, cardiovascular disease, and premature mortality (Deshpande et al., 2008). In the U.S., T2D imposes a substantial economic burden, exceeding \$402 billion annually (Dall et al., 2019). This includes increased medical expenses and reduced workforce participation and productivity (Raghupathi & Raghupathi, 2018). Multiple persistent impacts of T2D highlight the urgency for effective prevention strategies.

The period of prediabetes typically lasts five years or more (Irons et al., 2004; Tabák et al., 2012) and is responsive to intervention efforts (Echouffo-Tcheugui et al., 2023; Fonseca, 2008; Schulze & Hu, 2005). However, conventional prevention programs have shown limited effectiveness in altering disease-relevant behavior or reducing T2D incidence over time in community and clinical settings (Ely et al., 2017; Golovaty et al., 2023; Yates et al., 2009; Wilson et al., 2023). Up to 70% of individuals with prediabetes, comprising about 34.5% of U.S. adults, are expected to develop T2D (Centers for Disease Control and Prevention, 2020; Tabák et al., 2012). Early intervention is crucial for individuals at risk of T2D or meeting prediabetes criteria due to its significant pathophysiological impacts and risks of severe health complications.

Disparities in uptake, adherence, and outcomes are pronounced in common lifestyle interventions, particularly among underserved populations (Cannon et al., 2020; Ritchie et al., 2020). Structural factors, such as inadequate access to resources that promote nutrient-rich diets and physical activity, drive these disparities (Gaskin et al., 2014). Higher risk, prevalence, and disease burden are observed in racially underrepresented and economically disadvantaged groups (Golden et al., 2019). This includes higher risk of developing prediabetes (Bansal, 2015; Centers for Disease Control and Prevention, 2020) and distress (Khanolkar et al., 2016). Addressing these disparities is crucial given the significant health impacts and risks associated with prediabetes. Even the characterization of prediabetes as primarily a risk factor rather than a pathological condition itself may contribute to underutilization and low adherence to preventive treatments (Lawal et al., 2020).

1.2. Resource Barriers to Early Intervention in Primary Care Settings

Intervention in the prediabetic period is vital for slowing or preventing the progression of T2D (Abel et al., 2018; Christian et al., 2008). Principles of early intervention within health behavior change models like the Transtheoretical Model (Prochaska & DiClemente, 1983) emphasize the significance of timely preventive actions (Abel et al., 2018; Christian et al., 2008). In the US, primary care visits are one important setting for prevention education (Hing, 2010). The Endocrine Society's Clinical Practice Guidelines recommend that inpatient diabetes education be an integral part of the comprehensive discharge planning process for patients with T2D or newly recognized hyperglycemia (Korytkowski et al., 2022). However, several barriers hinder effective delivery in these settings.

Despite initiatives like co-payment removal under the Patient Protection and Affordable Care Act (Code of Federal Regulations, 2011), primary care visits have declined across demographics (Rao et al., 2019), a trend that accelerated during the coronavirus disease 19 (COVID-19) pandemic (Tu et al., 2022). The persistent high prevalence of non-communicable diseases (Bennett et al., 2018), compounded by a projected shortage of primary care physicians (Dall, 2018), suggests that comprehensive care delivery will continue to be impacted. Recent temporal models highlight the infeasibility of PCPs delivering guideline-recommended care within the current healthcare framework (Porter et al., 2023). This shortage is reflected in short consultation times, averaging just 18 minutes (SD=13.5 min; Neprash et al., 2021) that minimally increase with T2D diagnoses (Chen et al., 2009). Access to physicians, endocrinologists, and diabetes educators is lowest among historically underserved groups (American Diabetes Association, 2018), correlating with disparities in chronic condition management and healthcare decision-making (American Diabetes Association, 2018; Neprash et al., 2023; Dugdale et al., 1999; Rao et al., 2019).

Even when people are able to access primary care, PCPs often must prioritize managing extensive documentation requirements for electronic health records (e.g. documenting patients visits, entering orders for medication and imaging, and demonstrating regulation compliance) over direct patient engagement, hindering patient involvement in their own healthcare (Al-Badri & Hamdy, 2021). Diabetes prevention counseling is rare for patients meeting prediabetes criteria (Geiss et al., 2010), and many overburdened PCPs lack comprehensive knowledge and counseling skills for integrative prevention (Vrkatić et al., 2022). Most prediabetes patients are not referred to prevention programs (Mehta et al., 2017), with declining follow-up rates (Rao et al., 2019). Adequate education and counseling in primary care settings are largely inaccessible for many at-risk Americans, underscoring the need for more accessible preventive strategies.

1.3. Telehealth and Digital Health Interventions to Improve Occurrence of Self-screening and Early Intervention

The use of telemedicine and digital health tools is increasing, particularly in chronic illness management (Mann et al., 2020; Rao et al., 2019) and following the COVID-19 pandemic (Baum et al., 2021; Zeng, 2022); aligning with the WHO Global Strategy on Digital Health to enhance healthcare delivery (Mariano, 2020). Primary prevention focuses on delaying or preventing chronic conditions by identifying risk factors and providing appropriate care. Health assessments serve as 'teachable moments' prompting risk-reducing behaviors (Flocke et al., 2014; Xiang, 2016; Young et al., 2010). Virtual visits, like in-person visits, lead to increased prescribing (Lu et al., 2021) but lower rates of follow-up for diagnostic tests or referrals (Zhong et al., 2023). Effective early education and prevention, alongside low referral compliance, underscore the need for targeted psychoeducational interventions post-diabetes risk assessment. Computer-delivered interventions in primary care and telehealth improve diabetes distress and self-management (Fisher et al., 2013).

Many individuals with prediabetes are asymptomatic, but complications often become apparent by the time diabetes is clinically diagnosed, underscoring the importance of regular screenings (Duan et al., 2021). With the widespread availability and clinical use of glycated hemoglobin (HbA1c) screening tools, conducting reliable and timely screenings has become increasingly accessible (Sherwani et al., 2016). Screenings can prompt health behavior changes (Polello et al., 2009) and influence illness perceptions, potentially causing psychological distress (Croyle et al., 1997a; Croyle et al., 1997b). The International Diabetes Federation emphasizes self-assessment in national diabetes prevention (Alberti et al., 2007). However, screening rates in primary care are low (Brunisholz et al., 2021), and follow-up treatment plans after positive screenings are often lacking (Mainous et al., 2022). Online risk assessment tools, though non-invasive and affordable, have low follow-up rates after high-risk self-screening (Saaristo et al., 2010). These tools aid

early diabetes risk detection (Blüher et al., 2012) and promote health equity by increasing access for underserved populations (Timm et al., 2020).

Researchers and public health officials emphasize early intervention for high-risk individuals, advocating for minimizing barriers between risk identification and intervention to improve uptake (Jalkanen et al., 2021). The most common post-screening instruction after community risk assessments is physician referral, but compliance rates are low (Wright et al., 2014). Although online self-assessment tools can motivate risk-reducing actions (Waldron et al., 2011), they show similarly low follow-up rates in real-world settings (Diabetes Queensland, 2015). These tools often lack immediate prevention education and emotional skill-building, which could enhance motivation for protective behaviors (Van Cleave et al., 2012).

Follow-up information on risk assessment websites like the ADA's T2D online risk test encourages consulting a healthcare provider, provides educational materials to raise health risk awareness, and offers tools to locate a Diabetes Prevention Program. However, barriers to accessibility persist, especially for socially and economically disadvantaged individuals (Yates, Davies, & Khunti, 2009). Education is crucial, but the field has yet to offer immediate intervention opportunities. Enhancing prevention behaviors is possible with timely interventions during medical interactions or after in-clinic risk assessments (Sheridan et al., 2010).

Digital diabetes education and prevention interventions provided immediately after a positive risk screening offer a promising solution to address service provision gaps, whether the screening is self-assessed or physician-assessed. The 'screen and treat' approach, which involves identifying high-risk individuals and providing individualized interventions, is a critical component of multi-level strategies that also encompass population-wide approaches to influence public health policies on environmental moderators (Barry et al., 2017; Saaristo et al., 2010). Like the 'digital warm handoff' model (Reiter et al., 2018), interventions immediately post-assessment aim to enhance continuity of care, improve patient outcomes, and streamline the healthcare delivery process.

By offering digital diabetes education and prevention, there is a significant opportunity to enhance the currently low uptake rates of lifestyle interventions, a priority outlined by the U.S. Preventive Services Task Force (Nielsen et al., 2018; U.S. Preventive Services Task Force, 2021). They are scalable and more feasible for population-level health approaches, increasingly implemented globally. The timeliness and anonymity of digital diabetes education and prevention interventions following positive risk screenings bypass commonly identified barriers to care, such as financial costs, time limitations, and anticipated stigma. These interventions provide initial knowledge and skills to a significant number of individuals who might otherwise not participate in any prevention or management programs.

1.4. The Value of Brief Interventions in Early Risk Detection

This approach is particularly relevant for historically disadvantaged individuals, who have disproportionately high rates of pre- and Type 2 Diabetes and disease burden (Golden et al., 2012; Hill-Briggs et al., 2021). These disparities are driven in part by lower rates of prevention program utilization due to accessibility issues (Brown et al., 2003). Increasing awareness of the prominent role of health inequity and racial injustice in non-communicable disease outcomes, including expanded awareness during the COVID-19 pandemic, has resulted in support for intervention approaches that target social determinants of health (SDOH; Gómez et al., 2021). The World Health Organization (WHO) has identified access to care as a crucial factor in addressing SDOH, emphasizing the need to consider both the design and delivery of health services and programs (WHO, 2011). Attendance to multi-session interventions represents one barrier to access, as this can be logistically and financially challenging, particularly for socially and economically disadvantaged and rural patients (McGovern et al., 2016). Brief and single-session diabetes prevention interventions address gaps in service provision and facilitate engagement in ongoing self-management or program uptake, rather than replacing multi-session programs. Along with more accessible prevention programs, engagement facilitation interventions can influence program uptake (Gulliver et al., 2020). Brief interventions following diabetes risk identification can not only impact health outcomes directly but also increase self-referral rates to prevention programs, leading to higher enrollment compared to traditional physician referrals (Ritchie & Swigert, 2016).

There is a dose-response relationship between the number of lifestyle intervention sessions attended and outcomes like weight loss and diabetes onset (Galaviz et al., 2018). However, evidence suggests that reducing the frequency of common diabetes prevention programs can still achieve health goals (Dubé et al., 2012). Brief, single-session interventions can significantly impact health-related behavior change, including sleep and physical activity levels (Barreto, 2019), as well as enduring impacts on weight loss (Almeida et al., 2023). Pragmatic trials of the effects of brief, single session diabetes prevention consultations have demonstrated significant improvement in HbA1c at 12-month follow-up (Thatcher et al., 2022). Despite efforts to increase engagement with online assessment tools (Jalkanen et al., 2021), brief interventions immediately following high-risk determination are limited (Williams et al., 2022). One study provided standard diabetes education just prior to screening (Gulley et al., 2014). Initial evidence indicates that same-day prevention and self-management education interventions can positively impact outcomes for individuals newly diagnosed with prediabetes or type 2 diabetes, whether delivered in-hospital (Kawahara et

al., 2008; Wexler et al., 2012), in community pharmacies (Gomez-Peralta et al., 2021), or through technology-enabled approaches (Magee et al., 2021).

Web-based patient education technologies are increasingly utilized, and empirical examinations of multi-session technology-enabled diabetes education programs have shown promising results (Avdal et al., 2020; Davis, 2006). Video-based interventions may be particularly impactful in chronic illness contexts (Deshpande et al., 2023). However, to our knowledge, no empirical investigations exist on web-based interventions delivered immediately following positive diabetes risk screenings.

1.5. Psychological Mechanisms Driving T2D Prevention and Management

Beyond the need for timely and accessible interventions post-screening, conventional approaches to diabetes prevention may fall short in addressing cognitive and affective aspects such as distress (Powers et al., 2017). The etiology of T2D is multifactorial (Burns & Francis, 2024), with psychosocial components like stress-related factors, meta-cognitive skills, and weight stigma playing key roles in the condition's progression. Psychological factors significantly influence T2D development, management, and outcomes (Eriksson et al., 2008; Razzoli et al., 2017; Mooy et al., 2000). Perceived stress, anxiety, and depression are independently associated with diabetes onset and outcomes (Hasan et al., 2014; Louch et al., 2020; Novak et al., 2013; Smith et al., 2014).

Diabetes prevention and management require regular physical activity, a diet emphasizing nutrient (versus calorie) density, medication self-management, and blood glucose monitoring, all of which can compound psychological distress. Distress arises due to the demands of the self-care activities, as well as self-assessed self-management inadequacies, concerns about health complications, managing chronic pain, and distressing social situations and interactions with healthcare professionals (Nicolucci et al., 2013; Skinner, Joensen, & Parkin, 2020). This emotional distress, termed “diabetes distress,” is common (36% prevalence) among those with T2D and is distinct from depression (Fisher et al., 2007). Diabetes distress is linked to poor behavioral adherence, such as avoidance behaviors (Bauer et al., 2021), and adverse mental and physical health outcomes (Whitebird et al., 2009; Winchester et al., 2016). It exacerbates the progression of T2D by triggering biological responses like dysregulation of glucose metabolism and inflammatory processes, psychological responses such as rumination and anticipatory stress, and behavioral responses including the consumption of nutrient-poor foods and medication non-adherence (Cherrington et al., 2024; Cherry et al., 2023; Hackett & Steptoe, 2017; Kretchy et al., 2020). Social and structural factors like economic instability, food insecurity, transportation access issues, health literacy barriers, and lack of accessible health care have been cited as drivers of diabetes distress (Levy et al., 2022; Verdecias et al., 2023). Racial disparities in diabetes distress incidence, driven in part by perceived discrimination and low physician trust, have also been

documented (LeBron et al., 2014; Williams, 2020). Distress also impacts upstream outcomes, such as self-management self-efficacy and resultant self-management motivation (Lin et al., 2017), as well as self-care avoidance behaviors (Adu et al., 2019).

There is very little empirical work on distress related to the demands of diabetes prevention efforts in at-risk adults, despite the ADA's call for attention to distress in prediabetes (Young-Hyman et al., 2016). The standards of care in diabetes prevention involve intensive lifestyle changes similar to diabetes management (ADA, 2024; Rothenberger, 2010), and social and structural stigma is reported among those with prediabetes (Rony et al., 2023). Stress is negatively associated with prediabetes-relevant health behaviors (Ng & Jefferey, 2003), and regimen distress has been documented in specific prevention strategies like continuous glucose monitoring (Richardson et al., 2024). Distress is bi-directionally associated with diabetes precursors like metabolic syndrome (Nishina et al., 2011; Tang et al., 2017). Among ADA's diabetes prevention program participants, perceived stress and anxiety correlate negatively with physical activity levels (Delahanty et al., 2006). Overall, distress among high-risk individuals is associated with a 12.4% relative increase in diabetes incidence (Virtanen et al., 2014). Thus, addressing distress in T2D prevention is critical for comprehensive care.

Systematic studies on diabetes prevention distress or interventions aimed at reducing distress in at-risk populations are scarce, and this issue is often overlooked in clinical settings. Interventions addressing mental health in diabetes contexts have yielded mixed results in reducing distress and improving glycemic outcomes (Chew et al., 2017; Oyedemi et al., 2022; Schmidt et al., 2018), possibly because they use approaches designed for depression, not diabetes distress (Fisher et al., 2013), despite indications that distress may have stronger associations with self-efficacy and blood glucose concentrations (Lin et al., 2017). When specifically targeting diabetes distress, interventions show significant responsiveness (Fisher et al., 2013)

1.6. Mindfulness- and Acceptance- based Practices for Diabetes Prevention

Conventional diabetes prevention programs focus on stress management techniques like problem-solving, self-monitoring, and coping strategies (Diabetes Prevention Program Research Group, 2022). These may not adequately address distressing, unavoidable, or non-modifiable aspects of diabetes prevention. Effective psychological techniques should promote distress tolerance—the ability to endure emotional discomfort without resorting to illness-promoting behaviors or coping mechanisms; Simons & Gaher, 2005) —and persistence in prevention efforts. To manage distress more effectively, recent reviews and clinical guidelines recommend pairing diabetes education with psychological interventions (Chew et al., 2017; Halliday et al., 2020; Mangoulia et al., 2024; Schmidt et al., 2018).

"Third wave" therapies such as acceptance and commitment therapy (ACT), mindfulness-based cognitive-behavioral therapy, and emotion-focused behavioral therapy show promise in reducing diabetes distress and improving glycemic control (Coccaro et al., 2022; Fisher et al., 2018; Gonzalez et al., 2010). A meta-analysis found multi-session mindfulness- and acceptance-based interventions reduced diabetes distress and improved blood glucose levels and self-management in T2D patients (Ngan et al., 2021). ACT is an evidence-based treatment with strong potential for reducing psychological distress and preventing chronic disease using acceptance, mindfulness, and behavioral change strategies (Graham et al., 2016; Gregg et al., 2007). ACT, a "flexibility model" of self-regulation, teaches individuals present-moment awareness and how to flexibly engage in behaviors that facilitate overarching life goals (Bond et al., 2006). Focused Acceptance and Commitment therapy (fACT; Strosahl et al., 2012), a brief but evidence-based behavioral intervention, is commonly delivered by an integrated behavioral health consultant and is particularly well-suited for use in primary care settings (Glover et al., 2016). The Primary Care Behavioral Health Model outlines that behavioral health consultants aim to intervene with patients on the day of referral to primary care.

ACT enhances emotion regulation and psychological flexibility (rather than rigidity; Hayes et al., 2006) through encouraging acceptance (rather than avoidance) of internal and external experiences regardless of their valence; cognitive de-fusion (i.e., dis-identification with thoughts and feelings); present-moment awareness (rather than rumination or anticipatory stress); and values identification and values-consistent committed action (rather than habit- or shame-based behavior; Luoma et al., 2007). ACT includes techniques like cognitive restructuring, wherein individuals are encouraged to practice experiential acceptance in the face of non-modifiable stressors while attending to modifiable behaviors (Gillham et al., 2000; Hayes et al., 1999), with potential to improve adaptiveness of regulation techniques in the context of T2D prevention. Additionally, ACT promotes values identification and values-consistent committed action despite the presence of distress. Distress tolerance may enhance health-relevant behavioral goal attainment (Brown et al., 2005), and is associated with improved self-management outcomes in the context of chronic conditions (e.g., O'Cleirigh et al., 2007).

Initial evidence shows ACT-based interventions benefit individuals with chronic diseases by reducing psychological distress (Graham et al., 2016). Third-wave approaches have also shown reduced illness threat perceptions in those with chronic conditions and comorbid depression (Arat et al., 2018; Lemos, 2015; Shen et al., 2022). A recent study demonstrated the accessibility, feasibility, and efficacy of a multi-session program integrating ACT with diabetes education in reducing diabetes distress and improving self-care in T2D patients (Ngan et al., 2023). While preliminary evidence shows that ACT-based interventions can improve coping strategies, self-care, diabetes-related biomarkers, and psychological well-being for individuals diagnosed with diabetes (Gregg et al., 2007), these approaches have not been adapted to prevention-focused programs.

Third wave interventions are typically conducted over 6-7 sessions, whereas in community health settings, the most common number of treatment sessions attended in psychotherapy interventions is just one (Gibbons et. al., 2011). Single-session interventions incorporating ACT techniques have demonstrated benefit in people with chronic conditions (Dindo et. al., 2012; Schleider & Beidas, 2022). Single-session ACT interventions have shown benefits in chronic conditions (Dindo et al., 2012; Schleider & Beidas, 2022), including reduced Hemoglobin A1c levels and improved illness perceptions in diabetes (Khunti et al., 2012). Brief single-session ACT-based interventions remain less understood. Until structural barriers to prevention program attendance are addressed, enhancing brief interventions is necessary. Targeting key psychosocial mechanisms in brief interventions can effectively influence behavior change over time (Walton, 2014).

A preliminary observational study conducted by PI Lipsett surveyed 165 individuals with preclinical and clinical T2D to examine the impact of psychological risk and protective factors on T2D outcomes. We examined two risk factors (perceptions of diabetes-related threat and diabetes distress) and two protective factors (controllability awareness and psychological flexibility), along with their subscales (including experiential acceptance). We anticipated these factors would significantly predict diabetes distress and self-management behaviors in individuals with preclinical and clinical T2D. We employed a backwards stepwise elimination regression method to determine the relative contributions of our predictors (both composite scores and subscales). Our findings revealed that controllability awareness and experiential acceptance significantly predicted higher diabetes self-management behaviors and lower diabetes distress. Perceptions of diabetes threat were a significant predictor of diabetes distress only. Additionally, diabetes distress was significantly negatively associated with diabetes self-management behaviors (Lipsett & Berkman, in preparation).

1.7. Promoting Psychological Flexibility

The capacity to employ diverse regulatory strategies aligned with situational demands, termed "regulatory flexibility," significantly impacts health and well-being outcomes (Kashdan et al., 2020). Psychological flexibility, specifically, refers to the ability to persist or change behaviors in pursuit of goals despite encountering stressors and challenges (Luoma et al., 2007). A relationship exists between psychological flexibility and a range of health indicators, as well as psychological distress (e.g., Crouse et al., 2020). Furthermore, it promotes values-consistent actions and goal-related effort and progress (Kashdan et al., 2020). Psychological flexibility is posited to enhance self-regulation and promote healthier behaviors, especially under stress, which is pertinent in populations at risk for diabetes (Westphal et al., 2010). Conversely, difficulties in diabetes management may stem from behaviors characterized by psychological rigidity rather than alignment with personal values (Bond et al., 2011). Mindfulness- and acceptance-based

interventions enhance psychological flexibility, including when targeting distress (Fledderus et al., 2013). Improvements in psychological flexibility may account for a proportion of the improvements in psychological health and blood glucose following ACT-based intervention (Ngan et al., 2021).

Attempts to avoid or control distressing internal experiences can increase emotional distress and impede health-promoting behaviors. A key component of psychological flexibility, experiential acceptance, involves openness to and awareness of natural discomfort during goal pursuit (Association for Contextual Behavioral Science, n.d.; Block-Lerner et al., 2009). This receptive, non-interfering orientation towards present-moment experiences fosters a willingness to endure distressing experiences to achieve valued goals (Hayes et al., 1999). ACT may also be effective in promoting management of the emotional challenges associated with diabetes risk, and even training people to engage in emotional harnessing, utilizing distressing emotions to motivate goal pursuit (Kashdan et al., 2020). Instead of overly focusing on attaining pleasant emotions, effectively recognizing and harnessing difficult emotions can promote adaptive self-regulation. For example, exercise avoidance can result from the desire to avoid uncomfortable physical sensations.

1.8. Promoting Controllability Awareness

Situational controllability describes how much a person can affect the outcome of a particular situation (Heth & Somer, 2002). Preventing diabetes requires addressing both modifiable and non-modifiable risk factors. Risk factors for T2D and diabetes distress vary widely in their modifiability—from highly changeable factors such as nutrient intake and physical activity to less mutable influences like genetics and awaiting feedback from health professionals. In the context of diabetes prevention, situational controllability may influence the adaptiveness of regulatory efforts, such as when problem-focused coping strategies are employed rather than emotion-focused coping strategies in response to non-modifiable stressors (Lazarus, 1993; Troy et al., 2013). Control-oriented coping strategies are well-suited for modifiable aspects, while acceptance-oriented strategies are more appropriate for non-modifiable factors (Folkman, 2013; Folkman & Moskowitz, 2004). Situation-strategy incongruence can increase illness threat perceptions (Folkman, 1984) and distress (Vitaliano et al., 1990).

The cognitive tendency to differentiate between controllable and uncontrollable aspects of life situations is known as controllability awareness, a key component of stress tolerance (Heth & Somer, 2002). This concept differs from perceived controllability, which itself predicts stress and behavior. While perceived controllability involves appraising a situation's controllability, controllability awareness focuses on the tendency to respond based on recognizing which outcomes are controllable. Adaptively coping with situations by leveraging this awareness is linked to reduced distress and improved health-related quality of life (Atal & Cheng, 2016). Controllability awareness in the context of health correlates with lower perceived stress,

effective self-management behaviors, and better overall health (Heth & Somer, 2002). Learning to flexibly implement well-matched situation-strategy approaches may decrease diabetes distress. For instance, using problem solving to identify opportunities for physical movement and practicing mindfulness in response to anticipatory stress about future health complications. Thus, training skills in 1) identifying the degree of controllability of a given situation and 2) psychological flexibility across situational demands should support the adaptiveness of regulatory efforts in diabetes prevention.

1.9. Perceptions of Threat in Diabetes Prevention

The mental representation and response to health-related stressors play a crucial role in psychological distress and behavior change (Fortune et al., 2002; Petrie et al., 2007). Various illness perceptions (e.g., threat, avoidability, controllability, treatment efficacy) significantly impact lifestyle changes and the use of prevention treatments (Hampson et al., 1990; Stafford et al., 2008). In particular, threat perceptions, including beliefs about diabetes' controllability and risks, are linked to increased distress (e.g., Light et al., 2021; Timmermans et al., 2017) and avoidance behaviors such as social isolation, avoiding medical appointments, and neglecting self-care (Kemp et al., 1999; Moss-Morris et al., 1996), which correlate with diabetes prevalence (Christiansen et al., 2021) and outcomes (Hagger and Orbell, 2003; Scharloo et al., 1998). Threat perceptions are also related to elevated stress-related biomarkers like C-Reactive Protein, which increase the risk of complications in T2D (Goldberg, 2009).

Illness perceptions, particularly about curability and controllability, are strong predictors of treatment engagement, self-care, distress, and health outcomes for various chronic conditions (Abbott et al., 2021; Asuzu et al., 2017; Cooper et al., 1999; French et al., 2006; Nouwen et al., 2009). These perceptions are especially influential in the early phases of behavior change (Van Ommen et al., 2018). The misconception that prediabetes inevitably progresses to T2D is common (Nuñez, 2016) and leads to non-adherence, especially in underserved populations (Cannon et al., 2020; Mercado et al., 2021). Low perceptions of curability are prevalent among screen-identified individuals, who often believe T2D is caused by heredity rather than behavior (Klein Woolthuis et al., 2013). Perceptions of controllability include beliefs about the efficacy of one's behaviors (self-efficacy) and available treatments (program efficacy).

The relationship between threat perceptions and health behaviors is curvilinear: too little or too much threat perception can be counterproductive, leading to precautionary or hyper defensive strategies that both result in avoidant behaviors (Peters et al., 2013; Rogers, 1975). Extreme threat perceptions in diabetes prevention programs can be driven by excessive reliance on threat messaging, causing distress and avoidance of health behaviors (Peters et al., 2013; Ruiter et al., 2014). Programs that focus solely on behavior change, without addressing uncontrollable psychosocial and environmental determinants, may exacerbate threat

perceptions and reduce efficacy. Additionally, messaging that does not emphasize the preventability or curability of diabetes may further promote avoidance behaviors through extreme threat perceptions. The misconception that prediabetes inevitably progresses to diabetes is widespread and associated with risk-promoting behaviors (San Diego & Merz, 2022). Even the use of the term ‘prediabetes’ has come under scrutiny (Thomas et al., 2017), in part for the implication of the inevitability of diabetes onset. T2D is now understood to be preventable (ADA, n.d.; Pal & Nanda, 2017), and those diagnosed can achieve remission through evidence-based approaches (Lean et al., 2018; Shibib et al., 2022; WHO, 2016).

1.10. The Present Study

This study examines whether a brief web-based psychological and educational intervention, incorporating principles of Acceptance and Commitment Therapy (ACT) following a positive T2D risk assessment, can significantly reduce psychological distress and enhance self-management behaviors. The ultimate goal is to improve treatment uptake and long-term health outcomes for patients at high risk for chronic illnesses. This intervention targets psychological mechanisms to influence behavior change recursively over time and is designed for effective implementation using the RE-AIM framework. At the individual-level, this framework emphasizes factors such as reach, effectiveness, and maintenance. At the organizational-level, adoption, implementation, and sustainability of lifestyle interventions are considered (Balis et al., 2019; Glasgow et al., 1999). Designed to be administered both online and in healthcare environments, the intervention requires reasonable resource investments from health care providers and those seeking care.

The study provides a preliminary test of the efficacy of the Acceptance and Commitment Therapy for Diabetes Prevention + Diabetes Prevention Education (ACT + DPE) program delivered immediately following a positive risk assessment on cognitive (psychological flexibility, controllability awareness, and perceptions of diabetes risk-related threat) and affective (diabetes risk-related distress, state anxiety, and state stress) outcomes immediately following the intervention, compared to a conventional Diabetes Prevention Education program (DPE Only).

The primary pre-registered hypothesis was that the ACT + DPE group will have greater meta-cognitive flexibility and less distress compared to the DPE Only group. We also collected secondary measures related to an exploratory analysis to assess self-management activation, treatment expectations and intentions, and readiness to change¹. We hypothesize that, compared to the Diabetes Education Only group,

¹ We also pre-registered and collected a measure of self-management self-efficacy, a bespoke single-item measure derived from the General Self-Efficacy Scale (GSE-6; Romppel et al., 2013). However, it was removed due to the data being unusably restricted in range (Appendix A.8).

the Acceptance and Commitment Therapy + Diabetes education group will have equivalent self-management activation, and higher scores on treatment expectations and intentions and readiness to change.

2. Method

2.1. Design

This study employed a randomized controlled trial (RCT) design with two arms: an experimental group and a control group. The experimental group received the Acceptance and Commitment Therapy for Diabetes Prevention + Diabetes Prevention Education (ACT + DPE) program, while the control group received a conventional Diabetes Prevention Education (DPE Only) program. Detailed descriptions of each web-based intervention arm are provided in subsequent sections.

2.2. Ethical Considerations

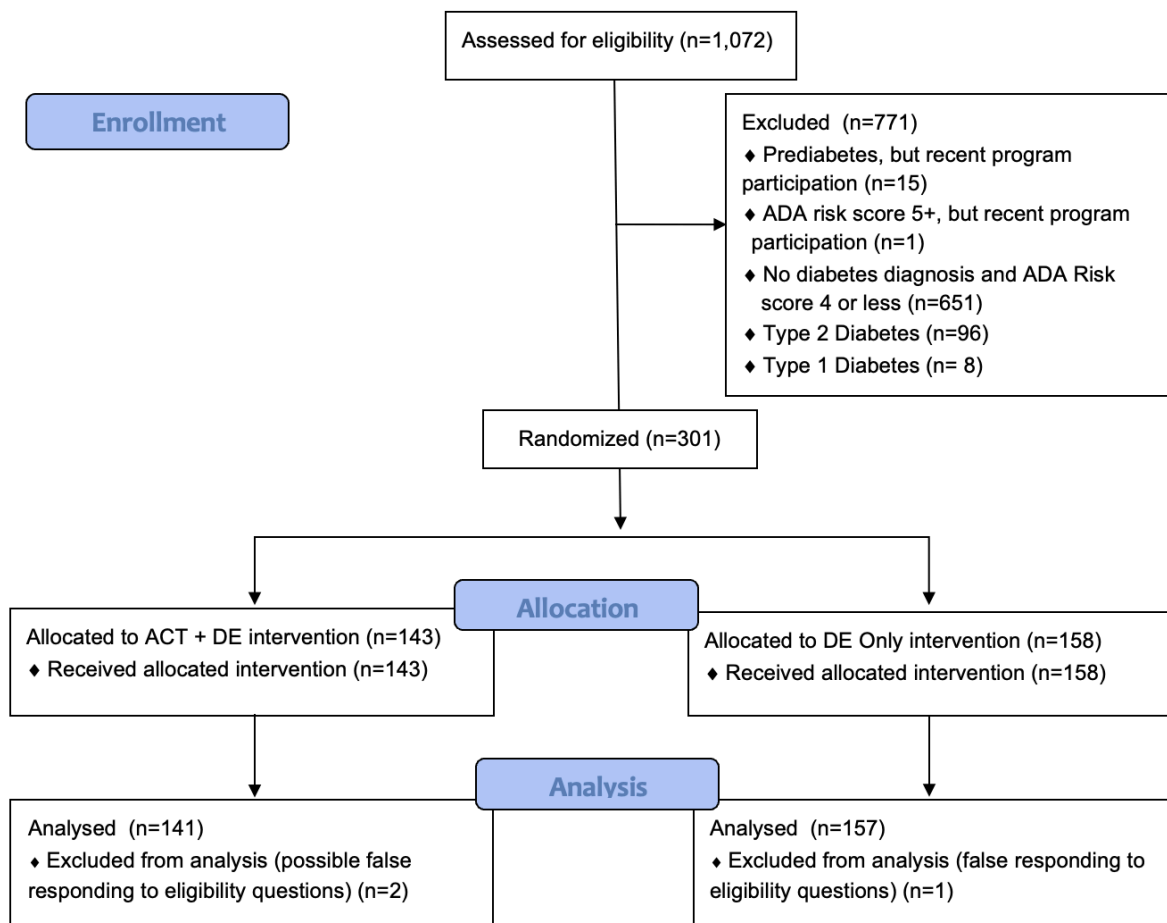
This study was approved by the University of Oregon Institutional Review Board and all participants provided written informed consent prior to enrollment. The study was registered at ClinicalTrials.gov (NCT05260983) and pre-registered at Open Science Framework (<https://osf.io/zpna4>).

2.3. Participants

Participants were 298 adults at high risk for developing T2D, who had not previously attended a diabetes prevention program. Age group (not age explicitly) was collected within the American Diabetes Association Risk Assessment and so was collected as a categorical measure. Overall, participants were 18-40 (N = 110), 40-49 (N = 77), 50-59 (N = 54), and 60 or older (N = 57). See Table 1 for baseline characteristics. Mean diabetes risk was 5.89 (SD = 0.89). The American Diabetes Association's (ADA) standards of medical care in diabetes considers those scoring 5 or higher to be at increased risk for diabetes (ADA, 2018). Participants were recruited through CloudResearch services.

Figure 1

Consort Flow Diagram



2.4. Eligibility

Participants were assessed for eligibility through a Qualtrics survey sent using Amazon's Mechanical Turk (i.e. "mTurk"). Eligible participants were United States residents, at least 18 years of age, English-speaking, and had 90% or higher task completion ratings within mTurk. Eligible participants 1) self-reported a “pre-diabetes” diagnosis or received a score of 5 or greater on the ADA risk test and 2) were not enrolled in a lifestyle program for diabetes prevention presently or within the past year. See consort flow diagram (Figure 1) for description of enrollment, analysis, and allocation values.

Table 1.*Baseline Demographic Characteristics for Enrolled Participants*

Characteristic	Full Sample (N = 298)	DPE Only (N = 157)	ACT + DPE (N = 141)	Condition Difference
Age (ADA Risk Categories)				$\chi^2(1)=1.43, p=.70$
18-40 years	110(36.9%)	61(38.9%)	49(34.8%)	
40-49 years	77(25.8%)	37(25.6%)	40(28.4%)	
50-59 years	54(18.1%)	27(17.2%)	27(19.1%)	
60 or older	57(19.1%)	32(20.4%)	25(17.3%)	
Gender				$\chi^2(1)=1.69, p=.19$
Female (%)	133(44.6%)	64 (40.8%)	69(48.9%)	
Male (%)	165(55.4%)	93(59.2%)	72(51.1%)	
Race				$\chi^2(5)=3.14, p=.68$
White (%)	212(71.1%)	115(73.2%)	97(68.8%)	
Asian (%)	33(11.1%)	15(9.6%)	18(12.8%)	
Black or African American (%)	32(10.7%)	15(9.6%)	17(12.1%)	
Hispanic and/or Latinx (%)	17(5.7%)	9(5.7%)	8(5.7%)	
Native American /Indigenous or Alaska Native (%)	2(0.7%)	2(1.3%)	0(0%)	
Unknown	2(0.7%)	1(0.6%)	1(0.7%)	
Conventional Body Mass Index (BMI)				$\chi^2(4)=8.07, p=.09$
<18.5	34(11.4%)	13(8.3%)	21(14.9%)	
18.5-24.9	100(33.6%)	49(31.2%)	51(36.2%)	
25.0-29.9	104(34.9%)	65(41.4%)	39(27.7%)	
30-39.9	50(16.8%)	26(16.6%)	24(17.0%)	
40 or over	10(3.4%)	4(2.5%)	6(4.3%)	
Mean household Income				$F(1,292)=0.46, p=.50$
~\$10,000/year	36(12.1%)	18(11.8%)	18(12.8%)	
~\$27,500/year	54(18.1%)	27(17.6%)	27(19.1%)	
~\$47,500/year	89(29.9%)	46(30.1%)	43(30.5%)	
~80,000/year	73(24.5%)	38(24.8%)	35(24.8%)	
~117,500/year	42(14.1%)	24(15.7%)	18(12.8%)	
Self-reported Diagnosis Status				$\chi^2(2)=0.81, p=.67$
Prediabetes	132(44.3%)	69(43.9%)	63(44.7%)	
ADA Risk score 5 or more	166(55.7%)	88(55.3%)	78(56.1%)	

Note. Participant age and BMI were collected as categorical measures, following the ADA Risk Test.

2.5. Procedure

2.5.1. Community-engaged Intervention Development

Prior to conducting the study, we developed an expert advisory board, consisting of practitioners who have expertise with the development and delivery of the intervention material and study population. These included: Dr. Jennifer Gregg, co-author of *Acceptance and Commitment Therapy for Diabetes Self-Management*; Dr. Lilian Dindo, a clinical psychologist specializing in daylong psychotherapeutic interventions, especially acceptance and commitment therapy for chronic health problems; Dr. Kathryn Kanzler, a clinical psychologist with expertise in ACT interventions and diabetes prevention in underrepresented populations; Raquel Villarreal, MA, NBC-HWC, a board-certified integrative health coach with expertise in culturally-adapted T2D prevention in community health settings; and Joe Burge, MA, NBC-HWC, a board-certified integrative health coach with expertise in computer-delivered T2D prevention. Advisory board members reviewed the study materials and provided feedback for refining the study via meetings with the PI.

Additionally, we conducted a 3-hour focus group composed of U.S. individuals ($N = 5$) who have prediabetes or Type 2 Diabetes and who were interested in contributing to the study design. Focus group participants were recruited using snowball social network sampling (Berg, 2006) and compensated \$54 for their participation. The focus group participants reviewed the study materials (consent form, surveys, intervention materials, and debrief) and provided feedback for improvement in understandability, minimizing stigma, effectiveness, access and relatability to the general public (see Appendix A.9 for script and agenda; see Table S.A.1 for sample of questions posed to focus group and participant responses). Guided by a process of thematic mapping (see Figure S.A.5), content from the community advisory board meetings and focus group was used to refine the study design and will not be reported.

2.5.2. Randomization

After assessing eligibility, but prior to intervention delivery, participants were randomized to one of two digital health diabetes prevention interventions using an automated digital randomizer: an intervention grounded in Acceptance and Commitment Therapy (ACT) and Diabetes Prevention Education (DPE) or DPE alone.

2.5.3. Pre-intervention Surveys

Eligible participants were consented and completed primary and secondary measures immediately prior to the intervention via Qualtrics (Qualtrics, 2024).

2.5.4. Intervention Groups

Both programs are approximately 45 minutes and include educational videos, interactive activities, and a workbook.

2.5.4.1. Diabetes Prevention Education Only (Active Control Condition; N =158)

This arm followed conventional T2D prevention program content. Topics covered include understanding diabetes and prediabetes, recognizing risk factors, the significance of early intervention, diabetes disease process, nutritional management, the importance of physical activity, diabetes medications, blood glucose monitoring, utilizing glucose results, and the prevention, detection, and treatment of complications. Participants are educated on the metabolic mechanisms of diabetes, the role of insulin, and the health consequences of unmanaged blood sugar levels. The intervention emphasizes the importance of maintaining a healthy weight, being physically active, and making nutritious food choices to mitigate the risk of diabetes.

Key activities in the program included setting realistic health goals, developing personalized action plans, and engaging in regular self-monitoring practices such as tracking food intake and physical activity. The intervention provided practical tips for incorporating more physical activity into daily routines, making healthier food choices, and managing stress. Participants were also encouraged to seek social support from groups, classes, and healthcare professionals to sustain their lifestyle changes. The overarching approach of the program is to empower individuals with the knowledge and tools necessary to make long-term, sustainable changes to their behavior, thereby reducing their risk of developing type 2 diabetes.

2.5.4.2. ACT for Diabetes Prevention + Diabetes Prevention Education (Experimental Condition; N =143)

This novel web-based diabetes prevention intervention incorporated principles of Acceptance and Commitment Therapy (ACT), drawing upon previous ACT-informed manuals for clinical populations and brief interventions in primary care settings (Gregg, 2004; Callaghan et al., 2005; Strosahl et al., 2012). The intervention delivered abbreviated diabetes education content alongside mindfulness and acceptance training to manage diabetes distress. Topics included: Clarifying values for a rich and fulfilling life, food as energy, relationship between stress and health, choosing how to respond to stress, noticing challenging thoughts and feelings, techniques to handle difficult thoughts and feelings, and approaching setbacks as opportunities. Participants explored personal values related to prevention self-management, set personalized goals based on available resources, identified values and emotions, and learned to act in a valued direction while encountering difficult experiences.

The ACT + DPE intervention was designed to use counter-moralizing terms, such as replacing “healthy foods” with “foods that give you important nutrients”. In addition, this training took a weight-inclusive approach by focusing on values that drive actions rather than on body size or weight loss (e.g. removing terms like “too heavy” or framing goals around weight loss). Our previous analysis (Lipsett & Berkman, in review) demonstrated that the ACT + DPE training, as compared to DPE Only, led to significantly reduced body shame. This reduction in body shame served as a mediator, influencing the treatment's effectiveness on lowering threat perceptions and anxiety levels. The program emphasized the significance of supportive interpersonal relationships and a strong sense of community connectedness in enhancing life satisfaction and health outcomes. Participants engaged in reflective activities to clarify their values, identify barriers, and develop practical action plans that align with their values. Through this approach, the intervention aimed to equip individuals with tools to sustain behavior changes, reduce stress, and live a healthier, more fulfilling life, thereby reducing their risk of developing type 2 diabetes.

2.5.5. Post-intervention Surveys

Primary and secondary measures were collected immediately following the intervention via qualtrics.

2.5.6. Blinding

As the intervention was conducted with pre-recorded videos and interactive modules, blinding of the facilitator was not relevant. PI Lipsett was blinded to condition for all data analyses described in this paper.

2.6. Measures

A full description of the measures described below is in Appendix A.1- A.7. As noted below, modifications were made to tailor the questionnaire to those with prediabetes or diabetes risk. For instance, wording was changed from ‘diabetes’ to ‘prediabetes’ or ‘diabetes risk’ and from ‘diabetes care’ to ‘diabetes prevention’.

2.6.1. Cognitive Measures

2.6.1.1. Personalized Psychological Flexibility Index-Diabetes Prevention

We measured psychological flexibility in relationship to self-identified health goals using a modified version of the 15-item Personalized Psychological Flexibility Index (PPFI) developed by Kashdan et al. (2020). The PPFI aims to measure how effectively an individual continues to pursue important life goals despite experiencing distress, a key factor in overall health (Kashdan & Rottenberg, 2010). The

PPFI was developed to improve upon other existing measures of psychological flexibility (e.g. the Acceptance and Action Questionnaire; Bond et al., 2011). Unlike measures that overlook the valued goals driving individuals to manage distress, or fail to differentiate from negative emotionality, the PPFI provides a comprehensive assessment. (Cherry et al., 2021). Participants are first asked to identify a goal they plan to work on, allowing responses to reflect a meaningful and relevant context. We adapted the measure such that participants were prompted to set a goal specific to diabetes prevention. Sample questions include: "I avoid the most difficult goal-related tasks." and "I put off pursuing this goal when I could be doing a more enjoyable task." Items are measured on a 7 point likert scale of "strongly disagree" (1) to "strongly agree" (7). Three subscales are calculated: Emotional non-avoidance, emotional acceptance subscale, and emotional harnessing. Overall psychological flexibility scores are computed by averaging all items and range from 5-35, with higher scores reflecting less challenge in pursuing valued life goals despite presence of distress.

2.6.1.2. Diabetes Prevention-Related Controllability Awareness

The 20-item tailored Diabetes Prevention-Related Controllability Awareness Inventory (CAI-DP; Heth & Somer, 2002) evaluates "controllability awareness," which is the tendency to respond based on an understanding of the controllability of potential outcomes. The CAI-DP measures how an individual's behavioral and emotional responses to daily life situations, whether stressful or not, reflect an awareness of the controllable and uncontrollable aspects of those outcomes, without explicitly focusing on controllability distinctions. The inventory examines various facets of controllability, including personal control (confidence in managing responsibilities), shared control (effectiveness in situations requiring shared responsibility), others in control (acceptance of situations outside one's responsibility), and no one in control (acceptance of unpredictable or uncontrollable outcomes). Statements assess these aspects, such as "I have the determination necessary to prevent diabetes" and "When it comes to my diabetes risk, I will try not to worry when there is no way to change how things will turn out." Responses range from "Disagree strongly (1) to "Agree strongly" (5), with higher scores indicating higher levels of controllability awareness. The CAI-DP is specifically tailored to assess controllability awareness in the context of diabetes risk management.

2.6.1.3. Perceptions of Diabetes Risk-related Threat

Perceptions of diabetes risk-related threat were measured with an index of the tailored 9-item Brief Illness Perceptions Questionnaire (B-IPQ; Broadbent et al., 2006; Moss-Morris et al., 2002) assessing cognitive (e.g. "How much do you believe your diabetes risk will affect your life?") and emotional (e.g. "How much does your diabetes risk affect you emotionally? (e.g. does it make you angry, scared,

upset, or depressed?”) representations of T2D, but modified for preclinical populations. The scale is designed to quantitatively measure the components of illness representations as described by Leventhal’s Common-Sense Model (CSM) of self-regulation (Leventhal et al., 1984, 1997).

2.6.2. Affective Measures

2.6.2.1. Diabetes Risk-related Distress

To our knowledge, there is no validated measure for assessing emotional or regimen distress among those with high risk for developing diabetes, despite standards of care that include intensive lifestyle modification (ADA, 2024). The Modified 5-item Diabetes-Related Distress scale (DDS4; Fisher et al., 2008), with the inclusion of an additional item from the original 17-item Diabetes Distress Scale (DDS; Polonsky et al., 2005) and modified for preclinical populations assessed participant concerns about diabetes prevention efforts and emotional burden of diabetes risk. Responses are collected using a 6-point likert scale ranging from “Not a problem” (1) to “A Very Serious Problem” (6), with higher scores reflecting higher levels of diabetes distress.

2.6.2.2. State Anxiety

The validated 6-item Spielberger State-Trait Anxiety Inventory (STAI: Y-6 item; Marteau & Bekker, 1992) assesses the state subscale of anxiety with acceptable reliability. Participants are prompted to respond to indicate “how you feel right now, at this moment”, followed by a list of common experiences (e.g. “I feel calm”, and “I am tense”). Responses range from “Not at all” (1) to “Very much” (4), with overall scores ranging from 6-24, where higher scores reflect higher states of anxiety.

2.6.2.3. Affective Stress

To assess affective stress, we used an item of the Positive and Negative Affect Scale (Watson et al., 1988). While participating in this diabetes prevention module, Participants rated the extent to which, while participating in the prevention program, they felt stress (e.g. out of control, unable to handle personal problems, overwhelmed by difficulties). Responses ranged from “Very slightly or not at all” (1) to “Extremely” (5), with scores ranging from 1 to 5.

2.6.3. Secondary Measures

2.6.3.1. Self-management Activation

Self-management activation was measured using the modified 4-item Patient Activation scale, which assesses participants' self-reported knowledge, confidence, belief in the importance of taking an active role, and plans to stay committed under stress for managing their health or chronic condition.

The original versions of this scale include a 22-item version (Hibbard et al., 2004) and a valid and reliable 13-item version (Hibbard et al., 2005). This measure evaluates several aspects: the belief in the value of proactive engagement, such as the importance of taking an active role in health care to prevent diabetes; confidence and knowledge necessary to take preventive actions against diabetes; plans to take action, like maintaining lifestyle changes such as healthy eating and exercising; and plans to remain committed during stressful times. For instance, items include statements like “When it comes to preventing diabetes, taking an active role in my own health care is the most important thing that affects my health,” and “I am confident that I can maintain lifestyle changes, like healthy eating and exercising, even during times of stress.” Each item is rated on a 4-point scale from “Strongly disagree” (1) to “Strongly agree” (4), with higher scores indicating higher levels of patient activation.

2.6.3.2. Treatment Expectations and Intentions to Engage (TEIE)

This 7-item survey assesses participant motivation, expectations, likelihood, confidence, and perceived efficacy of a treatment program (Deville & Borkovec, 2000). Items were selected and adapted from previously validated measures designed to assess treatment expectancy and rationale credibility in clinical outcome studies. Credibility refers to how believable, convincing, and logical the treatment is, whereas expectancy pertains to the improvements participants believe they will achieve (Deville & Borkovec, 2000). Participants are prompted with: “The following questions ask about your feelings and intentions specifically after completing the previous activities,” followed by questions that assess confidence in the program, treatment credibility, intentions to engage, and perceived program efficacy. Responses are given using a 5-point Likert scale, ranging from “Not at all” (0) to “Extremely” (4).

2.6.3.3. Readiness for Change

This measure assesses participants' readiness to engage in lifestyle changes to prevent diabetes (Biener & Abrams; 1991). The measure is a visual analog composed of 11 rungs and 5 anchor statements that respondents use to indicate where they are along the stages of change. For this study, the contemplation ladder anchor statements were altered to reflect stages of changes relevant to diabetes prevention behaviors. The measure reflects the principles of the Transtheoretical Model, which posits that individuals vary in their readiness to change behavior and that this readiness is predictive of their likelihood of behavior change (Prochaska & DiClemente, 2005). The response options correspond with the stage of precontemplation (e.g. “I have no thoughts about changing my health behaviors or enrolling in a prevention program.”), contemplation, preparation, action, and

maintenance (i.e. “I have changed my health behaviors and will never go back to the way I was before.”). Responses are from the least motivated (0) to the most motivated (10).

3. Statistical Analysis

Due to the prevalence of bots on Mechanical Turk (Chmielewski & Kucker, 2020), we minimized this issue by manually reviewing participant responses during the study. Three participants were excluded from analysis due to inconsistent responses regarding diagnosis on the eligibility form or indications of computer-generated text (Figure 1. Consort Flow Diagram). All analyses were performed using R Statistical Software (v4.1.2; R Core Team, 2021). Data transformation was performed using dplyr R package (Wickham, François, et al., 2023), tidyr R package (Wickham, Vaughan, et al., 2023), moments R package (Komsta & Novomestky, 2022), tibble R package (Müller & Wickham, 2023), broom R package (Robinson et al., 2023), purr R package (Wickham & Henry, 2023), and gtools R package (Warnes et al., 2023); Data visualization was done with ggplot2 R package (Wickham, 2016), knitr R package (Xie, 2023), kableExtra R package (Zhu, 2021), Hmisc R package (Harrell, 2022), corrplot R Package (Wei & Simko, 2021), psych R package (Revelle, 2022), and RColorBrewer R package (Neuwirth, 2022); Data analysis were performed using stats R package (R Core Team, 2021), nortest R package (Gross & Ligges, 2015), tidyverse R package (Wickham et al., 2019), rstatix R package (Kassambara, 2023), and car R package (Fox & Weisberg, 2019).

3.1. Analysis of Covariates

Preliminary analyses tested for condition differences in demographics and other baseline characteristics using chi-square (for categorical variables) and Analysis of Variance (ANOVA) tests (for continuous variables). Data was inspected for normality. Correlation heatmaps were created to visualize inter-item correlation levels. Covariates included within all models were: Diagnosis risk indicator (high risk versus prediabetes), age, gender, race, Body Mass Index (BMI), and socioeconomic status and social standing.

3.2 Analysis of Survey Measures

Multiple linear regression models were used to test group differences in post-intervention measures using the `lm()` function in R. The model included the post-intervention measure as the dependent variable and the group variable (control vs. treatment) as the independent variable to test whether there is a significant between groups difference in the post-intervention measure. We used the p-value criterion of $p < 0.05$ for determining statistical significance using two-tailed tests. In each model, we tested for group differences at

baseline in covariance. As described below, we ran the models with and without covariates for which there are differences at baseline per dependent variable.

4. Results

4.1. Preliminary Analyses

Descriptive statistics for the age, ethnicity, gender, BMI, socioeconomic status, diagnosis status (high-risk versus prediabetes diagnosis) can be found in Table 1. For all dependent variables below, we report the results of the models that controlled for all significant covariates. Results of these models and models without covariates included for primary dependent variables can be found in Table S.A.5 - S.A.10. Internal consistency for the items of the modified diabetes-related controllability awareness inventory was high for this dataset (Chronbach's $\alpha = 0.91$). Internal consistency for the items of the modified diabetes-prevention related distress scale was high for this dataset (Chronbach's $\alpha = 0.89$)

4.2. Primary Analyses

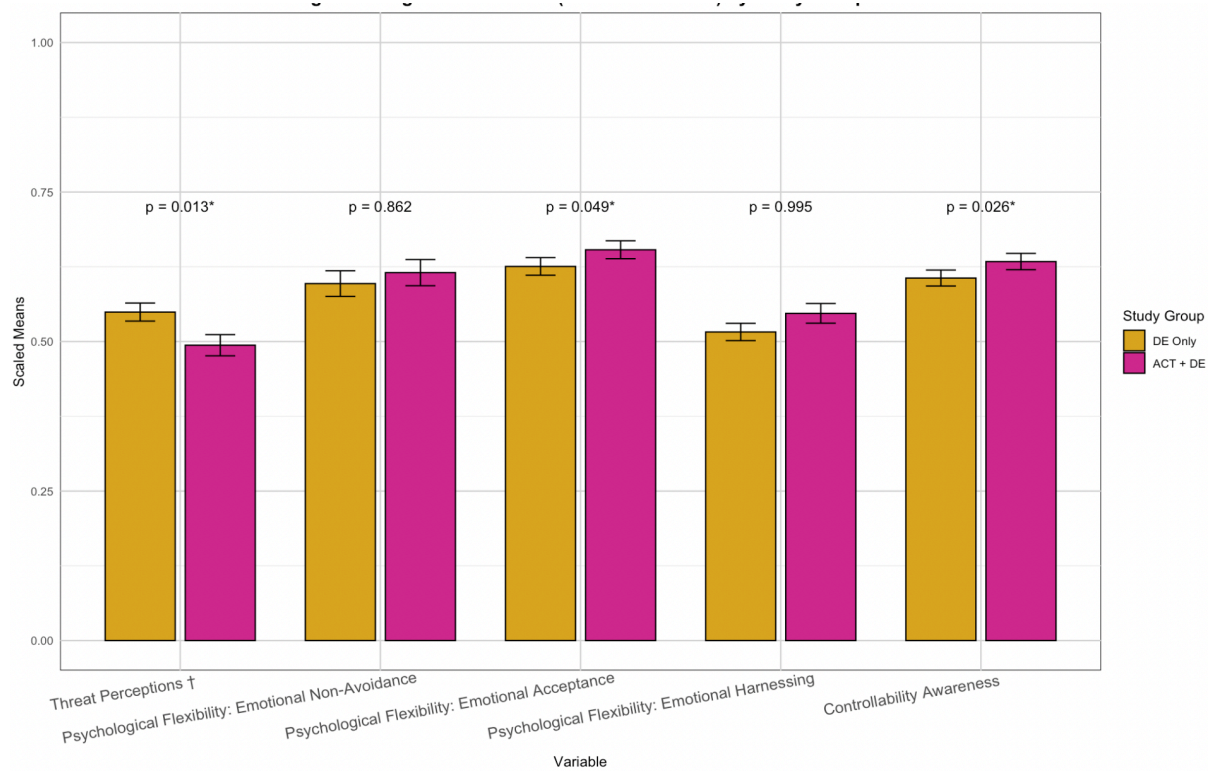
4.2.1. Results of Cognitive Measures

4.2.1.1. Personalized Psychological Flexibility Index-Diabetes Prevention

The mean $\pm$ SD of post-intervention emotional acceptance scores was 4.74 ± 1.08 for the DPE Only group and 4.97 ± 1.05 for the ACT + DPE group. Compared to the DPE Only group, the ACT + DPE intervention group had significantly higher post-intervention *emotional acceptance* when controlling for significant covariates ($\beta = 0.307$, $SE = 0.155$, $t = 1.981$, $p < 0.05$, $F(9,140) = 2.681$, $R^2 = 0.147$). The mean $\pm$ SD of post-intervention emotional non-avoidance scores was 4.84 ± 1.43 for the DPE Only group and 4.90 ± 1.37 for the ACT + DPE group. The mean $\pm$ SD of post-intervention emotional harnessing scores was 4.09 ± 1.08 for the DPE Only group and 4.26 ± 1.18 for the ACT + DPE group. No group differences were found in the psychological distance subscales for *emotional non-avoidance* ($\beta = -0.029$, $SE = 0.166$, $t = -0.174$, $p = 0.862$, $F(9,141) = 0.857$, $R^2 = -0.009$) or *emotional harnessing* ($\beta = -0.001$, $SE = 0.17$, $t = -0.006$, $p = 0.995$, $F(3,149) = 0.749$, $R^2 = 0.045$). See Figure 2 and Tables S.A.3 - S.A.5.

Figure 2

Cognitive Measures (Post-intervention) by Study Group



Note. p-values displayed reflect regression models with study group predicting the outcome variable, controlling for significant covariates (Table 2).

† = variable hypothesized to be lower in the experimental group.

4.2.1.2. Expected Diabetes Prevention-Related Controllability Awareness

The mean $\pm$ SD of post-intervention controllability awareness scores was 65.74 ± 9.98 for the DPE Only group and 67.57 ± 10.76 for the ACT + DPE group. Compared to the DPE Only group, the ACT + DPE intervention group had significantly higher controllability awareness when controlling for significant covariates ($\beta = 0.256$, $SE = 0.114$, $t = 2.242$, $p < 0.05$, $F(8,259) = 6.103$, $R^2 = 0.133$). See Figure 2 and Table S.A.2.

4.2.1.3. Perceptions of Diabetes Risk-related Threat

The mean $\pm$ SD of post-intervention diabetes risk-related threat scores was 5.49 ± 1.88 for the DPE Only group and 4.94 ± 2.09 for the ACT + DPE group (possible range: 0 to 11). Compared to the DPE Only group, the ACT + DPE intervention group had significantly lower post-intervention perceptions of diabetes risk-related threat when controlling for covariates ($\beta = -0.278$, $SE = 0.111$, $t = -2.509$, $p < 0.05$, $F(4,290) = 7.435$, $R^2 = 0.114$). See Figure 2 and Table S.A.7.

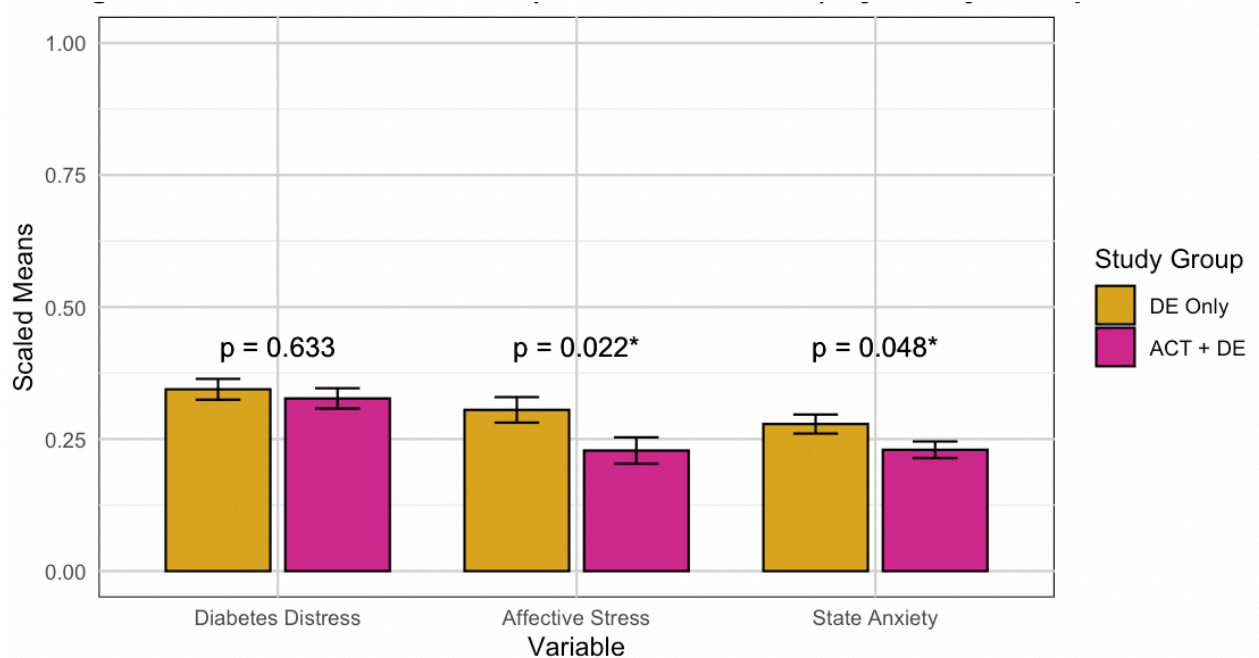
4.2.2. Results of Affective Measures

4.2.2.1. Diabetes Risk-related Distress

The mean $\pm$ SD of post-intervention DV scores was 2.65 ± 1.18 for the DPE Only group and 2.57 ± 1.09 for the ACT + DPE group. No group differences were found in post-intervention diabetes-related distress when controlling for significant covariates ($\beta = -0.056$, $SE = 0.118$, $t = -0.478$, $p = 0.633$, $F(6,261) = 3.268$, $R^2 = 0.092$). See Figure 3 and Table S.A.6.

Figure 3

Affective Measures (Post-intervention) by Study Group



Note. p-values displayed reflect regression models with study group predicting the outcome variable, controlling for significant covariates (Tables S.A.6, S.A.8, and S.A.9).

4.2.2.2. Affective Stress

The mean $\pm$ SD of post-intervention DV scores was 1.85 ± 0.96 for the DPE Only group and 1.64 ± 0.93 for the ACT + DPE group (possible range: 1 to 5). Compared to the DPE Only group, the ACT + DPE intervention group had significantly lower post-intervention affective stress (log-transformed) when controlling for significant covariates ($\beta = -0.264$, $SE = 0.114$, $t = -2.305$, $p = 0.022$, $F(2,294) = 3.755$, $R^2 = 0.049$). See Figure 3 and Table S.A.8.

4.2.2.3. State Anxiety

The mean $\pm$ SD of post-intervention state anxiety score was 36.71 ± 13.51 for the DPE Only group and 33.79 ± 11.15 for the ACT + DPE group (possible range: 20-80). Compared to the DPE Only group, the ACT + DPE intervention group had significantly lower post-intervention anxiety when controlling for significant covariates ($\beta = -0.227$, $SE = 0.114$, $t = -1.989$, $p = 0.048$, $F(2,293) = 4.148$, $R^2 = 0.054$). See Figure 3 and Table S.A.9.

Table 2.

Summary of Means and Primary Outcomes for Regression Models with Significant Covariates by Group

	DPE Only	ACT + DPE	β (SE)	t-value	p-value
	M $\pm$ SD	M $\pm$ SD			
	Raw values		z-scored values		
Measure					
<i>Protective Factors</i>					
Psychological Flexibility (Emotional Acceptance)	4.74 $\pm$ 1.08	4.97 $\pm$ 1.05	0.307 (0.155)	1.981	< 0.05*
Psychological Flexibility (Emotional Non-Avoidance)	4.84 $\pm$ 1.43	4.90 $\pm$ 1.37	-0.029 (0.166)	-0.174	0.862
Psychological Flexibility (Emotional Harnessing)	4.09 $\pm$ 1.08	4.26 $\pm$ 1.18	-0.001 (0.17)	-0.006	0.995
Controllability Awareness	65.74 $\pm$ 9.98	67.57 $\pm$ 10.76	0.256 (0.114)	2.242	< 0.05*
<i>Risk Factors</i>					
Threat Perceptions	5.49 $\pm$ 1.88	4.94 $\pm$ 2.09	-0.274 (0.110)	-2.483	< 0.05*
Diabetes Risk-related Distress	2.65 $\pm$ 1.18	2.57 $\pm$ 1.09	-0.056 (0.118)	-0.478	0.633
Affective Stress	1.85 $\pm$ 0.96	1.64 $\pm$ 0.93	-0.264 (0.114)	-2.305	< 0.05*
State Anxiety	36.71 $\pm$ 13.51	33.79 $\pm$ 11.15	-0.227 (0.114)	-1.989	< 0.05*

Note. B = regression coefficient; SE = standard error. Means are presented unscaled, whereas regression coefficients are scaled to account for covariates and other model parameters.

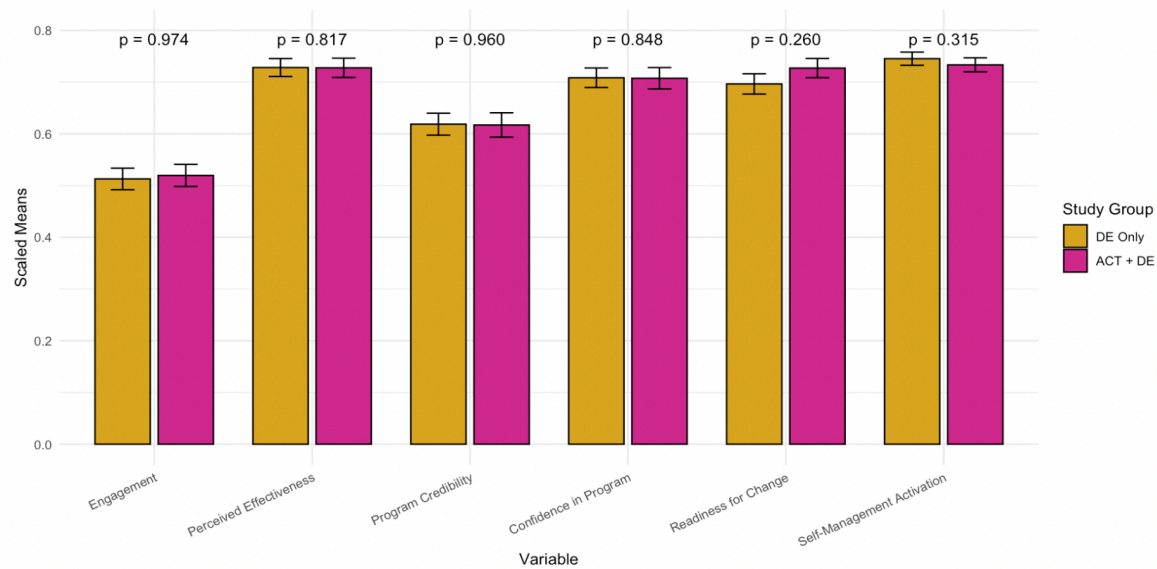
4.2.3. Secondary Measures

4.2.3.1. Confidence in Treatment

When controlling for significant covariates, groups did not differ in program engagement ($\beta = -0.003$, $SE = 0.115$, $t = -0.033$, $p = 0.974$, $F(4,292) = 3.919$, $R^2 = 0.051$), perceived effectiveness ($\beta = -0.027$, $SE = 0.116$, $t = -0.232$, $p = 0.817$, $F(2,294) = 3.487$, $R^2 = 0.023$), program credibility ($\beta = -0.006$, $SE = 0.116$, $t = -0.050$, $p = 0.960$, $F(1,295) = 0.002$, $R^2 = -0.000$) or perceived program benefit ($\beta = -0.022$, $SE = 0.116$, $t = -0.192$, $p = 0.848$, $F(2,294) = 2.026$, $R^2 = 0.007$) (Figure 4). On average, participants rated themselves as very confident to extremely confident in the *effectiveness* (3.18 ± 0.65 for DPE Only; 3.18 ± 0.66 for ACT + DPE; possible range: 0 to 4) of the programs; somewhat confident to very confident in the *benefit* (2.83 ± 0.94 for DPE Only; 2.83 ± 0.98 for ACT + DPE; possible range: 0 to 4) and credibility (2.47 ± 1.06 for DPE Only group; 2.47 ± 1.12 for ACT + DPE group; possible range 0 to 4) of the programs; and somewhat confident in their expectations to *engage* (2.05 ± 1.04 for DPE Only; 2.08 ± 1.02 for the ACT + DPE; possible range: 0 to 4) in a similar program.

Figure 4

Secondary Outcomes Measures (Post-intervention) by Study Group



Note. p-values displayed reflect regression models with study group predicting the outcome variable, controlling for significant covariates (available upon request).

4.2.3.2. *Self-management*

When controlling for significant covariates, groups did not differ in self-management activation ($\beta = -0.119$, $SE = 0.118$, $t = -1.007$, $p = 0.315$, $F(8, 280) = 1.093$, $R^2 = 0.03$) or readiness to change ($\beta = 0.141$, $SE = 0.124$, $t = 1.129$, $p = 0.26$, $F(1,258) = 1.275$, $R^2 = 0.005$) (Figure 4). The mean $\pm$ SD of post-intervention self-management activation scores was 3.24 ± 0.48 for the DPE Only group and 3.20 ± 0.48 for the ACT + DPE group. The mean $\pm$ SD of post-intervention readiness to change scores was 6.38 ± 2.37 for the DPE Only group and 6.70 ± 2.18 for the ACT + DPE group (possible range: 0 to 10).

5. Discussion

This study enhances our understanding of ACT-based interventions in diabetes prevention, highlighting their potential to reduce cognitive and emotional distress and improve metacognitive skills compared to conventional programs. Conducted as an RCT, it evaluated the effects of a brief, web-based ACT-informed diabetes prevention education versus standard education alone. The findings contribute to literature on accessible interventions for diabetes prevention, particularly in high-risk populations. The ACT + DPE intervention significantly enhanced cognitive and emotional outcomes compared to DPE alone, including increased awareness of controllability and emotional acceptance, and reduced perceptions of diabetes-related threat, emotional stress, and state anxiety. These results can be understood in the context of previous research on the importance of psychological flexibility and emotional regulation in managing chronic diseases (Fisher et al., 2012; Lawson et al., 2013). The study underscores the potential of brief ACT + DPE interventions to meaningfully contribute to global efforts in preventing type 2 diabetes. Our findings reinforce the critical need for early and effective interventions to combat the increasing prevalence of T2D.

5.1. *Implications of Findings*

Increased controllability awareness following the ACT-based program suggests participants may have gained skills to better align their self-management strategies across different situations. Furthermore, higher emotional acceptance post-intervention among ACT participants indicates improved psychological flexibility. These increases in controllability awareness and emotional acceptance underscore the potential of targeted psychological mechanisms in short diabetes prevention programs. Emotional acceptance is anticipated to foster persistence in goal pursuit amid challenges in prevention efforts (Luoma et al., 2007), potentially buffering against subsequent diabetes-related distress, as observed in other chronic illnesses (Fawson et al., 2023). These findings support prior research showing that mindfulness- and acceptance-based interventions

can enhance psychological flexibility (Fledderus et al., 2013). Enhancements in these cognitive skills suggest improved regulatory flexibility and coping effectiveness in diabetes prevention (Folkman, 2013; Pearson, 2018). The skills acquired through these interventions may recursively influence risk-reducing behaviors and distress tolerance over time (Southward, 2014; Walton, 2014), warranting longitudinal tracking in future studies.

Findings suggest that integrating mindfulness and acceptance-based principles with diabetes prevention education can mitigate some aspects of psychological and emotional distress. Following the intervention, the DPE Only group, with an average score of 37, approached the threshold indicating "moderate anxiety" (38-44). Notably, 41% of DPE Only participants fell into categories indicative of moderate to high anxiety (45-80), compared to 31% in the ACT + DPE group. Relative reductions in perceptions of affective stress, state anxiety, and perceived diabetes threat underscore the potential of these techniques to enhance psychological and emotional well-being following a positive diabetes risk assessment. These positive outcomes in self-regulation and emotional health were achieved without compromising perceived program benefits, engagement, credibility, or effectiveness, which were similar across both groups. Although the effects of the brief ACT + DPE intervention were modest, they offer initial evidence that web-based approaches can influence cognitive and emotional factors critical for diabetes prevention success. This is promising as such interventions could help overcome resource barriers in primary care, providing a scalable and efficient option for preventive education.

This study provides some insight into the impact of diabetes prevention education programs on distress among individuals at risk for diabetes, revealing reduced levels of diabetes risk-related threat in the ACT + DPE group. Future research should explore whether similar patterns emerge in multi-sessions self-management programs for individuals with T2D. Additionally, investigating whether decreases in these threat perceptions translate into improved health behaviors, particularly during early prevention stages, warrants further exploration. There is a need for methods that can effectively capture the complex interplay among threat perceptions, avoidance-approach motivation, risk awareness, distress, and efficacy in diabetes prevention and management contexts.

The orientation of ACT therapies, which focus on enhancing psychological flexibility and promoting engagement in meaningful behaviors despite distress, may account for the absence of group differences in diabetes risk-related distress, despite increases in emotional acceptance. This approach aligns with mindfulness strategies that acknowledge distress as an inevitable part of human experience and instead target "stress about stress"—the amplification of stress due to pathological meta-cognitions about demanding situations. While the initial impact of the ACT-informed diabetes prevention approach on psychological flexibility is promising, longitudinal studies are necessary to determine whether the ACT + DPE group can strengthen participants' ongoing ability to pursue meaningful prevention behaviors despite distress. Given

that both groups averaged in the "moderate distress" category post-intervention, with about one-third experiencing "high distress" (scores of 3 or more), further investigation into distress during early prevention efforts is crucial.

The psychological flexibility measure is designed to capture three skills that can be applied when confronting challenging emotions that arise during goal pursuit: maintaining awareness of them (non-avoidance), embracing them (acceptance), and utilizing them to motivate goal pursuit (harnessing). All three of these dimensions were higher for the ACT + DPE group, yet only reached significance for the emotional acceptance subscale. This may reflect the focus of the content and activities within the ACT-informed diabetes prevention program, which were more geared towards fostering acceptance of emotions. For instance, activities like mindfulness meditation, defusion exercises, and values clarification are designed to enhance emotional acceptance. Elements of the content reflected both awareness, acceptance, and harnessing broadly, but not specific to being energized by the difficult emotions (e.g. participants were told *"The goal right now is to learn how to notice the challenging thoughts and feelings you have about your health and to connect to the big question behind those thoughts and feelings: 'what do I need to do to take care of myself?'"*). Program content had a strong focus on identifying emotions and clarifying values to motivate action plans. It is possible that this focus on values-derived motivation overshadowed the possibility of using difficult emotions themselves to motivate goal pursuit. Still, content was present which explicitly spoke to elements of emotional awareness. For instance, participants heard the suggestion: *"Rather than getting 'hooked' by our worries about our health, or attempting to avoid difficult thoughts and emotions, the alternative is to move into our feelings. We do this by stepping back and learning just to bring our awareness to them, taking whatever might be valuable in them, and leaving the rest"* followed by a short "noticing" practice. The items that compose the emotional avoidance scale for the PPFI tend to be more descriptive of behavioral avoidance (e.g. "I avoid the most difficult goal-related tasks." and "I put off pursuing this goal when I could be doing a more enjoyable task."), whereas items that compose the emotional acceptance scale tend to be more descriptive of emotional acceptance (e.g., "While pursuing this goal, I try to accept my negative thoughts and feelings rather than resist them." and "I am willing to experience negative thoughts and emotions related to this goal."). It is possible that the approaches used in the present program were more effective for enhancing emotional acceptance, but not reducing behavioral avoidance. These findings support the integration of psychological flexibility approaches into preventive healthcare strategies, highlighting the potential for enhanced participant well-being and engagement in diabetes risk reduction behaviors. The findings may also reflect inconsistencies with the factor structure of the PPFI itself (e.g. Jo et al., 2023). The 3-factor structure demonstrated adequate between-item shared variance for each of the structures and so was used for the present analysis. However, only the emotional non-avoidance and emotional acceptance measures displayed strong factor loading, with the emotional harnessing items showing overlap with the other two factors (Appendix H).

The findings indicate practical implications for diabetes prevention programs. Interventions like ACT + DPE, by enhancing emotional resilience and reducing perceived threat and anxiety related to diabetes risk, may effectively address cognitive and affective drivers of prevention behaviors while maintaining program engagement and efficacy. These implications underscore the importance of integrating psychological support into diabetes care frameworks early in risk detection (Helitzer et al., 2007). The observed enhancements in cognitive and affective outcomes suggest that integrating ACT principles into brief diabetes prevention efforts can improve short-term participant well-being beyond traditional education-only approaches. By promoting psychological flexibility and acceptance of distressing thoughts and emotions, the ACT + DPE intervention may empower individuals to more effectively engage in health-promoting behaviors. This approach shows promise for enhancing diabetes prevention strategies by addressing psycho emotional barriers often associated with lifestyle changes (Golden, 2018).

5.2. Limitations and Potential Biases

Despite demonstrating significant benefits immediately post-intervention, this study has several limitations. The absence of baseline measures for our outcome variables raises the possibility of randomization failure and baseline group differences influencing our results. However, given the large sample size, any baseline differences were likely evenly distributed between intervention and control groups. Additionally, outcome measures in this study were evaluated shortly after interventions. Future steps include assessing the program's long-term efficacy. The use of short-form versions of measures, such as the self-management activation measure, may not fully capture constructs and could compromise reliability. Future research could incorporate longer, more comprehensive, and ecologically valid measures, such as behavioral or ecological momentary assessment, to capture program effects. The use of abbreviated measures might have limited the depth of psychological assessment, potentially overlooking nuanced changes in participant outcomes. Nonetheless, assessing both immediate "micro" engagement with digital interventions and longer-term "macro" behavior change remains valuable. Moreover, the study's sample predominantly consisted of financially incentivized individuals participating in a brief intervention, which may restrict generalizability to less motivated or diverse populations with varying health literacy levels.

Intervening at the point of a positive online diabetes risk assessment may not be optimal in all cases, but light-touch interventions can effectively reach individuals who do not follow up with healthcare practitioners post-screening. These brief interventions target influential psychosocial mechanisms that can foster behavior change over time (Walton, 2014). Participants were informed that the intervention aimed to raise awareness, emphasizing that a diagnosis requires consultation with a healthcare provider. Delivering this prevention intervention to individuals not clinically classified as prediabetic carries minimal risk, aligning with

arguments favoring population-based over interventions following health care screenings (Barry et al., 2017). Community health screening programs often offer counseling and resources regardless of current risk status, acknowledging disparities in follow-up (Curtis et al., 2021). Primary prevention principles advocate for early intervention at the earliest stages of risk (Schulze & Hu, 2005). Automated web-based screening and immediate brief interventions are scalable at a population level, facilitating timely prevention measures even before glucose dysregulation is detectable in blood, potentially enhanced through automated machine learning for diabetes detection (Chaki et al., 2022).

5.3. Future Research Directions

The U.S. Preventive Services Task Force (2021) has urged further research on the effects of lifestyle interventions for screen-detected prediabetes and diabetes on long-term health outcomes. Future research could explore the long-term effectiveness of brief online ACT-based interventions immediately following high-risk assessments to sustain behavior change and improve clinical outcomes in diabetes prevention. Subsequent studies could also quantify enrollment rates in follow-up programs and characteristics of individuals opting for longer programs following brief engagement interventions. Engagement expectations in our study, where confidence in further program participation did not differ across interventions, reflect global challenges in program uptake (Nielsen et al., 2018).

Investigating the scalability and cost-effectiveness of integrating ACT principles into existing healthcare models could inform broader implementation strategies. Despite the promising results of multi-session telemedicine interventions (Ashrafzadeh & Hamdy, 2019), additional research is required to determine their effectiveness and practicality in community health environments. Additionally, embedding ACT + DPE program content into electronic health records (Mann & Linn, 2012) could enhance integration within healthcare systems.

Computer-delivered diabetes screenings can sometimes be inaccurate, potentially providing false reassurance and delaying referral, though evidence suggests this is uncommon (Stiglic & Pajnkihar, 2015). Improving the accuracy of online risk calculators (Stiglic & Pajnkihar, 2015) is crucial. Population-wide strategies may justify a more inclusive threshold for intervention given the low potential for harm. Challenges such as data privacy and ergonomic considerations in using engagement technologies in healthcare settings require further investigation (Prey et al., 2014). Future studies could also enhance digital prevention programs by making them more adaptive and personalized, using algorithms that consider individual risk factors, behavioral readiness, and specific interests (e.g., Davis, 2006).

While these findings provide initial indications that the brief ACT + DPE intervention can confer beneficial upstream psychological and expected outcomes, it is crucial to understand the downstream impact

of interventions. Given the intention of this engagement facilitation study to encourage additional engagement with prevention programs, actual enrollment into such programs would provide additional insight into program effectiveness. The mean of readiness to change, which did not significantly differ across groups, was 6.5 (SD), which is commonly thought to reflect a person being in the ‘preparation’ stage that indicates plans to take action soon. There is indication that readiness to change scores for diabetes self-management reliably predict progression through the stages of change toward actually engaging in those behaviors (Jones et al., 2003).

Expanding this intervention to multi-session versions of the program is warranted, but should assess diabetes management behaviors and T2D biomarkers (e.g. HbA1c), potentially targeting individuals with metabolic syndrome. These efforts could contribute to more comprehensive diabetes prevention strategies. Initiating interventions for individuals with metabolic syndrome could enhance preventive efforts against type 2 diabetes. Still, continuing to refine and disseminate single-session interventions may better address the access issues faced by underrepresented populations.

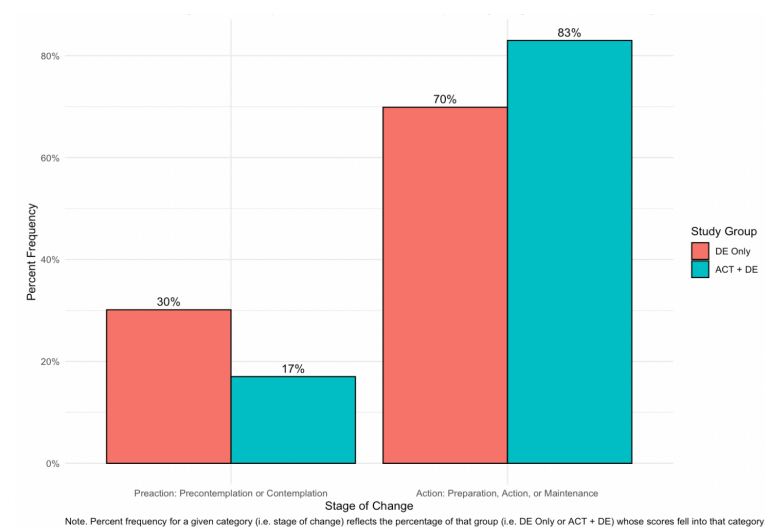
There is a need for long-term, randomized controlled trials to rigorously evaluate the effectiveness and sustainability of interventions like ACT-informed diabetes prevention programs. Research should also focus on assessing feasibility and acceptability across diverse populations and healthcare settings. Innovative approaches are needed to increase preventive health measures, given current low delivery rates and the affordability of some preventive strategies. These approaches encompass a variety of strategies such as establishing patient-centered medical homes (Baker & Laughlin, 2017), integrating community health workers, and incorporating behavioral health consultants and health coaches, (DeJesus et al., 2018), social ecological approaches, advancements in screening algorithms paired with mitigation strategies for health and computer literacy barriers (Masoud, 2023), and interdisciplinary collaborations in public health (Fisher et al., 2005). These initiatives aim to deliver comprehensive and coordinated care across different healthcare settings.

Future studies could engage in more nuanced examinations regarding content that is relevant for unique stages of change (Prochaska & DiClemente, 2005) following brief interventions. There is some indication in this study that the ACT-informed diabetes prevention interventions may be particularly helpful in motivating people who would’ve otherwise remained in precontemplation and contemplation stages of change and into preparation stages. The two groups differed in their level of readiness to change ($d = 0.14$) despite not being significant. Responses for 1 in 5 of the DPE Only participants indicated no plans to change their behavior (i.e. a score of 4 or less), compared to approximately 1 in 10 in the ACT + DPE group – and compared to ratings of the DPE Only Group, 10% more of the participants in the ACT + DPE group provided rating that suggest they are deciding to commit to change and are poised to begin taking action soon. This pattern of results (see Figure 5) suggests an underlying shift from preaction (precontemplation and contemplation stages) to action (preparation and action)(Prochaska & DiClemente, 2005). An individual’s

stage of change prior to a diabetes prevention intervention is predictive of subsequent session attendance. In particular, those in the action categories before the intervention are significantly more likely to be high attenders than those in the preaction category (Helitzer et al., 2007). Future studies could explore whether

Figure 5

Readiness to Change Scores Depicted as Related to Corresponding Stage of Behavior Change



ACT-based diabetes prevention interventions are particularly helpful in motivating people who would've otherwise remained in precontemplation and contemplation stages of change and into preparation stages. It is unknown what level of engagement would occur if this brief intervention were implemented in real-world settings, given that participants were incentivized to participate. Readiness to change and intentions to engage in treatment do not necessarily covary. For instance, someone could have strong intentions

to engage in self-managed risk-reducing behaviors and assess that use of treatment is unnecessary. Obtaining data regarding intentions to engage in both self-managed or physician- / program- supported prevention would help illuminate those nuances.

Despite the higher prevalence of diabetes among people of color compared to white individuals, participation in diabetes randomized controlled trials (RCTs) often fails to reflect this distribution (Li et al., 2022). The present study also lacked adequate proportional ethnic representation. Nevertheless, our participant groups included significant representation of economically disadvantaged and high-distress individuals, with more than 1 in 10 reporting a household income below the U.S. federal poverty guidelines for 2024 (U.S. Dept. HHS, 2024) and almost 86% of participants reporting a household income below the U.S. average (World Population Review, 2024). Additionally, more than one-quarter of participants reported moderate or severe psychological distress at baseline. While using mTurk for this study poses potential risks to data quality due to issues such as inattentive responses and demographic skew (Chmielewski & Kucker, 2020), along with prohibiting examination of community and regional factors that may be relevant for outcomes, it also offers advantages by targeting a population that is more likely to engage with digital platforms. This engagement is crucial for interventions delivered online, as it may lead to higher participation and retention rates, thus enhancing the study's overall feasibility and relevance in real-world digital health

contexts. Exploration of additional individual differences measures is also warranted. For instance, the patterns of results seen in this study indicate that the impact of including ACT-informed components may be particularly beneficial for female participants (Appendices D and E).

Future research should also refine low-cost, scalable interventions like those examined here to address socio-cultural factors and environmental influences impacting diabetes prevention efforts, aiming for more inclusive healthcare practices (Barry et al., 2017; Curtis et al., 2021). Underrepresented communities face barriers to healthcare access compounded by socio-political factors that deter uptake (e.g., concerns about stigma and treatment accessibility). The U.S. Preventive Services Task Force (2021) emphasizes the need for studies with diverse racial and ethnic samples representative of diabetes prevalence in the U.S. Young adults, experiencing significant increases in diabetes rates and decreases in prevention behaviors (Wang et al., 2021), are a particularly vulnerable group. Enhancing the cultural relevance of online prevention programs through adapted visuals, relevant examples, and resources addressing community-specific barriers could improve engagement and outcomes in these populations.

6. Conclusion

In conclusion, the Acceptance and Commitment Therapy + Diabetes Prevention Education intervention group demonstrated significantly better cognitive and affective outcomes related to diabetes prevention compared to standard education alone. The ACT-informed diabetes prevention intervention is a brief, web-based, cost-effective, and interactive program designed following RE-AIM principles. It can be readily delivered via computer following a T2D risk assessment in primary care, community health settings, or through population-wide screening approaches. This low-cost intervention has the potential to promote widespread engagement with ongoing prevention strategies and programs for individuals at risk for T2D through common online self-assessment tools. Continued research efforts are needed to examine long-term impacts and refine and adapt these interventions for diverse populations and healthcare settings.

CHAPTER III: TRAINING MINDFUL SELF-REFLECTION AND PSYCHOLOGICAL DISTANCE REDUCES EVALUATIVE MENTALIZING, EMOTIONAL REACTIVITY, AND PSYCHOSOCIAL DISTRESS

(pre-registration: osf.io/jrn2s)

As co-PI for this study, I designed the methods alongside co-PIs Elliot Berkman and David McCormick. I designed and delivered the mindful self-reflection training. I preprocessed and analyzed the data, and compiled this dissertation document, with support from Dani Cosme in pre-processing the neural data. Study activities were also supported by the research team (see acknowledgments). Study 2 was funded by the Tiny Blue Dot Foundation as part of the “Science of Perception Box” project. The content is solely the responsibility of the authors and does not necessarily represent the official views of these funders.

1. Introduction

1.1. Mental Health Risk in Young Adults

Young adults show considerably higher rates of mental illness and mental health risks compared to the broader adult population, with a particularly swift increase in psychological distress among this age group (Twenge et al., 2019). Symptoms of anxiety and depression among this group increased markedly during the COVID-19 pandemic (Hawes et al., 2022), with reports that risk for clinical depression among young adults in the U.S. has tripled (Alzueta, 2023). Previous research has demonstrated that entry into college is a critical window for normative development, with downstream impacts on adjustment later in life (Schulenberg et al., 2004; Tanner et al., 2016). National studies indicate that up to 77% of undergraduate students report moderate to high psychological distress (American College Health Association, 2023), which is a principle driver of young adult suicide, poor academic performance, and disengagement from school (e.g., Fergusson & Woodward, 2002). Reducing psychological distress in early adulthood has the potential to reduce life course onset and severity of mental health issues.

The present study examines how meta-cognitive tendencies, such as psychological immersion and evaluative mentalizing, contribute to mental health outcomes for college students. In particular, the role of psychological immersion and evaluative mentalizing in maladaptive self-reflection is highlighted. Factors that can contribute to adaptive self-reflection, especially during autobiographical reflection on distressing interpersonal experiences, are examined. Existing interventions often overlook the impact of these meta-cognitive tendencies when reflecting on distressing interpersonal experiences, despite the clear link between interpersonal rumination and both social relationships and mental health (Nepon et al., 2011). This

study argues that self-distancing practices have strong potential to encourage adaptive self-reflection of distressing interpersonal experiences, with resultant benefits for emotion regulation, stress resilience, and psychosocial well-being. Furthermore, combining mindfulness with self-distancing holds promise for enhancing attentional regulation while promoting experiential awareness, rather than avoidance, of reflection on distressing past events. By examining the effects on meta-cognitive processes, emotional regulation, and well-being, this study seeks to offer a comprehensive understanding of how these practices can be optimized to improve mental health outcomes in college-transitioning adults.

1.2. Evaluative Self- and Other- Mentalizing during Following Distressing Interpersonal Experiences

Psychological distress is driven by demands related to both chronic and daily life stressors (Serido et al., 2004). Stress itself can be defined broadly as the result of the process by which one appraises both the extent to which a given situation is demanding and one's capacity to cope given available resources (Folkman et. al., 1986; Lazarus & Launier, 1978). While stress has profound impacts on mortality and morbidity (Schneiderman et al., 2005), meta-cognitions about stress are themselves key determinants of these outcomes (Crum et al., 2013). Exposure to demanding life situations is inevitable - and the ability to reflect on these demanding and emotionally difficult life experiences is a critical meta-cognitive skill. For young adults, meta-cognition about stress is related to well-being, physical health, academic performance, and prosocial behavior (e.g. Keech et. al., 2018; Tan & Singh, 2022). Psychological tendencies engaged during reflection on difficult life experiences may be a driver of downstream chronic psychological distress.

A significant proportion of our daily mental activity is characterized by "stimulus-independent thought," commonly referred to as mind wandering (Killingsworth & Gilbert, 2010), which includes ruminative brooding. Distressing interpersonal interactions are one of the most commonly reported triggers for self-referential thinking and rumination (Joubert et al., 2022). Interpersonal relationships hold significant importance for college students, influencing both their academic and personal development (Allen & Bowles, 2018; Martin, 2014). Consequently, the rumination that arises from distressing interpersonal experiences is particularly pertinent for this population.

Practices that build stress resilience are especially important for individuals facing high levels of adversity, a group that predominantly includes underrepresented and minoritized populations. Given that social factors such as poverty, ethnicity, and gender minority status influence exposure to chronic and daily life stressors, broader initiatives to address social and structural determinants are needed to address impacts of inequitable stress exposure. More comprehensive and systemic approaches are beyond the scope of this paper. The practices presented here, while designed to prevent long-term impacts of distressing life experiences, do not represent a comprehensive approach to population-level stress resilience.

In general, people commonly engage in autobiographical reflection, which informs self-concept (Vanderveren et al., 2019). Efforts to evaluate and understand one's emotions, cognitions, and behaviors are particularly pronounced following difficult life experiences (Papageorgiou & Wells, 2001). However, repeatedly focusing on negative information about the past (i.e., ruminating) negatively impacts emotional and psychological well-being, life satisfaction, performance, and behavior regulation (e.g. Felsman et. al., 2017; Kane, & Mcvay, 2012). Yet experiential avoidance can exacerbate distress (Kashdan et al., 2006) and self-reflection on stressful experiences can be adaptive (Crane et al., 2019). How a person reflects on experiences of adversity can result in prolonged emotional reactivity and disruptions to daily functioning for some (Michalak et al., 2011), even if that reflection can build resilience to future stressors and compassion for others (Crane et al., 2019; Seery et al., 2013). Self-reflection can facilitate both adaptive coping and resultant benefits to mental and physical health (e.g., Pennebaker & Graybeal, 2001) and maladaptive coping and resultant physical and mental health detriment (e.g. Joormann et al., 2006), even exacerbating rumination and negative affect (Smith & Alloy, 2009), especially in populations with depression (Gotlib & Joormann, 2010).

While self-reflection on stressful experiences can increase distress, it can also produce psychologically resilient outcomes when insight is gained from the process (Crane et al., 2019; Falon et al., 2022) and contribute to resolution of ongoing distress (Kross, 2009; Pennebaker & Chung, 2007). Developing the meta-cognitive ability to differentiate between adaptive self-reflection and maladaptive forms of rumination, then, is a key determinant of emotional and psychological health (Dunn & Luchner, 2022). It follows that effective programs to mitigate psychological distress should promote adaptive self-reflection through engaging in self-reflective practices aimed at developing self-insight through understanding one's emotions, thoughts, and behaviors related to adverse experiences (Crane et al., 2019).

1.3. Training Attention Regulation through Mindfulness-based Practices

As automaticity is a key feature of mind-wandering (Killingsworth & Gilbert, 2010), adaptive self-reflective practices likely rely at least initially on intentional regulation of attention. The ability to apply attentional regulation is a determinant of psychological health (Garland et al., 2014; Wolkin, 2015). Mindfulness-based practices, generally described as involving 1) the ongoing monitoring of present-moment experiences and 2) the establishment of an attitude of acceptance, encourage the kind of attention regulation skills that can counter automaticity (Lindsay & Creswell, 2019). Meditation is not exclusively a state free from cognitions, but rather a *practice* of re-directing the focus of one's attention back to present moment experiences when the mind wanders to thoughts of the past, the future, or commentary about the present moment. Indeed, meditative experiences may be best characterized as a continuous alternation between cognitive processes that are either automatic or volitional (Cardoso et al., 2004; Hasenkamp et al., 2012).

Mindfulness skills might be helpful in reflecting on difficult life experiences to the extent that present-moment, non-judgmental awareness can mitigate the distress that often accompanies reflecting on these experiences.

Beyond attention regulation, mindfulness practices also promote meta-cognitive awareness, including awareness of others and one's own present moment experience, as well as narratives and evaluations held about past experiences. Mindfulness practices facilitate self-transcendence, described as a reduction in self-salience and conceptualizing oneself as an isolated being, along with an increased experience of connection to other people and to the land (Levenson et al., 2055; Yaden et al., 2017). A key mechanism of mindfulness is decentering (i.e., perceiving thoughts, feelings, and sensations as impersonal events occurring in the mind rather than as aspects of one's identity; Hanley et al., 2020) and, ultimately, selfless awareness (i.e., identification with the phenomenon of experiencing itself). Decentering is conceptually similar to psychological distance and dis-identification, as well as cognitive defusion practices within Cognitive Behavioral Therapy (Hayes et al., 2006; Twohig & Levine, 2017). Mindfulness techniques may facilitate adaptive self-reflection by enhancing attention regulation, facilitating decentering, and impacting cognitive representations and derived meaning of distressing events.

1.4. Targeting Self-immersion following Distressing Interpersonal Events to Improve Emotion Regulation and Stress Resilience

Psychological immersion describes reflection on experiences from an egocentric perspective and is associated with emotional reactivity, distress, and interpersonal conflict – outcomes that extend over time (Kross & Ayduk, 2017). It has been theorized that psychological distance practices, such as transcending one's egocentric viewpoint and engaging negative autobiographical experiences from a self-distanced perspective (Kross et al., 2012), can promote adaptive self-reflection (Kross et al., 2011; Murdoch et al., 2023), reduce short-term emotional and physiological reactivity (Kross & Ayduk, 2011; Kross & Ayduk, 2017; Margola et al., 2010), and buffer against long-term effects of rumination (Ayduk & Kross, 2010). Interventions that encourage self-regulation through adopting a self-distanced perspective on negative events can support adaptive coping across diverse circumstances (e.g. Pennebaker & Chung, 2007). Riley et al. (2022) have demonstrated the buffering effect of self-distancing, along with mindfulness and self-compassion, on rumination and resultant impacts on health behaviors. Various forms of self-distancing can be helpful to people when engaging with distressing internal experiences, including noticing their temporality (Watkins et al., 2000), creating visualized spatial distance (Powers & LaBar, 2019), and reducing the degree to which a person identifies with the negative experience (“disidentification”; Rosenberg, 2020).

1.5. Neural Mechanisms Mindfulness and Self-distanced Reflection Techniques

Patterns of neural activity during self-distancing vary widely across studies, influenced by diverse manipulation techniques and strategies (Kross & Ayduk, 2017). Observations include reduced activation in emotional reactivity and interoception-related regions (e.g., limbic areas, insula; Christian et al., 2015), alongside shifts in distress-associated regions such as increased prefrontal-parietal regulation and decreased amygdala activation (Dörfel et al., 2014). During self-immersion and blame attribution, increased activity in self-referential processing regions has been documented (Kestemont et al., 2015; Kross et al., 2009).

Cortical midline structures (CMS), in particular, encompassing the medial orbital prefrontal cortex, posterior precuneus, medial prefrontal cortex, and left inferior frontal gyrus; appear to be relevant during self-distanced reflection about emotionally difficult experiences (Kross et al., 2009). CMS, integral to default mode network functions like self-referential processing and social cognition (Brewer et al., 2013; Iacoboni, et al., 2004; Northoff et al., 2006; Northoff & Bermpohl, 2004; Schilbach et al., 2006; Qin & Northoff, 2011), are implicated in evaluative processing related to both self and others (Lombardo et al., 2010; Uddin et al., 2007). Some have argued that the CMS processes the “self as shaped by social relationships” (Uddin et al., 2007; pg. 153). These distinctions may also vary across present (versus past) reflection tasks (D'Argembeau et al., 2008).

Beyond distinctions in self versus other referential processing, evaluations during these states can reflect empathetic perspective-taking or self-other judgments (Kogler et al., 2020; Wondra & Ellsworth, 2015), as with appraisals of blame (Williams et al., 2020). The dorsomedial prefrontal cortex (dmPFC) is implicated in self-referential processing and habitually attributing blame, which can lead to psychological immersion and distress (Bennet, 2017; Sweeney et al., 1986). Causal attributions are common following emotionally difficult experiences and rely on these mentalizing abilities. These efforts to attribute causality generate insight and guidance for future social interactions, yet can also be the content of ruminative brooding.

Neural activation patterns in CMS correlate with emotion regulation, perspective-taking, and meditative states (Drevets & Raichle, 1998; Healey & Grossman, 2018; Farb et al., 2007; Creswell et al., 2007). In some cases, deactivation in CMS has been associated with emotion regulation, acceptance, and reduced rumination (Messina et al., 2021). Reflection on life experiences is a complex process which likely involves dynamic patterns among subregions of the cortical midline and other structures. Moreover, experienced meditators have been found to display alterations in precuneus activity (Goldin et al., 2009), possibly reflecting the ongoing alternation between automatic or volitional cognitive processes described earlier.

1.6. Potential Impacts on Psychosocial Well-being

Psychosocial well-being, a multi-faceted construct, integrates the emotional, psychological, and social aspects of an individual's life and their overall satisfaction. Life satisfaction, as well as mental, behavioral, and physical health, are significantly informed by supportive interpersonal relationships and a strong sense of community connectedness (Cohen & Wills, 1985; Holt-Lunstad et al., 2015). For instance, low social connectedness (commonly operationalized using scales, e.g. Lee & Robbins, 1995; or through experience sampling methods; e.g. Mehl & Connor, 2012) is associated with depression and anxiety (Wickramaratne et al., 2022). Conversely, distress in social interactions and overall depression indicate psychosocial difficulties. Beyond direct social interactions, reflecting on thoughts, feelings, desires, needs, and motivations surrounding difficult interpersonal experiences shapes self and social perceptions and psychosocial well-being broadly. This includes inferences we make about our own mental states (i.e., self-mentalizing or self-referential thinking) and the mental states of others (i.e., other-mentalizing).

Contemplative practices have been shown to confer health benefits in part due to their impact on interpersonal functioning (Webb et al., 2013) and social connectedness (Rehman et al., 2023). Extending this mechanistic understanding, the proximal impact of contemplative techniques may first demonstrate influence over cognitive patterns surrounding interpersonal and social experiences (i.e. social cognition). Generally, modifying maladaptive cognitions related to self- and other- mentalizing can improve interpersonal functioning and reduce depression (Drapeau et al., 2019). For instance, self-immersion in mentalizing often leads to self-rumination (Kross & Ayduk, 2017), while engaging in psychological distance following distressing interpersonal experiences is linked with lower depressive symptomatology (Tucker, 2015). Modifying maladaptive cognitions could look like learning to shift away from an over-emphasis on the self in mentalizing, which is otherwise linked with social anxiety disorder and psychopathology generally (Maresh & Andrews-Hanna, 2021). Additionally, learning to refrain from teleological thinking during mentalizing, i.e., making inferences about someone's internal experience based on their actions, as with 'She volunteered for the task just to get a promotion'. Psychotherapeutic techniques increasingly target meta-cognitive skills and mindfulness – and have been applied directly to mentalizing processes (e.g. Jain & Fonagy, 2020). Still, social aspects of cognitive processes that are the target of mindfulness techniques are rarely explicitly examined.

Beyond benefits to interpersonal functioning, mindful reflection on difficult interpersonal experiences through self-distancing could improve personal growth, sense of purpose, and perceptions of community connectedness. First, adverse experiences can be a source of beneficial change, as with posttraumatic growth (Tedeschi & Calhoun, 2004). Given that self-distancing can facilitate constructive reasoning and positive emotionality (Dorfman et al., 2021), it may be a mechanism by which improvements in personal growth occur following adversity. Next, self-distancing may attenuate the development of a sense of

purpose following difficult life experiences. Indeed, narrative autobiographical reflection that utilizes self-distancing is associated with greater sense of purpose (Żurawska-Żyła et al., 2022). Finally, not only does community connectedness influence the degree to which potential interpersonal distress impacts psychological well-being (e.g. Wall et al., 2022), but applying mindfulness and self-distancing techniques to reflecting on distressing interpersonal experiences could likewise enhance community connectedness. Mindfulness is correlated with greater social connectedness in part due to enhanced decentering (Adair et al., 2018).

1.7. Mindfulness and Self-distancing Interventions

To our knowledge, no intervention studies have yet been performed which train both mindfulness and self-distancing explicitly in the context of reflecting on emotionally difficult past experiences. This gap highlights a potential area for innovative approaches in psychoeducational interventions, particularly for populations such as college students who frequently encounter new and challenging social environments. Potential impacts of such interventions on interpersonal distress and social connectedness are promising, considering that the transition to college represents a dramatic shift in the social landscape of students. This period often involves a significant increase in physical and emotional distance from family and friends, while also immersing students into new residential settings where forming new social networks is crucial. Beyond this, incorporating positive psychology approaches, including those that develop positive life skills and engagement, into academic courses for new college students is a promising approach to promoting student resilience. Randomized control trials of positive psychology courses have shown them to be effective in enhancing student well-being and academic performance (Kleinman et al., 2014; Hood et al. 2021; Hobbs et al., 2022), including longitudinally (Hobbs et al., 2024).

1.7. The Present Study

Extensive research demonstrates that young adults, especially college students, experience high levels of psychological distress due to academic pressures and social challenges. Self-reflection, a highly influential process impacting self-concept, emotional reactivity, social connection, and well-being, can either exacerbate rumination or promote insight and growth, making it a critical lever for interventions. Meta-cognitive skills such as mindful awareness and psychological distance are crucial for promoting emotional and psychological well-being by facilitating adaptive self-reflection and reducing evaluative mentalizing and emotional reactivity. However, current mental health strategies often fall short in addressing the meta-cognitive tendencies during reflections on distressing interpersonal experiences. The novelty of combining mindfulness and

self-distancing lies in the potential for attentional regulation developed through mindfulness to potentiate the impact of self-distancing. However, while mindfulness-based practices are effective in regulating attention and fostering non-judgmental present-moment awareness, they rarely include explicit techniques for dynamically engaging with rumination about past experiences, potentially promoting experiential avoidance. Furthermore, interventions rarely attempt to collect measures of psychosocial well-being or process-based measures of self-reflection. Through the integration of multi-modal measures, including neural and linguistic data captured during the process of self-reflection on emotionally distressing events, the present study aims to provide a comprehensive understanding of how combined mindfulness and self-distancing interventions can influence meta-cognitive processes, emotional regulation, and psychosocial well-being among college-transitioning adults.

The present study integrates the literature reviewed above to investigate the effects of a mindfulness-based psychological distance intervention for learning to adaptively self-reflect on difficult life experiences coupled with a positive psychology and neuroscience course. We quantify the extent to which mindful self-reflection training along with a positive psychology and neuroscience (PPN) course, and/or a PPN course alone, increases self-distanced reflection and improves well-being among college students compared to an introductory psychology course. We additionally characterize how the mindful self-reflection training + PPN course alters neural activity as students adopt a self-distanced mindset in regions associated with other-focused perspective taking such as right temporoparietal junction and posterior precuneus, with empathy and compassion such as dorsomedial prefrontal cortex and left inferior frontal gyrus, and with stress-resilience such as anterior insula and orbitofrontal cortex compared to students in an introductory psychology course. We examined three overarching hypotheses:

1.7.1. Hypothesis 1: Improvements in Evaluative Mentalizing and Psychological Immersion

We hypothesized that students in the PPN course alone and in the mindful self-reflection training + PPN course would have significantly larger pre- to post-intervention improvements in psychological immersion and self- and other- mentalizing, including pre-to-post intervention:

- a) decreases in self-immersion and blame attributions and increases in other-focus and self-transcendence within written reflections of emotionally difficult experiences (Hypothesis 1a).
- b) increases in activation in the right temporoparietal junction, posterior precuneus, and left inferior frontal gyrus in the distanced > immersed contrast when reflecting on emotionally difficult past experiences (training group only) (Hypothesis 1b).
- c) increases in self-reported interpersonal perspective-taking, self-transcendence, and self-acceptance (Hypothesis 1c).

1.7.2. Hypothesis 2: Improvements in Emotion Regulation and Stress Resilience

We hypothesized that students in the PPN course alone and in the mindful self-reflection training + PPN course would have significantly larger pre- to post-intervention improvements in emotion regulation and stress resilience, including pre-to-post intervention:

- a) increases in positive emotional tone within written reflections of emotionally difficult experiences (Hypothesis 2a).
- b) decreases in emotional anxiety within written reflections of emotionally difficult experiences (Hypothesis 2b).
- c) increases in activation in the anterior insula and orbitofrontal cortex in the distanced > immersed contrast when reflecting on emotionally difficult past experiences (training group only; Hypothesis 2c).
- d) decreases in self-reported emotional reactivity immediately following reflection tasks (Hypothesis 2d).
- e) decreases in self-reported perceived stress (Hypothesis 2e).

1.7.3. Hypothesis 3: Improvements in Psychosocial Well-being

We hypothesized that students in the PPN course alone and in the mindful self-reflection training + PPN course would have significantly larger pre- to post-intervention improvements in psychosocial well-being [operationalized here as a multidimensional construct encompassing both psychological (intrapersonal) and social (interpersonal) aspects of well-being], including pre-to-post intervention:

- a) decreases in psychological immersion within written reflections of emotionally difficult experiences (Hypothesis 3a).
- b) increases in self-reported relationship quality, community connectedness, sense of purpose, and personal growth (Hypothesis 3b).
- c) decreases in self-reported depression and interpersonal distress (Hypothesis 3c).

2. Method

2.1. Participants

Participants were 276 (93 in MRI subsample) English-speaking, adult undergraduate students (mean age = 21.57 years; SD = 3.65; see Table 3 for baseline characteristics) at the University of Oregon, which included: 165 students in the PPN course (44 of whom received the mindful self-reflection training and participated in the MRI) and 111 in-person introductory psychology students (49 of whom participated in the MRI). This study was approved by the University of Oregon Institutional Review Board. Students were

recruited via flyers and announcements made in both the PPN and Psychology courses during weeks 1, 2, and 3, which detailed the eligibility, basic study procedures, and options for participation.

Interested students were assessed for survey eligibility (see Figure 1, Consort Flow Diagram) and, if eligible, consented and completed baseline surveys and the writing prompts via Qualtrics online survey platform (Qualtrics, 2024). Students then self-selected to be assessed for eligibility for participation in the MRI sub-group (if attending either course in person) and / or mindful self-reflection training (if in the PPN course). Additional informational sessions were offered to describe the study in greater detail and review common questions regarding fMRI procedures.

2.1.1. Consort flow and participant payment.

Eligibility for participation in the MRI sub-group was initially assessed via Qualtrics for 647 people (see Figure 6, Consort Flow Diagram). Of these, 65 were excluded at screening for various reasons, including not being enrolled in either class ($n=3$), being enrolled in both classes ($n=53$), not providing consent ($n=6$), and not responding ($n=3$). This left 582 participants who were screened eligible for the study.

2.1.1.1. Neuroimaging subgroups

A subgroup eligibility assessment was conducted. Among the 582 eligible participants, 224 students in the expressed interest in participating in the training (PPN course) and / or neuroimaging sessions (PPN course and control course) and were screened for subgroup eligibility. If screened eligible at this stage, participants were then called by the study team to review their responses and collect additional information as needed to make a final eligibility assessment; reiterate study details and guidelines; and to schedule their baseline MRI session. Of these, 102 were deemed eligible for both survey and neuroimaging, while 122 were ineligible for neuroimaging due to factors such as PTSD ($n=7$), neurological disorders ($n=4$), claustrophobia ($n=20$), pregnancy ($n=0$), presence of metal ($n=75$), canceled MRI appointments ($n=1$), and non-response ($n=5$). Those 102 remained eligible for the survey only group. Of the 102 eligible for the neuroimaging subgroup, 49 general psychology (control subgroup) students were enrolled and 49 PPN (experimental subgroup) students were enrolled, 5 of whom did not attend the training following the baseline scan. The training subgroup lost participants to follow-up for neuroimaging ($n=6$) and survey ($n=6$), with non-responses ($n=3$) and scheduling issues ($n=3$) as reasons. The control subgroup lost participants to follow-up for neuroimaging ($n=4$) and survey ($n=4$), with non-response ($n=3$) and claustrophobia ($n=1$) as reasons. Ultimately, 44 in the PPN course + Mindful self-reflection training neuroimaging subgroup, and 49 in the general psychology course neuroimaging subgroup were analyzed. Participants in the fMRI PPN + mindful self-reflection subgroup received up to \$100 for completion of all study activities (\$25 for completing the baseline scan, \$50 for completing the post-scan, \$25 if the

participant attended at least 12 well-being training sessions). Participants in the general psychology course neuroimaging subgroup received up to \$75 total or course research credit (\$25 for completing the baseline scan and \$50 for completing the post-scan).

2.1.1.2. Survey only groups

504 participants were eligible for the survey only, with some also waitlisted for neuroimaging (n=4). The survey only groups included 156 in the general psychology course, 334 in the PPN course, and 14 in the PPN course + Mindful self-reflection training. 94 participants from the general psych course, 223 participants from the PPN course, and 4 participants from the PPN course + mindful self-reflection training were lost to follow-up due to non-responding. Thus, 62 participants from the general psych course, 111 participants from the PPN course, and 10 participants from the PPN course + mindful self-reflection training were analyzed. Participants in the survey-only groups received \$5 for completing the post-surveys.

2.2. Eligibility

All participants were 18 years of age or older and were not simultaneously enrolled in both the PPN Course and the General Psychology course. Participants in the MRI sub-group were not eligible for participation in the MRI sub-group if they had a current major neurological disorder (e.g., epilepsy), a PTSD diagnosis, or any of the following: cardiac pacemakers or defibrillators, embedded shrapnel, buck shot, or bullets; cerebral aneurysm clips; deep brain stimulators, cochlear implants in the ear; metal foreign bodies embedded in the eye; tattoos or permanent make-up on the head; or chance that the person may be pregnant or become pregnant during the study. The following criteria were excluded dependent on features identified on a case-by-case basis by a trained scan operator: vascular stents, filters, or coils; spinal or ventricular shunt; neurostimulator (Tens unit); biomedical implants; bio-stimulation devices; metal implants in the body or head; electrodes on the body, head, or brain; insulin pump; prosthesis; dental work, braces, retainers, or dentures; tattoos on your neck or body; hearing aids; internal pacing wires; medication skin patch; non-removable piercings; or surgeries or incidents that may have left metal in the body. Participants who were unsure if they were claustrophobic had the opportunity to try out the mock scanner. Participants deemed questionably eligible or expressed interest after MRI and well-being training subgroups filled to capacity were put on a waitlist to be selected at random if spots opened.

Figure 6

Consort Flow Diagram: Study 2

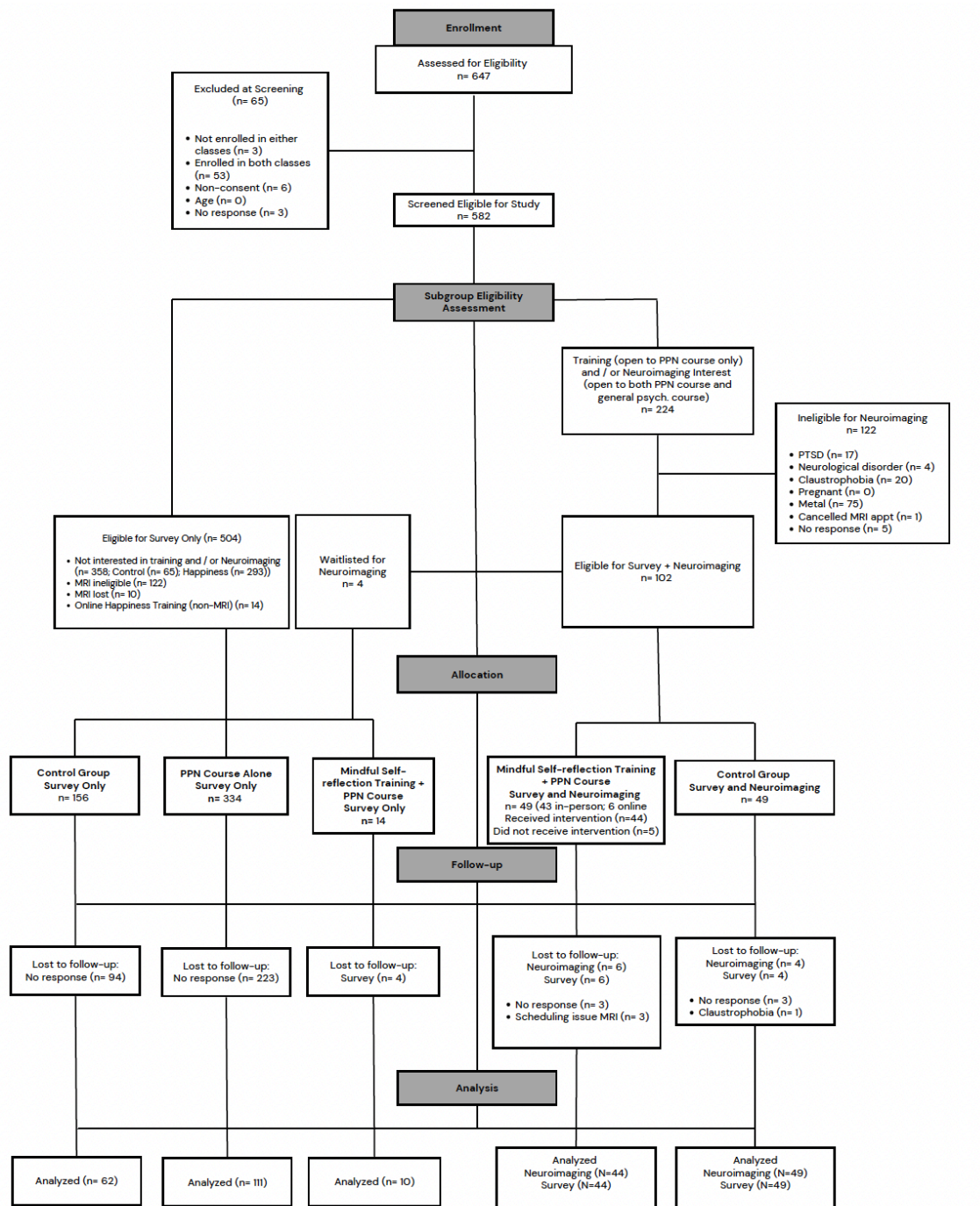


Table 3*Baseline Characteristics of Enrolled Participants: Study 2*

Characteristic	Full Sample (N = 289)	PPN Course Alone (N = 126)	Control Condition (N = 112; 50 MRI)	Mindful Self-Reflection Training + PPN Course (N = 51; 50 MRI)	Condition Difference Statistic
Age in years	21.57 (3.65)				F(2,227) = 1.83
Gender Identity					χ^2 (6) = 6.41
Female	193 (66.78%)	79 (62.70%)	80 (71.43%)	34 (66.67%)	
Male	78 (26.99%)	37 (29.37%)	26 (23.21%)	15 (29.41%)	
Transgender	3 (1.04%)	0 (0%)	3 (2.68%)	0 (0%)	
Not gender identified	6 (2.08%)	2 (1.59%)	3 (2.68%)	1 (1.96%)	
Race					χ^2 (14) = 11.08
Latinx/Hispanic/Chicano	22 (7.61%)	7 (2.42%)	12 (4.15%)	3 (1.04%)	
Indigenous/Native American or Native Alaskan	2 (0.69%)	0 (0.00%)	1 (0.35%)	1 (0.35%)	
Non-hispanic White	164 (56.75%)	66 (2.84%)	65 (22.49%)	33 (11.42%)	
Native Hawaiian or other Pacific Islander	1 (0.35%)	1 (0.35%)	0 (0.00%)	0 (0.00%)	
Asian/Asian-American	17 (5.88%)	6 (2.08%)	9 (3.11%)	2 (0.69%)	
Non-hispanic Black/African-American	40 (13.84%)	24 (8.30%)	15 (5.19%)	1 (0.35%)	
Multi-racial	26 (9.00%)	9 (3.11%)	8 (2.77%)	9 (3.11%)	
Other	7 (2.42%)	4 (1.38%)	2 (0.69%)	1 (0.35%)	
Decline to respond	10 (1.95%)	9 (1.76%)	0 (0%)	1 (0.20%)	
Parental educational attainment					χ^2 (14) = 15.99
Less than high school degree	3 (1.04%)	1 (0.79%)	1 (0.89%)	1 (1.96%)	
High school diploma or equivalent (including GED)	21 (7.27%)	6 (4.76%)	11 (9.82%)	4 (7.84%)	
Some college but no degree	26 (9.00%)	8 (6.35%)	12 (10.71%)	6 (11.76%)	
Associate degree	11 (3.81%)	2 (1.59%)	7 (6.25%)	2 (3.92%)	
Bachelor's degree (4-year)	114 (39.45%)	54 (42.86%)	38 (33.93%)	22 (43.14%)	
Master's degree	46 (15.92%)	17 (13.49%)	18 (16.07%)	11 (21.57%)	
Doctoral degree	51 (17.65%)	27 (21.43%)	21 (18.75%)	3 (5.88%)	
Professional degree (JD, MD)	8 (2.77%)	3 (2.38%)	4 (3.57%)	1 (1.96%)	
Baseline Depression	15.37 (8.73)	13.28 (7.34)	15.90 (9.18)	19.10 (9.46)	F(2,227) = 8.56*

2.3. Procedure

All participants completed baseline surveys and writing prompts during weeks 1 and 2 of the course. For the MRI sub-group, baseline scan sessions took place during weeks 3 and 4 of the courses. During the baseline scan session, participants completed an MRI-subgroup-specific consent form related to the MRI and mindful self-reflection training activities. At baseline and post sessions, participants responded to the prompt: “For this journaling activity, please reflect on an interpersonal experience from your past in which you felt overwhelming negative emotion (e.g., anger, hostility, shame, embarrassment, sadness, grief, anxiety, worry, guilt, regret, fear). Take a moment to see the experience unfold in your mind’s eye. Write down the stream of thoughts that flow through your mind as you reflect on the situation and your feelings about the situation.” Randomization was not feasible because allocation to conditions was dependent on participant course enrollment and the training sub-group was drawn only from the experimental condition. Instead, volunteers to participate in the 4-week Mindful Self-reflection training and neuroimaging were gathered from the students in the PPN course. Volunteers for the neuroimaging control cohort were taken from the introductory psychology course. During weeks 6-9, the mindful self-reflection training subsample attended training sessions. Participants underwent MRI scanning just before and just after the 4-week project period.

Neuroimaging data was collected at the University of Oregon Lewis Center for Neuroimaging's 3T Siemens Skyra, with resulting images transferred to a high performance computational grid for analysis (see Neuroimaging data acquisition). The same surveys applied at the beginning of the course were administered to all students following completion of the course.

2.3.1. Baseline Neuroimaging session

Participants in the MRI subgroup attended two neuroimaging sessions: one during the 2 weeks prior to the start of the mindful self-reflection training (baseline session) and one during the 2 weeks following the training (post-session).

2.3.1.1. Pre-Scanning Preparation

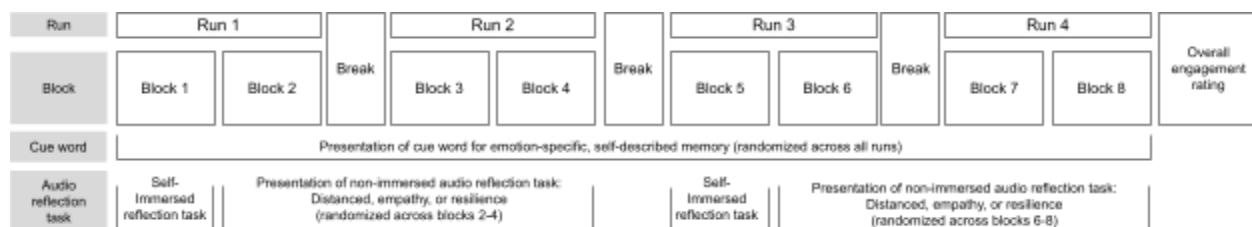
Before entering the scanner, participants were asked to write about 8 autobiographical memories involving challenging interpersonal experiences. These memories were related to anger, shame, sadness, anxiety, guilt, fear, rejection, exclusion, abandonment, judgment, or criticism (see Appendix B.9). Participants created cue phrases to remind them of each memory while in the scanner.

2.3.1.2. Order of reflection task runs and blocks

Once in the scanner, participants recalled each cued memory, one-by-one when instructed, as they listened to a guided audio clip of one of four reflection strategies (Appendix B.1). Participants listened to the audio clips of guided reflections in four separate runs, with two blocks per run, and a break between each run (Figure 7).

Figure 7

Visualization of Runs and Blocks

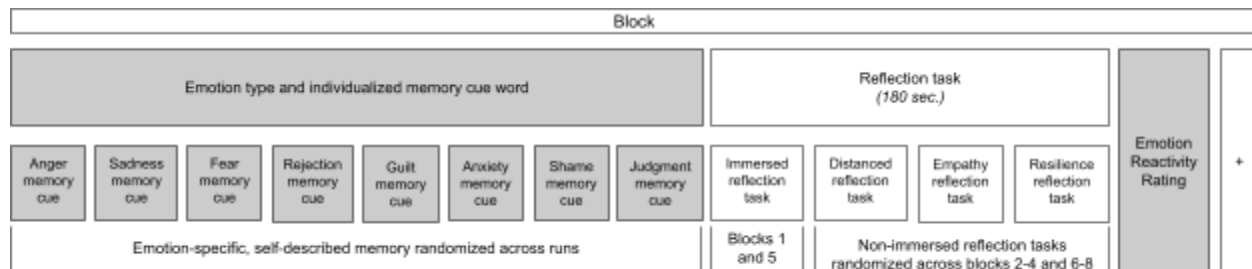


Each block began with the memory cue phrase and the associated emotion displayed on a screen, with emotion-specific, self-described memory randomized across eight blocks. Next, the participant heard a guided audio of one of four reflection tasks: self-immersion, self-distance, empathy, and resilience (Appendix B), followed by rating emotional reactivity to the reflection task, a visual fixation

cross, and a 30 second break (Figure 8). Trials were separated by a visual fixation cross with a jittered duration averaging 2s to improve signal estimation. The order of these conditions was randomized across the blocks for each participant, ensuring that each of the two sets of four blocks (approximately 180 seconds per audio clip) began with the self-immersed condition followed by the other three conditions in random order.

Figure 8

Description of reflection task by block



2.3.1.2. Post-reflection emotional reactivity ratings

Following each guided audio reflection, participants rated their emotional reactivity to the reflection, followed by a visual fixation cross.

2.3.1.3. Overall Engagement Rating

At the completion of the four runs, participants were asked to rate their degree of task engagement across all reflections.

2.3.2. Intervention Groups

2.3.2.1. PPN Course Alone (Experimental Group 1)

Participants (N = 111) were enrolled in a positive psychology course at the University of Oregon. The course extends traditional positive psychology approaches to emphasize skills designed to reduce self-oriented mental rhetoric and increase feelings of connectedness, empathy, compassion, and understanding towards others, both within and outside one's social cohort. The 10-week positive psychology course included weekly: lecture modules, online discussion post, quiz, readings (120 min), self-guided "activities in daily life", in-person discussions (50 min), and optional evening meditations.

2.3.2.2. Mindful Self-Reflection Training and PPN Course (Experimental Group 2)

In addition to the PPN course, a subgroup of participants ($N = 44$) participated in a series of 45-minute facilitator-led trainings 3-5 nights/week during weeks 6 through 9. The training focused on activities to promote mindfulness (especially attention regulation and equanimity) and self-distancing (i.e., the ability to observe one's own thoughts and internal narrative from a distance) when reflecting on difficult life experiences. For instance, students were led through mindful breath awareness practices and practices such as guided imagery to create spatial distance, decision-making from "future self" and "alternate scenario" perspectives, and journaling from the "narrator" perspective. Participants were also taught to recognize emotions as indications of underlying needs.

2.3.2.3. Introductory Psychology Course (Active Control Group)

Students ($N = 205$) in the control condition participated in a 10-week introductory psychology course. Topics include human development, social and personality psychology, emotion and motivation, health psychology, and psychopathology and clinical treatment for mental health disorders. The format is a large in-person lecture twice weekly, weekly small-group discussion sections, and out-of-class reading and experiential activities (e.g., implicit bias training; self-assessment of personality). The time commitment of this course is similar to that of the experimental group. A subgroup of the students ($N = 49$) participated in the neuroimaging sessions.

2.3.3. Post-intervention Surveys and Neuroimaging Session

All participants completed follow-up surveys and writing prompts during weeks 10 through 11 via Qualtrics online survey platform (Qualtrics, 2024). Participants in the MRI subgroup attended a post-intervention neuroimaging session during weeks 10 and 11. The post-intervention neuroimaging sessions followed the same procedures as the baseline session, using the same memories from the baseline memory recall task. Following the session, participants were debriefed and payment was given.

2.3.4. Blinding

Double-blinding was not feasible because allocation to conditions was dependent on participant course enrollment and the training sub-group was drawn only from the experimental condition. Co-PI Lipsett was blinded to condition for all data analyses described in this paper. The staff rating the writing prompts were also blinded to condition.

2.4. Measures

Complete list of measures can be found in Table 4 and full measure descriptions can be found in Appendix B.2 - B.8.

2.4.1. Self-report Measures

Individual difference and demographic measures were gathered and used as covariates in analyses (i.e., mental health, age, gender identity, parental educational attainment as a measure of socioeconomic status, and ethnicity). Complete measure descriptions and scoring procedures can be found in Study 2 supplementary material Appendix B.2 - B.8.

2.4.1.1. Self- and Other- Mentalizing and Psychological Immersion

Self- and other- mentalizing and psychological immersion were measured with the *interpersonal perspective-taking subscale* of the Interpersonal Reactivity Index (Davis, 1983), the *self-transcendence inventory* (Levenson et al., 2005), and the *self-acceptance* subscale of the Ryff Scales of Psychological Well-Being (Bayani et al., 2008; Ryff, 1989).

2.4.1.2. Emotional Reactivity and Stress Resilience

Emotional reactivity and psychological distress were measured with a tailored *Emotional Reactivity* immediately following each memory recall task while in the scanner (Appendix B.10; Kross et al., 2005) and the *Perceived Stress Scale* (Cohen et al., 1983).

2.4.1.3. Psychosocial Well-being

Psychosocial Well-being was measured with the *inclusion of community in the self scale* (ICS; Mashek et al., 2007), the *relationship quality* (i.e., the positive relationship subscale of the Ryff Scales of Psychological Well-Being; Bayani et al., 2008; Ryff, 1989), the *interpersonal distress* subscale of the Interpersonal Reactivity Index (Davis, 1983), the *personal growth* and *sense of purpose* subscales of the Ryff Scales of Psychological Well-Being (Bayani et al., 2008; Ryff, 1989), and the *Center for Epidemiologic Studies - Depression Scale* (Lewinsohn et al., 1997; Radloff, 1977).

Table 4*Summary of Measures Collected via Writing Prompt, Neuroimaging, and Self-Report by Construct*

	Human-Coded Written Reflections	LIWC-Derived Linguistic Signatures of Written Reflections	Neural Activity for Distanced > Immersed Contrast	Self-report Surveys
Psychological Immersion; Self- and Other-Mentalizing	Psychological Immersion (MIDS) [†] Blame Attribution [†]	Psychological Immersion [†] Other- Versus Self-Focus [†] Self-Transcendence [†]	Right TPJ [†] Posterior Precuneus [†] dmPFC [†] Left Inferior Frontal Gyrus [†]	Interpersonal Perspective-Taking (Interpersonal Reactivity Index subscale) Self-Transcendence Survey Self-Acceptance (Ryff subscale)
Emotional Regulation & Stress Resilience		Positive Emotional Tone [†] Emotional Anxiety [†]	Anterior Insula [†] Orbitofrontal Cortex [†]	Perceived Stress Scale Emotional Reactivity [†]
Psychosocial Well-being		Interpersonal Psychological Distress [†]		Relationship quality (Ryff subscale) Community Connectedness (ICS) Interpersonal Distress (IRI subscale) Depression (CES-D) Sense of purpose (Ryff subscale) Personal Growth (Ryff subscale)

Note. [†] = collected while participant was actively reflecting on an emotionally difficult memory.

2.4.2. Measures of Immersed and Distanced Speech (MIDS) and Blame Attributions

The MIDS, which has been used in observational studies to assess immersed and distanced speech in clinical sessions, was applied here to assess participants' responses to the writing prompt (see Method section). The MIDS was developed using theoretical definitions of immersion and distancing used in prior research (Ayduk & Kross, 2010; Kross et al., 2012; Nigro & Neisser, 1983). Participant responses were classified into five mutually exclusive categories: what statements (immersed), attributive statements (immersed), insight statements (distanced), closure statements (distanced), or other. Immersed statements are conceptualized as those that have the primary focus on *recounting* the emotional details of one's past experience, whereas distanced statements are conceptualized as those that have the primary focus on *reconstructing* emotional experiences, reflecting a process of diminishment of the direct egocentric experience related to the stimulus (Ayduk & Kross, 2010; Liberman & Trope, 2008; Powers & LaBar, 2019). Reconstructing statements offer “descriptions of new realizations about or changes in the way participants

understood the causes underlying their feelings” (Ayduk & Kross, 2010, p. 845). “What” statements describe the specific chain of events, as in “what happened,” such as, “he left the house without saying anything and I was alone for the rest of the evening”, or the original thoughts or behaviors, as in “I told myself that I was a failure in relationship”. People may also describe feelings that were experienced at the time of the event and assign characteristics to themselves or others without explaining them or providing reasoning (i.e., attributive statements), as in “I am a careless person”. Insight statements describe underlying causes, relationships, or awareness about the event, their feelings, behaviors, and cognitions; as in “I see now that I reacted that way because I was feeling lonely”. Closure statements reflect a broader view of the event, establish relations between past and current experiences, or describe present-moment emotions; as in “I feel empathy for my past self because I see that my suffering had to do with a tendency to interpret criticisms as indications of being a failure”. Additionally, blame attributions that ascribed fault to self, other, or entity without providing reasons were identified independently, as these are thought to be associated with psychological immersion and negative affect (Kross et al., 2005). The training and coding procedures followed best practices in psychological research on quantifying self-distancing from language (Ayduk & Kross, 2010). An assessment of the psychometric validity of the MIDS by Barbosa et al. (2017) reported a Cronbach’s alpha of .95 and 0.91 respectively for immersion and distancing, with strong interrater reliability ($\kappa = .75$ to $.96$).

2.4.3. Linguistic Signatures of Psychological Distance and Well-being

We used an automated linguistic analysis system, Linguistic Inquiry Word Count (LIWC; Pennebaker et al., 2016), which quantifies psychological constructs within natural language (Tausczik & Pennebaker, 2010), to assess linguistic signatures of psychological distance and well-being in narrative written language. LIWC calculates the frequencies of words from predefined dictionaries that have been validated through comparisons with human assessments of the psychological content of text and quantifies the degree to which a passage of text reflects specific content (e.g., first- vs third-person perspective, positive affect, increased use of causation words). Qualitative and empirical evidence exists for the association between these word categories and established psychological and emotional states, including as they are related to psychological distance (Doré et al., 2015; Cohn et al., 2004) and emotion regulation (Nook et. al., 2017). For each participant, LIWC was used to compute percentage of words used across several word categories. Here, we focused our linguistic analysis on terms related to psychological distance, other- versus self- focused perspective-taking (i.e., frequency of words such as they, their, and them compared to frequency of words such as I, me, and my), self-transcendence, and psychological and emotional distress (i.e., positive emotional tone, emotional anxiety, and personal pronouns). Psychological distance reflects a composite linguistic measure that is factor-analytically derived from the LIWC score for articles (i.e., the, a, and), words of more than six letters, and the inverse scores for first-person singular pronouns, words indicating discrepancy from

reality (i.e., would, should, could), and present-tense verbs (i.e., is, are, and can), which has been used in previous research (Mehl et al., 2012; Nook et al., 2017). Low scores on the psychological distance measure reflect “use of personal, experiential, and present-focused language, whereas high scores reflect use of abstract, impersonal, and rational language” (Cohn et al., 2004). Word frequencies related to psychological and emotional distress included: a) positive emotional tone (i.e., words like good, well, new, and love); b) emotional anxiety words (i.e., frequency of words like worry, fear, afraid, and nervous) that have been associated with negative affect (Tov, Ng, Lin, & Qiu, 2013), and c) psychological distress (i.e., first-person singular pronoun use), which has been associated with emotional pain and depression (see Holtzman, 2017; Rude et al., 2004), as well as “psychological immediacy” (Tausczik & Pennebaker, 2010).

2.4.4. Neuroimaging Data Acquisition

Neuroimaging data were acquired using a 3T Siemens Prisma at the University of Oregon Lewis Center for Neuroimaging. Neuroimaging data were preprocessed using fMRIPrep 23.2.0 (Esteban et al., 2019). We acquired a high-resolution anatomical T1-weighted MP-RAGE scan (TR/TE = 2300/2.1 ms, 192 × 192 matrix, 1 mm thick, 160 sagittal slices, FOV = 256), functional images with a T2*- weighted multiband echo-planar sequence (72 axial slices, TR/TE = 2000.00/27.00ms, 90-degree flip angle, 100 × 100 matrix, 2mm thick, FOV = 200, multiband acceleration factor = 3), and opposite phase encoded echo-planar images to correct for magnetic field inhomogeneities (72 axial slices, TR/TE = 345.00/8.06ms, 40-degree flip angle, 100 × 100 matrix, 2mm thick, FOV = 200).

For the present analysis, we collapsed across emotion types and calculated a contrast to index self-immersed mindset from the four reflection conditions: (self-distance + empathy + resilience) > immersion. Within-subject models were specified using each condition of interest and other epochs (e.g., instruction and response periods) as regressors, as well as motion parameters. Once these within-subject models were fit, contrasts among the parameters were computed for each participant subtracting the average of the three self-distanced maps from the self-immersion map. Those contrasts were then entered into analyses at the group level with one contrast map per participant for each contrast of interest.

3. Statistical Analysis

All analyses were performed using R Statistical Software (v4.1.2; R Core Team, 2021). Data transformation was performed using dplyr R package (Wickham, François, et al., 2023), tidyr R package (Wickham, Vaughan, et al, 2023), moments R package (Komsta & Novomestky, 2022), tibble R package (Müller & Wickham, 2023), broom R package (Robinson et al., 2023), purr R package (Wickham & Henry, 2023), and gtools R package (Warnes et al., 2023); Data visualization was done with ggplot2 R package

(Wickham, 2016), knitr R package (Xie, 2023), kableExtra R package (Zhu, 2021), Hmisc R package (Harrell, 2022), corrplot R Package (Wei & Simko, 2021), psych R package (Revelle, 2022), and RColorBrewer R package (Neuwirth, 2022); Data analysis were performed using stats R package (R Core Team, 2021), nortest R package (Gross & Ligges, 2015), tidyverse R package (Wickham et al. 2019), rstatix R package (Kassambara, 2023), and car R package (Fox & Weisberg, 2019). A general summary of findings: comparing change scores of measures collected at baseline and post-intervention for experimental groups versus control group can be found in Table 5.

3.1. Analysis of Covariates

Unless otherwise noted, covariates included within the models were ethnicity, parental educational attainment (as a measure of socioeconomic status), age, gender identity, and baseline mental health. The mean of our sample at baseline was just below the typical cutoff of 16 for risk for clinical depression ($M = 15.37$, $SD = 8.73$; Lewinsohn et al., 1997). On average, those in the MRI subsample reported scores indicative of risk for clinical depression at baseline ($M = 17.5$, $SD = 9.32$).

3.2 Analysis of Survey Measures

We ran models without covariates and with those covariates that are significantly associated with the change scores for a given survey measure at the bivariate level.

3.3 Human-coded Analysis of Psychological Immersion and Blame Attributions in Writing Prompts

All participant responses to the prompt designed to elicit a negative autobiographical memory at pre and post were assessed for spontaneous immersion and distancing by a team of eight research staff who were trained in the used of MIDS, including reading and discussing articles related to immersed and distanced psychology and engaging in practice sessions and discussion using fabricated sample texts. The training was facilitated by a PhD candidate in Social Psychology with extensive experience in health and wellness coaching and a teaching qualification in Mindfulness-based Stress Reduction (MBSR; Kabat-Zinn, 1990). The coders then applied the rating system to the participant prompts, with three coders independently rating each response (see Table S.B.1. for the coding rubric). The coding process was supervised by the team member with the most experience. Coders identified instances of the four categories of immersed and distanced speech, or coded it as other if no category was identified, which occurred for less than 2% of sequences. Stretches of speech that indicated a particular category were assessed as one “sequence” of the occurrence of

immersed or distanced speech. The mean number of total moments was 5.47 per participant response. Percentage of moments with each category (distance versus immersed) and subcategory (what, attribution, insight, and closure) were calculated. Coders additionally assessed the presence of blame attributions in the text and percentage of blame attributions per response was calculated. Any disagreements were discussed by the coders and resolved through consensus with advising from the expert rater (Hill et al., 1997). We found moderate agreement among three raters in assigning ratings for blame attribution, with a Fleiss' Kappa value of 0.42 at baseline ($N = 528$, $z = 16.8$, $p < 0.001$) and 0.45 at post ($z = 13.6$, $p < 0.001$). We found fair agreement among three raters in assigning ratings for blame attribution, with a Fleiss' Kappa value of 0.34 at baseline ($N = 528$, $z = 18.3$, $p < 0.001$) and 0.39 at post ($z = 14.7$, $p < 0.001$). The recency of the autobiographical memory described was also assessed when possible, which is theorized to impact degree of psychological immersion (Beike & Wirth-Beaumont, 2005; Nasarudin et. al., 2023). Linear regression models to assess group (PPN course, mindful self-reflection training + PPN course, and control) differences in the change scores of our pre-registered coder-rated variables, where change scores represent the percent frequency of moments of immersed an distanced speech at post-intervention less the percent frequency of the moments of immersed an distanced speech at baseline. All models (see Analysis of Covariates) controlled for length of the expression and recency. To preserve statistical power, we report the models that include only those additional covariates associated with baseline DVs at the bi-variate level at $p < 0.05$ (referred to below as “significant covariates”). However, models that statistically adjusted for all covariates are reported in supplementary materials ([Supplementary Materials Table S.B.2.](#)).

3.4. Analysis of Writing Prompts Using LIWC

Linear regression models to assess group differences in the change scores of our pre-registered LIWC-derived variables, where change scores represent the percent frequency of the terms at post-intervention less the percent frequency of the terms at baseline. We report the models that include only those additional covariates that were associated with baseline DVs at the bi-variate level at $p < 0.05$ to maximize statistical power. Models that adjust for all covariates are reported in supplementary materials ([Supplementary Materials Table S.B.3.](#)).

3.5. Analysis of Neuroimaging Data

During preprocessing, anatomical images were segmented and normalized to MNI space using FreeSurfer (Fischl, 2012); functional images were susceptibility distortion corrected, realigned, and coregistered to the normalized anatomical images. Normalized functional data were then smoothed (6mm FWHM) in SPM12. We regressed the distanced > immersed contrast described above (across all emotion) on

group (PPN course + mindful self-reflection training vs. introductory psychology course) x time (pre vs. post) using SPM12 to quantify pre-post change in functional neural activity between the groups.

3.5.1. Neuroimaging Preprocessing

Results included in this manuscript come from preprocessing performed using *fMRIPrep* 23.2.0 (Esteban et al. (2019); Esteban et al. (2018); RRID:SCR_016216), which is based on *Nipype* 1.8.6 (K. Gorgolewski et al. (2011); K. J. Gorgolewski et al. (2018); RRID:SCR_002502).

3.5.1.1. Preprocessing of B0 Inhomogeneity Mappings

A total of 2 fieldmaps were found available within the input BIDS structure for this particular subject. A B0-nonuniformity map (or *fieldmap*) was estimated based on two (or more) echo-planar imaging (EPI) references with topup (Andersson, Skare, and Ashburner (2003); FSL None).

3.5.1.2. Anatomical Data Preprocessing

A total of 2 T1-weighted (T1w) images were found within the input BIDS dataset. Each T1w image was corrected for intensity non-uniformity (INU) with N4BiasFieldCorrection (Tustison et al. 2010), distributed with ANTs 2.5.0 (Avants et al. 2008, RRID:SCR_004757). The T1w-reference was then skull-stripped with a *Nipype* implementation of the antsBrainExtraction.sh workflow (from ANTs), using OASIS30ANTs as target template. Brain tissue segmentation of cerebrospinal fluid (CSF), white-matter (WM) and gray-matter (GM) was performed on the brain-extracted T1w using fast (FSL (version unknown), RRID:SCR_002823, Zhang, Brady, and Smith 2001). An anatomical T1w-reference map was computed after registration of 2 T1w images (after INU-correction) using mri_robust_template (FreeSurfer 7.3.2, Reuter, Rosas, and Fischl 2010). Brain surfaces were reconstructed using recon-all (FreeSurfer 7.3.2, RRID:SCR_001847, Dale, Fischl, and Sereno 1999), and the brain mask estimated previously was refined with a custom variation of the method to reconcile ANTs-derived and FreeSurfer-derived segmentations of the cortical gray-matter of Mindboggle (RRID:SCR_002438, Klein et al. 2017). Volume-based spatial normalization to one standard space (MNI152NLin2009cAsym) was performed through nonlinear registration with antsRegistration (ANTs 2.5.0), using brain-extracted versions of both T1w reference and the T1w template. The following template was selected for spatial normalization and accessed with *TemplateFlow* (23.1.0, Ciric et al. 2022): *ICBM 152 Nonlinear Asymmetrical template version 2009c* [Fonov et al. (2009), RRID:SCR_008796; TemplateFlow ID: MNI152NLin2009cAsym].

3.5.1.3. Functional Data Preprocessing

The following preprocessing steps were performed for each of the 8 Blood Oxygenation Level Dependent (BOLD) runs found per subject (across all tasks and sessions). First, a reference volume was generated, using a custom methodology of *fMRIPrep*, for use in head motion correction. Head-motion parameters with respect to the BOLD reference (transformation matrices, and six corresponding rotation and translation parameters) are estimated before any spatiotemporal filtering using *mcflirt* (FSL, Jenkinson et al. 2002). The estimated *fieldmap* was then aligned with rigid-registration to the target EPI (echo-planar imaging) reference run. The field coefficients were mapped on to the reference EPI using the transform. The BOLD reference was then co-registered to the T1w reference using *bbregister* (FreeSurfer) which implements boundary-based registration (Greve and Fischl 2009). Co-registration was configured with six degrees of freedom. Several confounding time-series were calculated based on the *preprocessed BOLD*: framewise displacement (FD), DVARS and three region-wise global signals. FD was computed using two formulations following Power (absolute sum of relative motions, Power et al. (2014)) and Jenkinson (relative root mean square displacement between affines, Jenkinson et al. (2002)). FD and DVARS are calculated for each functional run, both using their implementations in *Nipype* (following the definitions by Power et al. 2014). The three global signals are extracted within the CSF, the WM, and the whole-brain masks. Additionally, a set of physiological regressors were extracted to allow for component-based noise correction (*CompCor*, Behzadi et al. 2007). Principal components are estimated after high-pass filtering the *preprocessed BOLD* time-series (using a discrete cosine filter with 128s cut-off) for the two *CompCor* variants: temporal (tCompCor) and anatomical (aCompCor). tCompCor components are then calculated from the top 2% variable voxels within the brain mask. For aCompCor, three probabilistic masks (CSF, WM and combined CSF+WM) are generated in anatomical space. The implementation differs from that of Behzadi et al. in that instead of eroding the masks by 2 pixels on BOLD space, a mask of pixels that likely contain a volume fraction of GM is subtracted from the aCompCor masks. This mask is obtained by dilating a GM mask extracted from the FreeSurfer's *aseg* segmentation, and it ensures components are not extracted from voxels containing a minimal fraction of GM. Finally, these masks are resampled into BOLD space and binarized by thresholding at 0.99 (as in the original implementation). Components are also calculated separately within the WM and CSF masks. For each CompCor decomposition, the k components with the largest singular values are retained, such that the retained components' time series are sufficient to explain 50 percent of variance across the nuisance mask (CSF, WM, combined, or temporal). The remaining components are dropped from consideration. The head-motion estimates calculated in the correction step were also placed within the corresponding confounds file. The confounded time series derived from head motion estimates and global signals were expanded with the inclusion of temporal derivatives and quadratic terms for each (Satterthwaite et al. 2013). Frames that exceeded a threshold of 0.5 mm FD or 1.5 standardized DVARS were annotated as motion outliers.

Additional nuisance timeseries are calculated by means of principal components analysis of the signal found within a thin band (*crown*) of voxels around the edge of the brain, as proposed by (Patriat, Reynolds, and Birn 2017). All resamplings can be performed with *a single interpolation step* by composing all the pertinent transformations (i.e. head-motion transform matrices, susceptibility distortion correction when available, and co-registrations to anatomical and output spaces). Gridded (volumetric) resamplings were performed using nitransforms, configured with cubic B-spline interpolation. Prior to first-level modeling, preprocessed data were smoothed with a 6mm FWHM smoothing kernel using SPM12's spatial smoothing tool. Many internal operations of *fMRIPrep* use *Nilearn* 0.10.2 (Abraham et al. 2014, RRID:SCR_001362), mostly within the functional processing workflow.

3.5.4. Motion Artifacts

Prior to first-level modeling, we generated motion regressors using an automated motion assessment tool (Cosme et al., 2018). This tool applies a predictive model that utilizes the confound files generated by *fMRIPrep* and classifies whether or not fMRI volumes contain motion artifacts. The classifier is applied to each participant's task run and returns a binary classification indicating the presence or absence of motion artifacts for each volume. In addition, this tool transforms the realignment parameters into Euclidean distance for translation and rotation separately, and calculates the displacement derivative of each. This procedure yields a total of 5 motion regressors for first-level modeling.

3.5.5. First-level Modeling

Event-related condition effects were estimated in first-level analyses using a fixed-effects general linear model and a canonical hemodynamic response function. Regressors modeled each experimental condition (Self-immersion, Self-distance, Empathy, Resilience) during the audio presentation period. Additional regressors of no interest were added for the instruction and rating periods. Five motion regressors were modeled as covariates of no interest. Realignment parameters were transformed into Euclidean distance for translation and rotation separately; we also included the displacement derivative of each. Another “trash” regressor marked images with motion artifacts (e.g., striping) identified via automated motion assessment (Cosme et al., 2018) and visual inspection. Data were high-pass filtered at 360 seconds and temporal autocorrelation was modeled using FAST (Corbin et al., 2018). Linear contrasts for each condition of interest vs rest, Self-Distance > Self-Immersion, Empathy > Self-Immersion, Resilience > Self-Immersion, and Self-Distance + Empathy + Resilience > Self-immersion were estimated across runs for each participant.

3.5.6. ROI Definition and Parameter Extraction

Regions of Interest (ROIs) were defined using the Schaefer 200 cortical (Schaefer et al., 2018) and Harvard-Oxford subcortical parcellation atlases. To calculate the mean blood-oxygen-level-dependent (BOLD) signal across the voxels in each ROI, we use the 3dmaskave function in AFNI 18.2.04 (Cox, 1996). For each participant, we extracted the mean parameter estimate of the BOLD signal within each ROI for each contrast. Models were run with and without covariates, which are: age, gender identity, ethnicity, baseline mental health, and parental education attainment.

3.5.7. Analyzing Differences Between Task Conditions and Effects of the Intervention

Paired sample t-tests examined the baseline differences in neural activity between the composite of the self-distanced reflection task and the self-immersed reflection task (collapsed across intervention group) for our regions of interest. Then, regression analysis assessed significant differences by intervention group in pre-post change scores of the self-distanced>self-immersed contrast. In order to preserve statistical power, we report the models that include only those additional covariates that were associated with baseline DVs at the bi-variate level at $p < 0.05$. However, models that are statistically adjusted for all covariates are reported in supplementary materials (Supplementary Materials Table S.B.4).

4. Results

4.1. Preliminary Analyses

The age range spanned from a minimum of Min = 19 years to a maximum of Max = 62 years. Due to the high right skewness observed in the distribution of ages, as indicated by a skewness statistic of Skewness = 7.15, the data were analyzed with and without outliers included. Demographic distribution of ethnicity and socioeconomic status (as parental educational attainment) are in Table 3. Baseline mental health for our sample (MRI subsample) was $M = 15.37$ ($SD = 8.73$) ($M = 16.9$, $SD = 8.5$), with a median age of $Mdn = 21$ years ($M = 21$). Due to the skewness of the baseline depression variable, as indicated by a skewness statistic of Skewness = 1.02, the variable was log-transformed for inclusion as a covariate in the models.

For all dependent variables below, we report the results of the models that include covariates that were related to task features (e.g. with LIWC data task features) and / or significantly associated with the given dependent variable at the bivariate level. Results of these models and models with 1) no covariates included, 2) all pre-registered covariates included, and 3) all pre-registered covariates included and outliers removed are displayed for many of the dependent variables in the supplementary materials linked below.

For human-coded writing prompts, the average psychological distance (scaled) at baseline was significantly different between the control condition and the PPN course alone ($\beta = 8.711$, $SE = 2.147$, $t = 4.057$, $p < .001$), so we included baseline psychological distance in our models. Two features of the prompts were associated with pre- to post-intervention change in psychologically immersed speech at the bi-variate level: length of the expression and memory recency. Length of expression at both baseline ($\beta = -1.02$, $SE = 0.45$, $t = -2.30$, $p < 0.02$) and post ($\beta = -1.05$, $SE = 0.47$, $t = -2.27$, $p < 0.02$) was significantly associated with lower occurrence of immersed speech and so was included in our models. Memory recency at both baseline ($F(2, 277) = 3.824$, $p < .05$) and post ($F(2, 277) = 2.036$, $p = .1325$) was significantly associated with lower occurrence of distanced speech and so was included in our models. The average occurrence of blame attributions (scaled) at baseline significantly differed between the PPN course alone and the control condition ($\beta = -1.72$, $SE = 0.723$, $t = -2.372$, $p < .05$) and so was also included in our models. Neither length of expression nor memory recency was significantly associated with a change in the occurrence of blame attributions.

Table 5

General Summary of Findings: Comparing Change Scores of Measures Collected at Baseline and Post-Intervention for Experimental Groups versus Control Group

Measure	Intervention Group	Outcome (Relative to Control)
WRITTEN REFLECTIONS ON EMOTIONALLY DIFFICULT EVENTS		
Psychologically immersed speech and blame attribution <i>Human-coded MIDS and blame categories</i>	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>decreases</u>
	<i>PPN course alone</i>	Greater pre-to-post <u>decreases</u>
Positive emotional tone, emotional anxiety, psychological distress, and psychological immersion <i>LIWC-derived linguistic signature</i>	<i>Mindful self-reflection training + PPN course</i>	NS
	<i>PPN course alone</i>	NS
NEUROIMAGING DURING REFLECTION TASKS FOR SELF-DISTANCED > SELF-IMMERSED CONTRAST		
pPrecun <i>Neural substrate of self-referential processing</i>	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>decreases</u>
RIGHT TPJ <i>Neural substrate of other-focused perspective-taking and social cognition</i>	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>decreases</u>
dmPFC <i>Neural substrates of social cognition and evaluative mentalizing</i>	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>decreases</u>

Table 5 continued

Measure	Intervention Group	Outcome (Relative to Control)
antIns & OFC <i>Neural substrates of empathy and social behavior</i>	<i>Mindful self-reflection training + PPN course</i>	<i>NS</i>
IFG <i>Neural substrates of social cognition, emotion regulation, and stress resilience.</i>	<i>Mindful self-reflection training + PPN course</i>	<i>NS</i>
SELF-REPORT MEASURES (POST REFLECTION TASKS)		
Emotion reactivity to reflection task	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>decreases</u>
SELF-REPORT MEASURES (PRE & POST INTERVENTION)		
Self-transcendence	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>increases</u>
	<i>PPN course alone</i>	Greater pre-to-post <u>increases</u>
Interpersonal perspective-taking	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>increases</u>
	<i>PPN course alone</i>	Greater pre-to-post <u>increases</u>
Self-acceptance <i>subscale of Ryff Well-being Scale</i>	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>increases</u>
	<i>PPN course alone</i>	<i>NS</i>
Perceived stress <i>Self-report Survey</i>	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>decreases</u>
	<i>PPN course alone</i>	<i>NS</i>
Sense of purpose, personal growth, and relationship quality <i>subscales of Ryff Well-being Scale</i>	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>increases</u>
	<i>PPN course alone</i>	<i>NS</i>
Interpersonal distress	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>decreases</u>
	<i>PPN course alone</i>	<i>NS</i>
Community connectedness	<i>Mindful self-reflection training + PPN course</i>	<i>NS</i>
	<i>PPN course alone</i>	<i>NS</i>
Depression	<i>Mindful self-reflection training + PPN course</i>	Greater pre-to-post <u>decreases</u>
	<i>PPN course alone</i>	Greater pre-to-post <u>decreases</u>

Note. NS = Not significant. Results summary based on regression models (as described in the body of the paper) with the inclusion of significant covariates. Neuroimaging was not collected for the PPN course only and so is not reported.

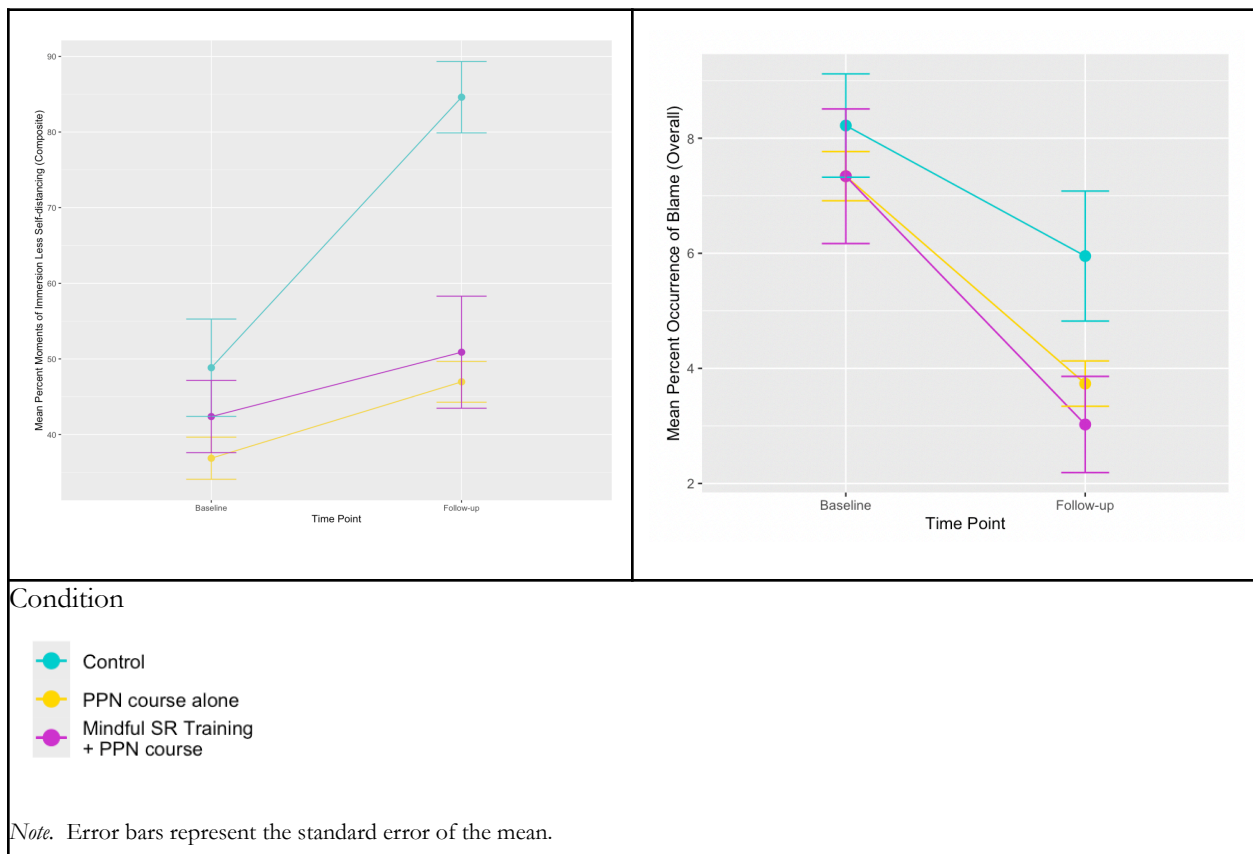
4.2. Primary Analyses

4.2.1. Human-Coded Analysis of Psychological Immersed and Distanced Speech in Writing Prompts

A linear regression analysis investigated the relationship between condition and pre- to post-intervention change in psychologically immersed speech and blame attribution. See full model outcomes and results of post-hoc analysis of MIDS subcategories in [Table S.B.2](#).

Figure 9

Line Graphs of Pre-to-post Change Scores for a) Self-Immersion Less Self-Distancing and b) Blame Attribution within Written Reflections by Condition



4.2.1.1. PPN course alone

The control group showed increases in psychologically immersed speech across the study.

Participation in the PPN course (vs controls) resulted in significantly less increases in the frequency of *psychologically immersed speech* ($\beta = -35.82$, $SE = 8.06$, $t = -4.44$, $p < .001$; with significant covariates)²

² Results remain significant when applying a Bonferroni correction for primary analysis human-coded writing prompts at a significance level of .025.

from pre- to post-intervention, controlling for baseline psychological distance, expression length, memory recency, and significant covariates (see [Table S.B.2](#)).

4.2.1.1. Mindful Self-reflection + PPN course

Participants in the mindfulness + PPN condition (vs controls) had significantly buffered the increase in frequency of *psychologically immersed speech* ($\beta = -33.43$, $SE = 11.14$, $t = -3.00$, $p < .01$)¹ from baseline to post-intervention, controlling for baseline psychological distance, expression length, memory recency, and significant covariates (see [Table S.B.2](#) and Figure 9).

4.2.2. Human-Coded Analysis of Blame Attributions in Writing Prompts

4.2.2.1. PPN course alone

Participants in the PPN course alone (vs controls) had modest but significantly greater pre-to-post decreases in percent occurrence of *blame attribution*. Both PPN course alone and the control groups experienced a decrease in blame attribution from baseline to post-intervention. The control group's mean (SD) percent frequency of blame attribution moments decreased from 9.02 (9.01) to 5.95 (9.32), whereas the PPN course alone group's mean percent frequency of blame attribution moments decreased from 7.31 (5.60) to 3.74 (5.32). The decrease was significantly smaller in the control group, suggesting that the PPN course effectively amplified the decrease in blame attribution ($\beta = -3.42$, $SE = 1.56$, $t = -2.193$, $p < 0.05$ with significant covariates)¹ from pre- to post-intervention.

4.2.1.1. Mindful Self-reflection + PPN course

Participants in the mindfulness + PPN group (vs. controls) had significantly greater pre-to-post decreases in the percent occurrence of *blame attribution*. Both Mindful Self-reflection Training + PPN course and the control groups experienced a decrease in blame attribution from baseline to post-intervention. The control group's mean (SD) percent frequency of blame attribution moments decreased from 9.02 (9.01) to 5.95 (9.32), whereas the Mindful Self-reflection + PPN course group's mean percent frequency of blame attribution moments decreased from 6.81 (5.75) to 2.93 (4.53). However, the decrease was significantly smaller in the control group, suggesting that the Mindful Self-reflection Training + PPN course effectively amplified the decrease in blame attribution ($\beta = -4.83$, $SE = 2.17$, $t = -2.23$, $p < 0.05$)³.

³ Results do not remain significant when applying a Bonferroni correction for primary analysis human-coded writing prompts at a significance level of .025.

4.2.3. LIWC-derived Analysis of Writing Prompts

Linear regression analyses were conducted to investigate the relationship between pre- to post-intervention change in the frequency of occurrence of terms related to psychological distance, other- versus self- focused perspective-taking, and self-transcendence, and psychological and emotional distress. See [Supplementary Materials Table S.B.3](#) for model summaries, including models with all covariates and with outliers removed).

4.2.3.1. PPN course alone

Participants in the PPN course alone (vs controls) had significantly greater increases in use of terms related to *self-transcendence* ($\beta = 0.19$, $SE = 0.07$, $t = 2.50$, $p = 0.013$; with significant covariates included), but did not significantly differ in use of the composite measure of *psychological distancing* ($\beta = 0$, $SE = 0.13$, $t = 0.01$, $p = 0.989$; no significant covariates) or *other- versus self-focus* ($\beta = 0.01$, $SE = 0.02$, $t = 0.45$, $p = 0.655$; no significant covariates). Compared to the control condition, PPN alone participants did not see a significant increase in *positive emotional tone* ($\beta = 0.46$, $SE = 0.24$, $t = 1.89$, $p = 0.06$; no significant covariates), nor a significant reduction of terms related to *emotional anxiety* ($\beta = -0.2$, $SE = 0.20$, $t = -0.99$, $p = 0.323$; with significant covariates included) or *psychological distress* ($\beta = -0.73$, $SE = 0.51$, $t = -1.43$, $p = 0.153$; with significant covariates). See [Supplementary Materials Table S.B.3](#) for complete model results.

Figure 10

Line Graphs of Pre-To-Post Change Scores for LIWC-Derived Other-Focus versus Self-Focus, Psychological Distance, and Positive Emotional Tone within Written Reflections by Condition

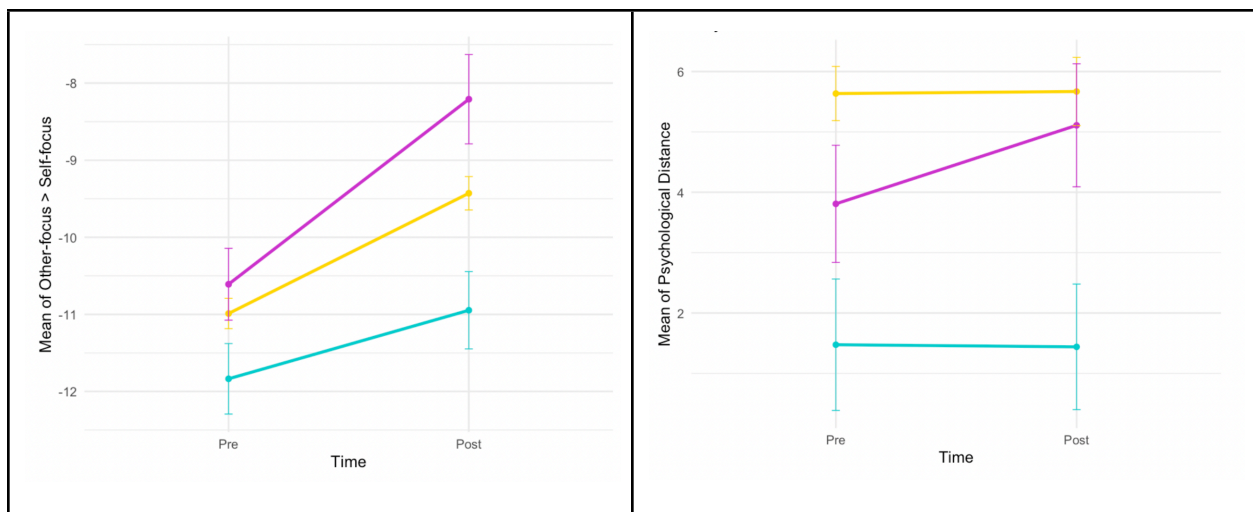
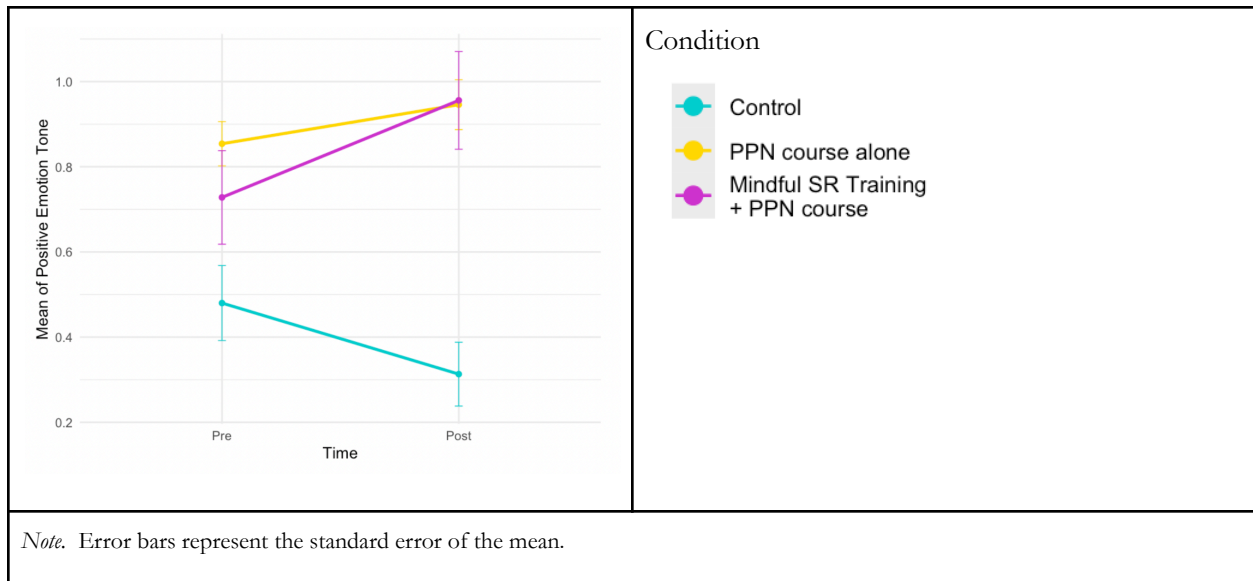


Figure 10 continued

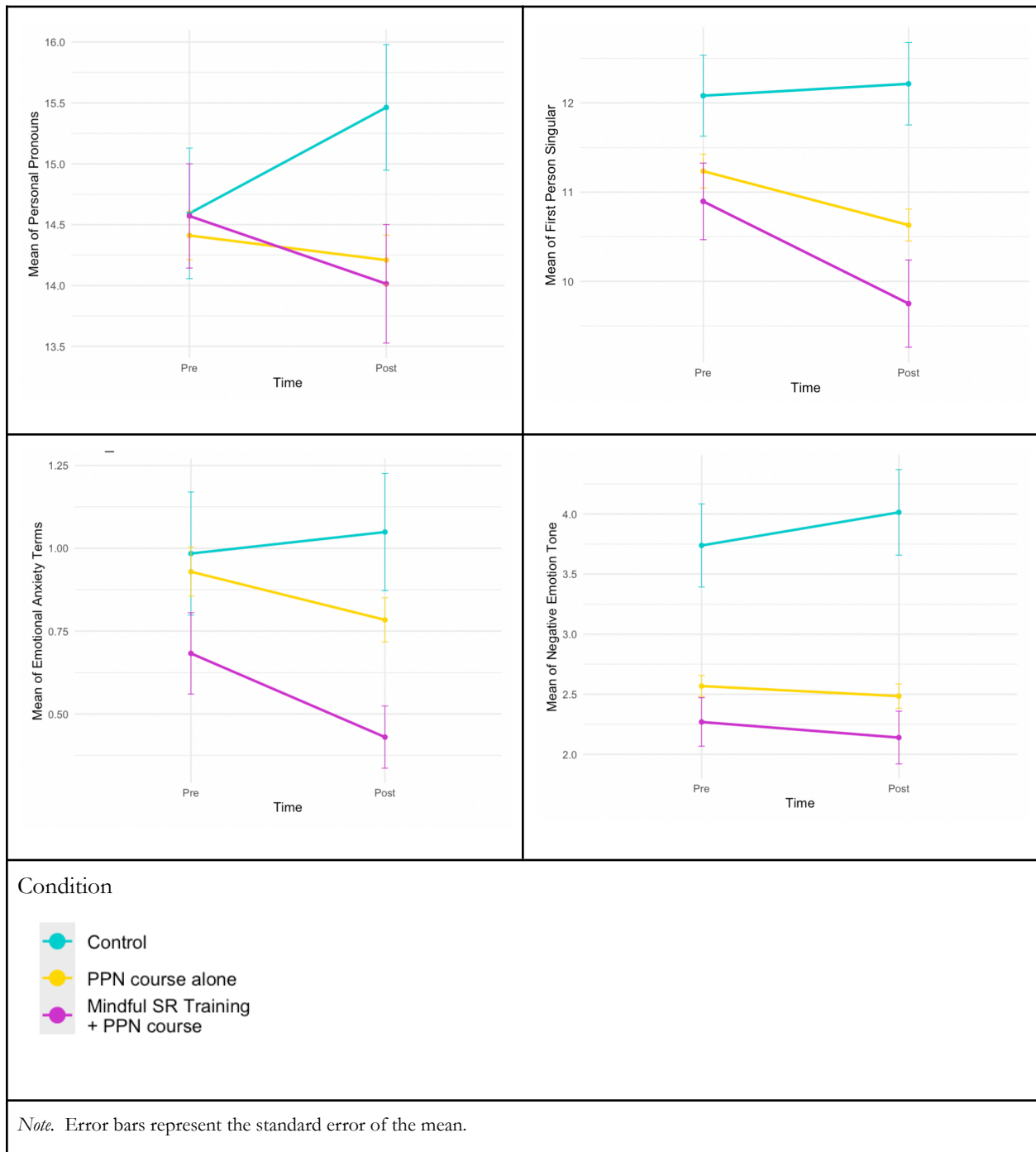


4.2.3.2. Mindful Self-reflection Training + PPN course

Participants in the mindful self-reflection training + PPN course (vs. controls) had significantly greater increases in the use of terms related to *self-transcendence* ($\beta = 0.25$, $SE = 0.11$, $t = 2.18$, $p = 0.03$; with significant covariates included) and *other- versus self-focus* ($\beta = 0.06$, $SE = 0.03$, $t = 2.09$, $p = 0.038$; no significant covariates), but not the composite measure of *psychological distancing* ($\beta = 0.14$, $SE = 0.20$, $t = 0.70$, $p = 0.483$; no significant covariates). Compared to the control condition, mindful self-reflection training + PPN course participants did not have significantly greater increases in use of terms related to *positive emotional tone* ($\beta = 0.42$, $SE = 0.37$, $t = 1.14$, $p = 0.255$; no significant covariates) or decreases in terms related to *emotional anxiety* ($\beta = -0.28$, $SE = 0.31$, $t = -0.91$, $p = 0.363$; with significant covariates) and *psychological distress* ($\beta = -1.32$, $SE = 0.77$, $t = -1.71$, $p = 0.088$; with significant covariates). See [Supplementary Materials Table S.B.5](#) for complete model results.

Figure 11

Line Graphs of Pre-to-post Change Scores for LIWC-Derived Personal Pronouns, First Person Singular, Emotional Anxiety Terms, and Negative Emotional Tone Within Written Reflections by Condition



4.2.4. Results of Neuroimaging Analysis

4.2.4.1. Baseline Neural Activity Differences by Reflection Task

Collapsing across treatment conditions, mean neural activation for the baseline reflection tasks were significantly different for the self-distance > self-immersed in multiple parcels for the *posterior precuneus* ($t = -6.83$ to -2.90 , $p = 0.00$ to 0.005 ; see Table 6), the *temporal parietal junction* ($t = 2.25$ to 3.11 , $p = 0.002$ to 0.027 ; both left and right hemisphere; see Table 6), and some parcels within the *orbitofrontal cortex* ($t = -2.55$ to $-.05$, $p = 0.01$ to 0.96 ; see Table 6), *anterior insula* ($t = -3.50$ to -0.99 , $p = 0.00$ to 0.33 ; see Table 6), or *left inferior frontal gyrus* ($t = -2.49$ to 1.50 , $p = 0.015$ to 0.87 ; see Table 6). Mean neural activation for the baseline reflection tasks was not significantly different for self-distance > self-immersed in the *dorsomedial prefrontal cortex* ($t = -1.36$ to 0.34 , $p = 0.18$ to 0.73 ; see Table 6).

Table 6

Results of t-tests for Activation for Self-Distanced Composite > Rest vs. Self-Immersed > Rest

Regions of the TPJ					Regions of the pPrecun				
Parcel M of Diff.	CI	t-stat	df	p.value	Parcel M of Diff.	CI	t-stat	df	p.value
183	-0.08 [-0.240.08]	-1.02	90	0.312	199	-0.33 [-0.52-0.14]	-3.42	90	0.001
148	0.23 [0.070.39]	2.94	90	0.004	97	-0.39 [-0.59-0.19]	-3.87	90	0.000
136	0.21 [0.020.4]	2.25	90	0.027	177	-0.62 [-0.81-0.44]	-6.83	90	0.000
78	0.26 [0.090.42]	3.11	90	0.002	82	-0.21 [-0.36-0.07]	-2.90	90	0.005
182	-0.12 [-0.30.05]	-1.41	90	0.161	113	-0.53 [-0.74-0.32]	-4.91	90	0.000
81	-0.04 [-0.210.13]	-0.48	90	0.631	198	-0.34 [-0.55-0.13]	-3.15	90	0.002
					71	-0.66 [-0.89-0.43]	-5.77	90	0.000

Regions of the IIFG					Regions of the aINS				
Parcel M of Diff.	CI	t-stat	df	p.value	Parcel M of Diff.	CI	t-stat	df	p.value
43	-0.02 [-0.240.2]	-0.17	90	0.869	154	-0.24 [-0.4-0.08]	-2.97	90	0.004
50	-0.19 [-0.34-0.04]	-2.49	90	0.015	155	-0.10 [-0.30.09]	-1.07	90	0.286
69	-0.17 [-0.340]	-1.99	90	0.049	83	-0.39 [-0.57-0.2]	-4.24	90	0.000
58	0.17 [-0.050.4]	1.50	90	0.136	47	-0.13 [-0.280.02]	-1.73	90	0.087
					48	-0.28 [-0.43-0.13]	-3.73	90	0.000

Table 6 continued											
Regions of the OFC						Regions of the dmPFC					
Parcel M of Diff.	CI	t-stat	df	p.value		Parcel M of Diff.	CI	t-stat	df	p.value	
56	-0.30 [-0.5-0.1]	-2.96	90	0.004		91	-0.14 [-0.310.03]	-1.66	90	0.101	
191	-0.03 [-0.240.18]	-0.29	90	0.771		89	-0.10 [-0.310.11]	-0.99	90	0.325	
159	-0.29 [-0.5-0.08]	-2.72	90	0.008		194	-0.02 [-0.210.17]	-0.20	90	0.844	
170	-0.03 [-0.220.16]	-0.32	90	0.751		195	-0.09 [-0.250.07]	-1.10	90	0.275	
65	-0.07 [-0.270.12]	-0.75	90	0.456							

4.2.4.2. Changes in Neural Activation in Self-distanced > Self-immersed for the Mindful Self-reflection Training + PPN Course

We then examined whether the changes in the self-distanced>self-immersed contrast from pre- to post-intervention significantly differed between the mindful self-reflection training + PPN course group versus the control group. Regression analyses were conducted to assess significant differences by intervention group in the change scores of the self-distanced composite>self-immersed contrast. Below, we report findings of the parcels for which significant differences were found. See [Supplementary Materials Table S.B.4](#) for results of all parcels with all four models.

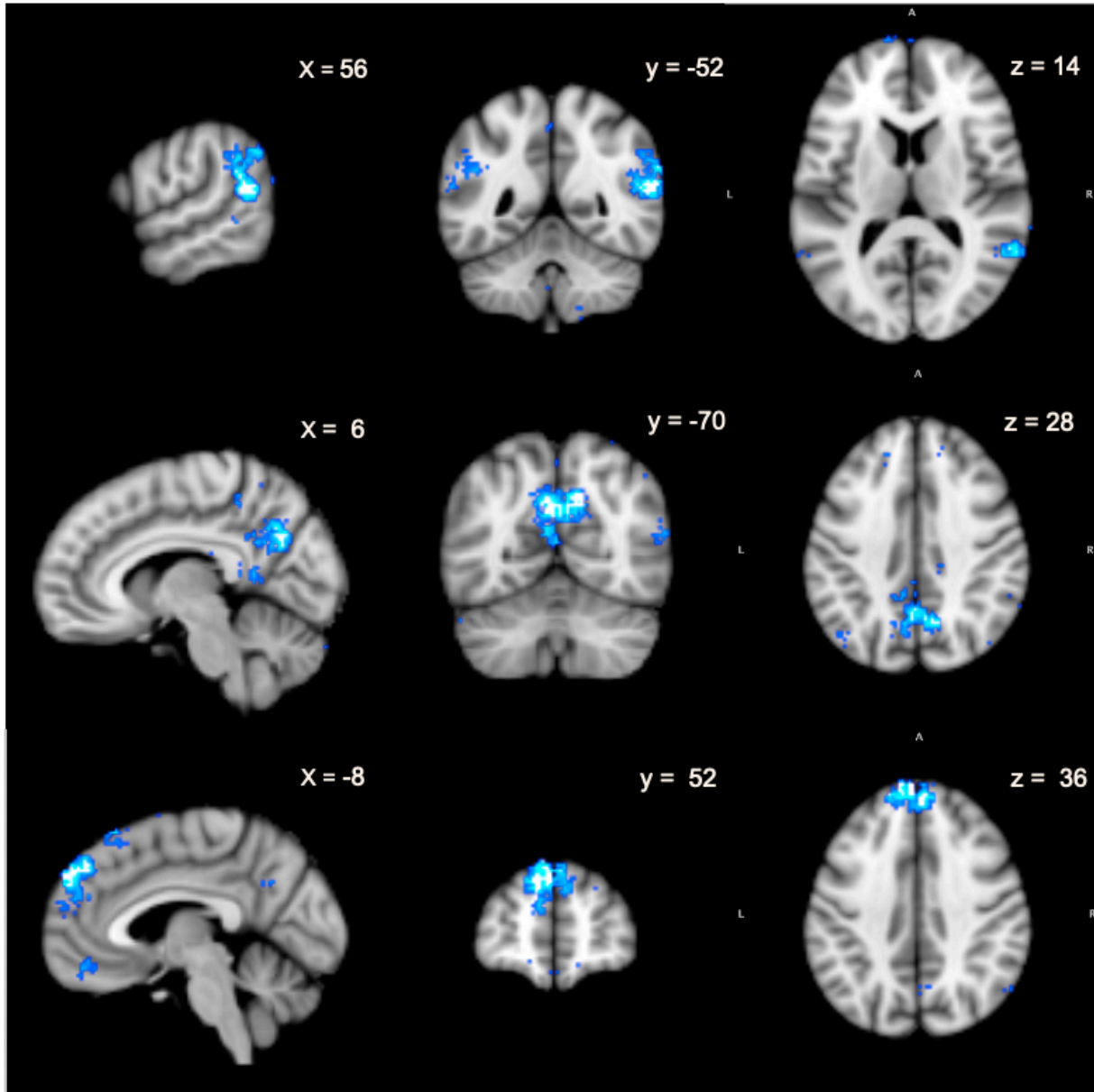
Four of the 31 parcels within the a priori ROIs tested showed significantly different change from baseline to post-intervention for the self-distanced>self-immersed contrast in the mindful self-reflection training + PPN course compared to the control condition. Specifically, brain activity decreased in the *posterior precuneus*, the *right temporal parietal junction*, and the *dorsomedial prefrontal cortex* (see [Table S.B.4](#) and Figure 11). We did not find significant pre-to-post differences in change scores of self-distanced>self-immersed contrast in the *left inferior frontal gyrus*, the *anterior insula*, or the *orbitofrontal cortex* (see [Table S.B.4](#)).

4.2.5. Results for Analysis of Emotional Reactivity Post-memory Reflection Task

Participants who received mindful self-reflection training + PPN course (vs. control) had significantly greater decreases in experience-specific emotional reactivity from pre- to post-intervention ($\beta = -0.51$, $SE = 0.15$, $t = -3.35$, $p < 0.01$; with significant covariate, ethnicity)(Figure 12).

Figure 12.

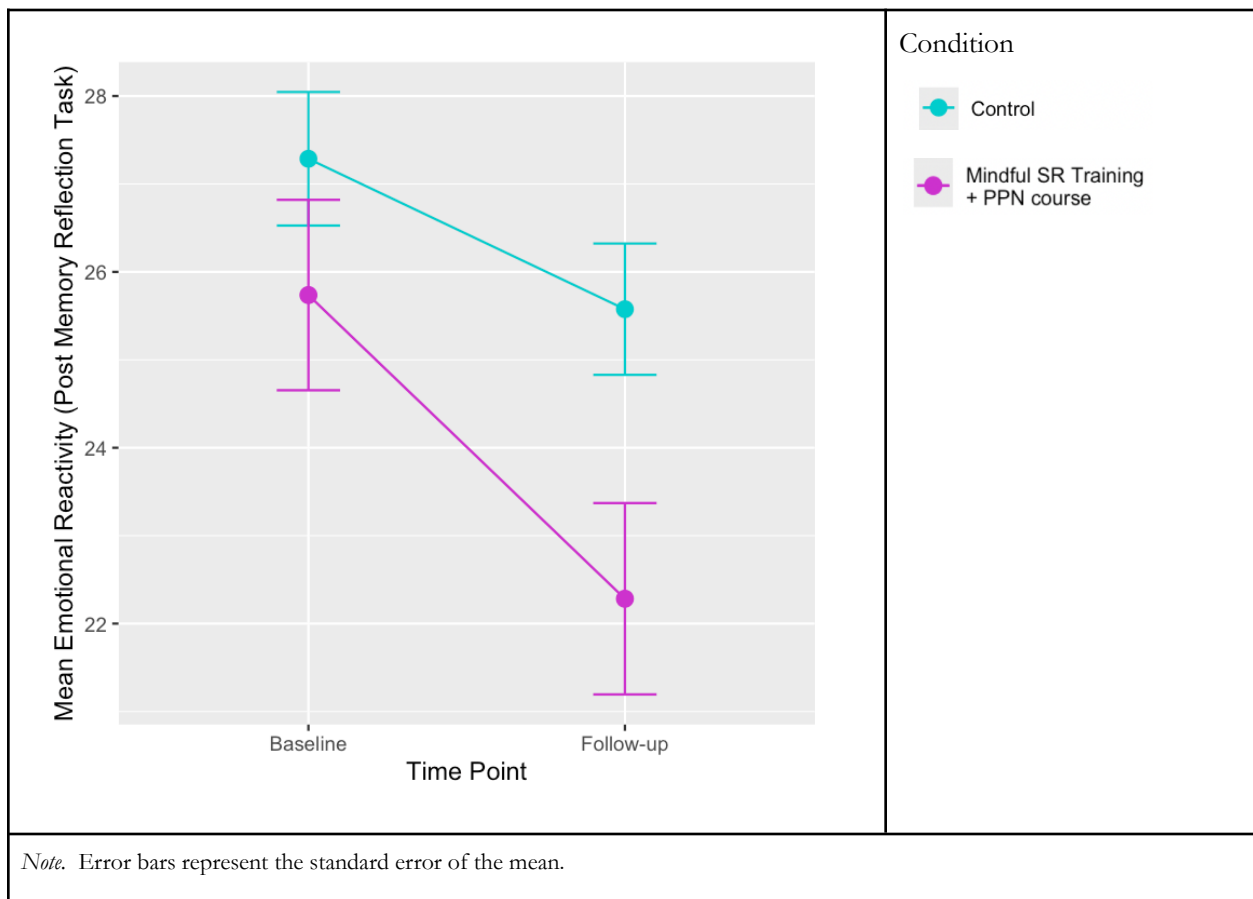
Visual depiction of neural regions that showed greater reductions in activity post-intervention for the Mindful Self-reflection training group (compared to the control group) for the contrasts for distanced > immersed.



Note. Coordinates reflect Schaefer 200 cortical (Schaefer et al., 2018) parcellation atlas. From top to bottom: Temporal parietal junction, posterior precuneus, and dorsomedial prefrontal cortex.

Figure 13

Line Graphs of Pre-to-post Change Scores for Emotional Reactivity Following the Memory Reflection Tasks by Condition

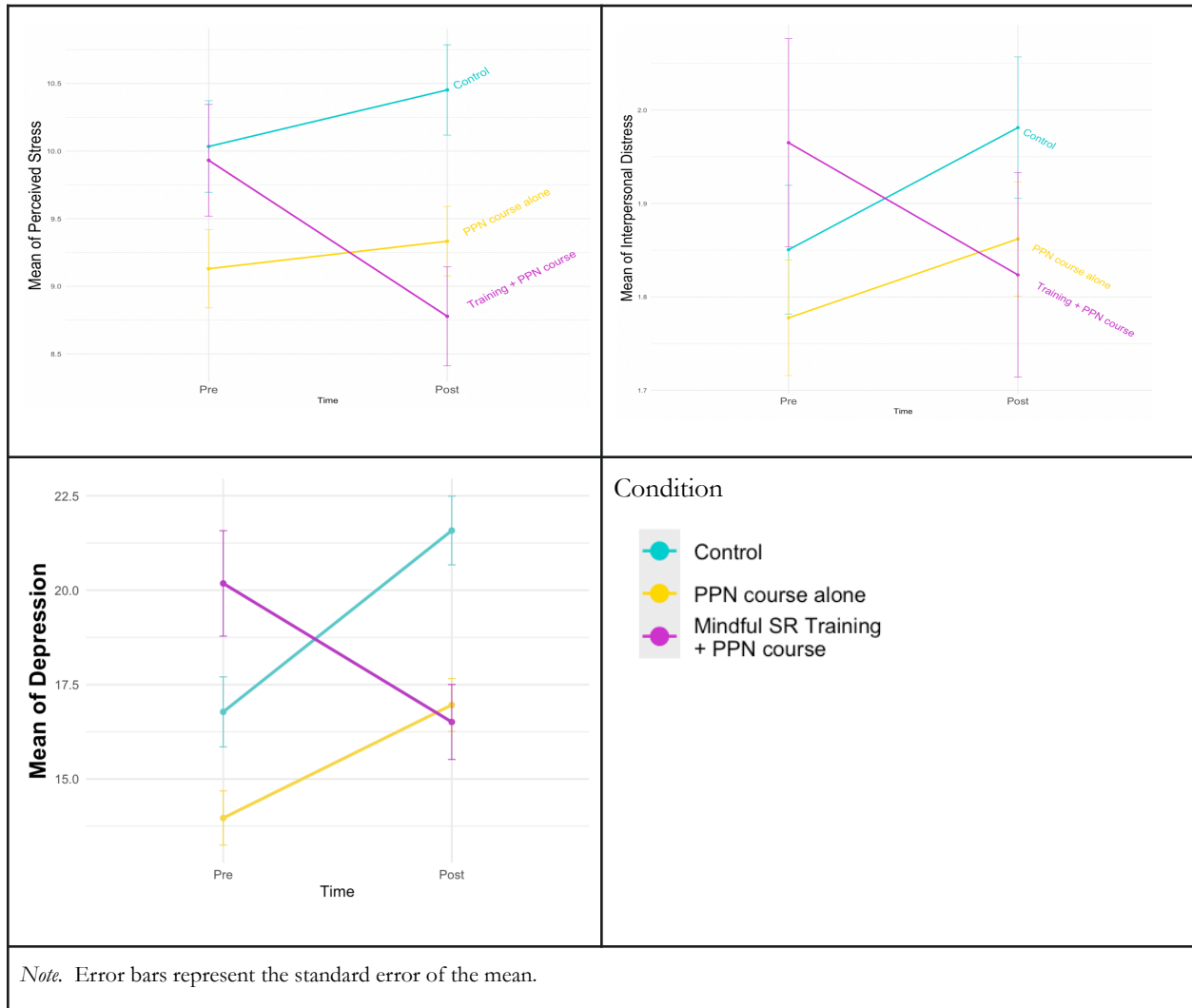


4.2.6. Self-report Measures

We ran time-by-condition interaction models to quantify the differential effects of the interventions on well-being outcomes. We specifically investigated whether the PPN course alone and the mindful self-reflection training + PPN course generated larger pre-post increases than the control training in well-being, community connectedness, self-transcendence, and interpersonal perspective-taking, and larger pre-post decreases in perceived stress and interpersonal distress. Regression models were fitted using the 'lme4' package version 1.1-23 (Bates et al., 2015). See [Supplementary Materials Table S5](#) for outcomes of all models.

Figure 14

Line Graphs of Pre-to-post Change Scores for Perceived Stress, Interpersonal Distress, and Depression by Condition



4.2.6.1. Analysis of Self-report Data for PPN Course Alone

Pre-post changes in *perceived stress* (z-scored) ($\beta = -0.16$, $SE = 0.16$, $t = -1.02$, $p = 0.31$; with significant covariates) and *interpersonal distress* (z-scored) ($\beta = -0.17$, $SE = 0.13$, $t = -1.37$, $p = 0.17$; with significant covariates) were no different between participants in the PPN course alone and participants in the control condition. Both groups experienced an increase in depression scores from baseline to post-intervention. The control group's mean (SD) score rose from 16.78 (9.81) to 21.58 (9.63), whereas the PPN course group's mean score increased from 13.97 (7.80) to 16.96 (7.88). However, the increase was significantly smaller in the PPN group, suggesting that the PPN course

effectively buffered the rise in *depression* ($\beta = -0.26$, $SE = 0.12$, $t = -2.19$, $p < 0.05$; with significant covariates).

For the PPN only course, there were no group differences in pre-post change in *self-acceptance* ($\beta = 0.1$, $SE = 0.12$, $t = 0.87$, $p = 0.39$; with significant covariates), *sense of purpose* ($\beta = 0.09$, $SE = 0.14$, $t = 0.65$, $p = 0.51$), or *personal growth* ($\beta = 0.2$, $SE = 0.13$, $t = 1.46$, $p = 0.14$) compared to the control group. For the PPN only course, there were also no group differences in pre-post change in *community connectedness* (z-scored) ($\beta = 0.25$, $SE = 0.14$, $t = 1.83$, $p = 0.07$; with significant covariates) or *relationship quality* ($\beta = 0.07$, $SE = 0.12$, $t = 0.6$, $p = 0.55$; with significant covariates). We found significantly greater increases in *interpersonal perspective-taking* (z-scored) from baseline to post-intervention in the PPN only group compared to the control group ($\beta = 0.32$, $SE = 0.13$, $t = 2.44$, $p < 0.05$), but this effect did not remain significant when including significant covariates ($\beta = 0.08$, $SE = 0.12$, $t = 0.7$, $p = 0.481$). We found significantly greater increases in *self-transcendence* (z-scored) ($\beta = 0.33$, $SE = 0.12$, $t = 2.78$, $p < 0.01$; with significant covariates) and *overall well-being* (z-scored) ($\beta = 0.29$, $SE = 0.14$, $t = 2.12$, $p < 0.05$, no significant covariates identified) from baseline to post-intervention in the PPN only group compared to the control group.

Figure 15

Line Graphs of Pre-to-post Change Scores for Self-Transcendence, Well-Being (Overall), Interpersonal Perspective-Taking, and Community Connectedness by Condition

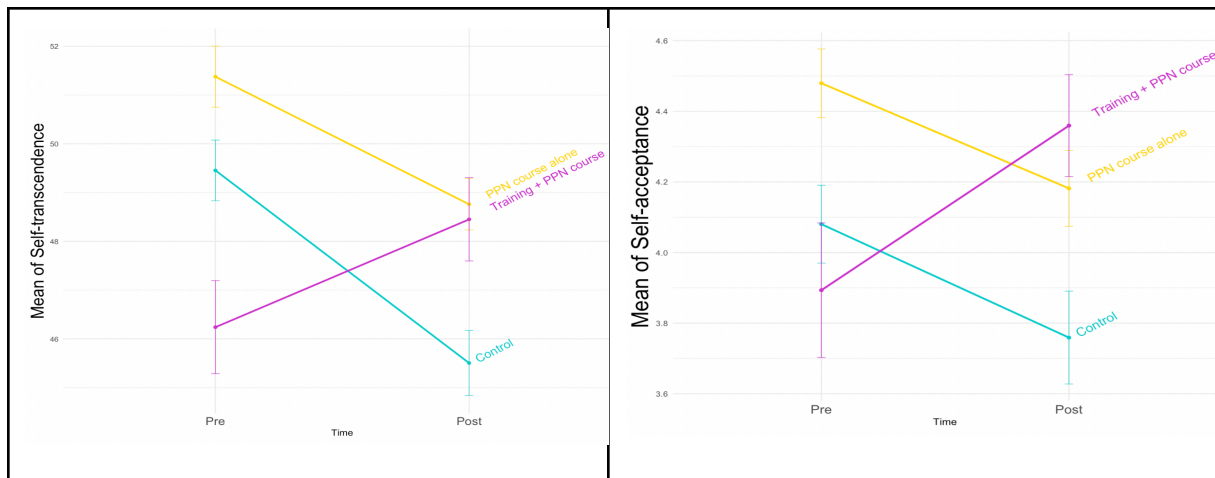


Figure 15 continued

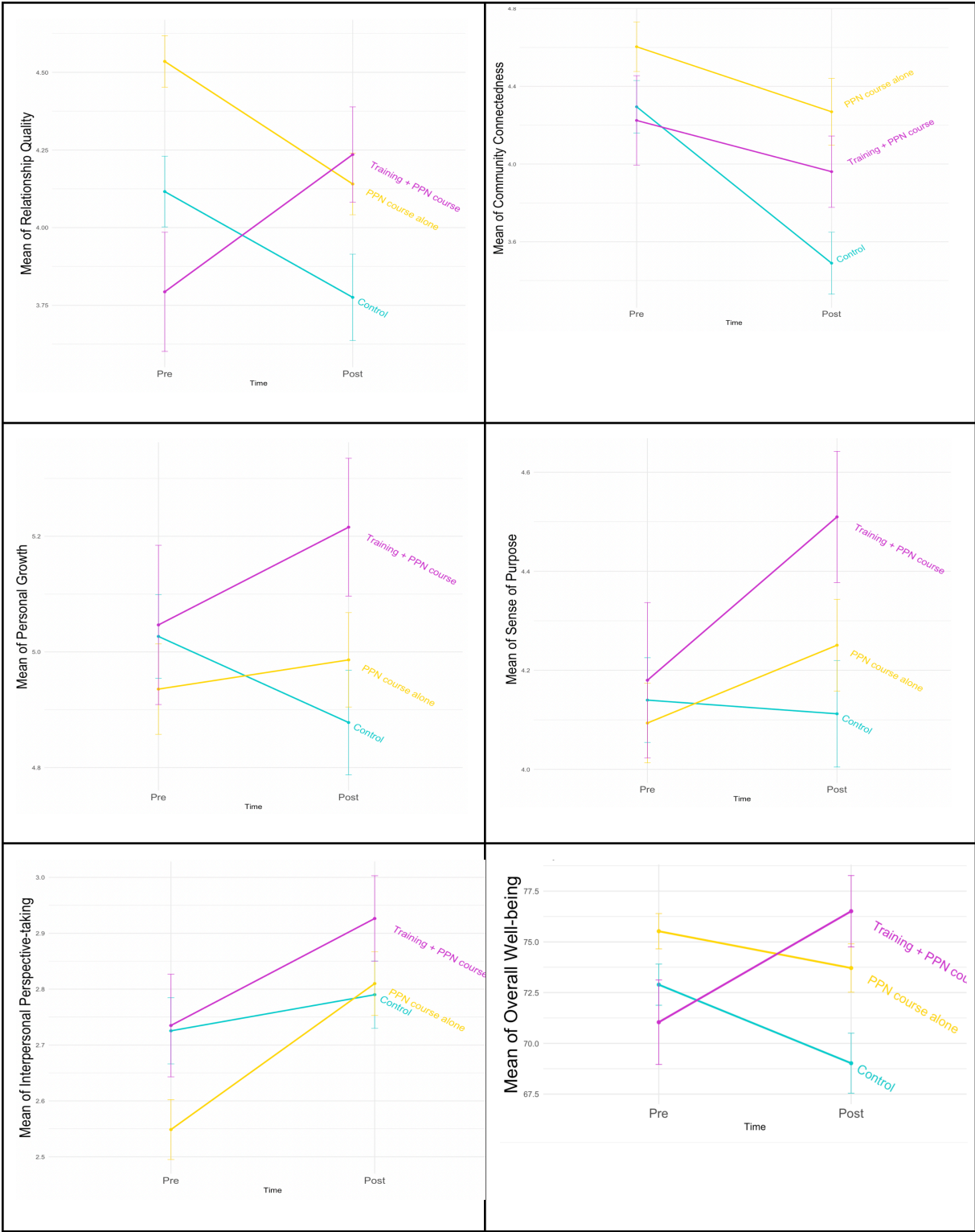
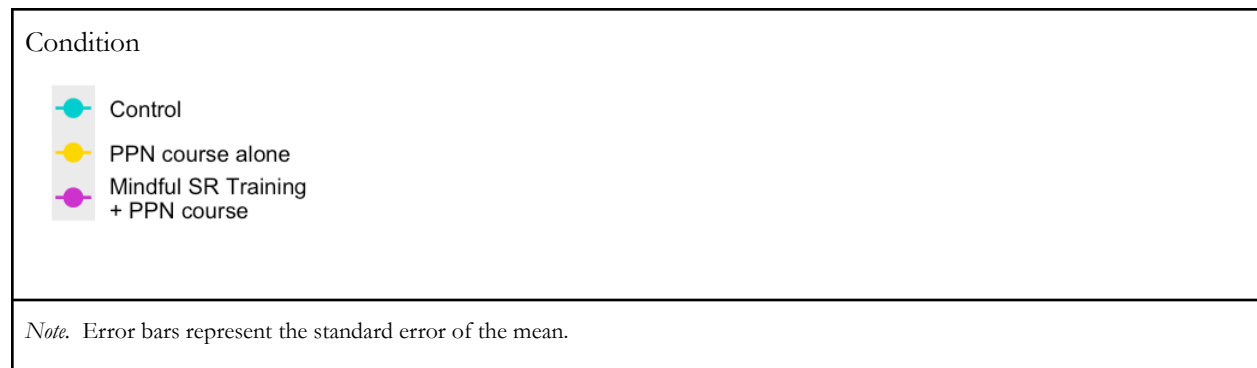


Figure 15 continued



4.2.6.2. Analysis of Self-report Data for Mindful Self-reflection Training + PPN course

Participants in mindful self-reflection training + PPN course (vs. controls) had significantly larger pre-post decreases in *perceived stress* (z-scored) ($\beta = -0.41$, $SE = 0.19$, $t = -2.12$, $p < 0.05$; with significant covariates) and *depression* (z-scored) ($\beta = -0.67$, $SE = 0.15$, $t = -4.41$, $p < 0.001$; with significant covariates). The control group's mean (SD) depression score rose from 16.78 (9.81) to 21.58 (9.63), whereas the Mindful Self-reflection Training + PPN course group's mean score decreased from 20.18(9.88) to 16.51(7.09). Participants in mindful self-reflection training + PPN course (vs. controls) had significantly larger pre-post decreases in *interpersonal distress* (z-scored) ($\beta = -0.37$, $SE = 0.17$, $t = -2.14$, $p < 0.05$), but these effects did not remain significant when controlling for covariates ($\beta = -0.21$, $SE = 0.16$, $t = -1.32$, $p = 0.19$; with significant covariates).

Participants in the Mindful Self-reflection Training + PPN course also showed larger pre-post increases in *sense of purpose* ($\beta = 0.5$, $SE = 0.17$, $t = 2.97$, $p = < 0.01$; with significant covariates), compared to the control group. Participants in mindful self-reflection training + PPN course (vs. controls) had significantly larger pre-post increases in *personal growth* (z-scored) ($\beta = 0.36$, $SE = 0.17$, $t = 2.09$, $p < 0.05$), but these effects did not remain significant when controlling for covariates ($\beta = 0.33$, $SE = 0.17$, $t = 1.97$, $p = 0.05$; with significant covariates). The control group's mean (SD) self-transcendence score decreased from 49.46 (6.59) to 45.50 (6.72), whereas the Mindful Self-reflection Training + PPN course group's mean score increased from 46.24 (6.75) to 48.45 (6.09)(Figure 14). Results for self-transcendence indicate an interaction effect, where participants in the training + PPN showed larger pre-post increases in *self-transcendence* (z-scored) ($\beta = 0.6$, $SE = 0.15$, $t = 4.04$, $p = < 0.001$; with significant covariates) compared to the control group. Similarly, the control group's mean (SD) self-acceptance score decreased from 4.08 (1.17) to 3.76 (1.32), whereas the Mindful Self-reflection Training + PPN course group's mean score increased from 3.89 (1.35) to 4.36 (1.03)(Figure 14). Results for self-acceptance indicate an interaction effect, where participants in

the training + PPN showed larger pre-post increases in *self-acceptance* (z-scored) ($\beta = 0.38$, $SE = 0.15$, $t = 2.53$, $p < 0.05$; with significant covariates) compared to the control group.

Similarly, training participants also revealed a greater pre-post increase in *relationship quality* ($\beta = 0.43$, $SE = 0.16$, $t = 2.75$, $p < 0.01$; with significant covariates), but not *interpersonal perspective-taking* (z-scored) ($\beta = 0.22$, $SE = 0.15$, $t = 1.45$, $p = 0.149$; with significant covariates) or *community connectedness* (z-scored) ($\beta = 0.16$, $SE = 0.17$, $t = 0.92$, $p = 0.36$; with significant covariates). Finally, training participants (vs controls) showed larger pre-post increases in *overall well-being* (z-scored) ($\beta = 0.83$, $SE = 0.18$, $t = 4.73$, $p < 0.001$; with significant covariates).

5. Discussion

Reflecting on emotionally distressing autobiographical interpersonal experiences can lead to either further distress or adaptive outcomes. While present-moment awareness is a valuable mindfulness tool, it is often misinterpreted as the need to be free of thoughts. However, reflecting on difficult experiences is an inevitable part of developing present-moment awareness and has the potential to generate insight, empathy, and resolution. Learning to reflect on these experiences using mindful awareness and psychological distance can influence attributions (Roldão, 2023), promote experiential awareness (Lindsay & Creswell, 2019), perspective-taking (Sassenrath et al., 2014), and reconstrual (Pennebaker & Chung, 2007), while reducing emotional and physiological distress reactivity (Ayduk & Kross, 2010). Ultimately, these meta-cognitive skills may support adaptive coping and health behaviors (Riley et al., 2022), self-transcendence, interpersonal closeness (Kross & Ayduk, 2017), and various aspects of psychological well-being (Petrova et al., 2021).

5.1. Increased Self-distancing and Reduced Blame Attribution following Mindful Self-reflection Training and PPN Course

Extending previous research, we demonstrate that a positive psychology and neuroscience course coupled with a 4-week mindful self-reflection training can increase adaptive construal of emotionally difficult past experiences. Participants' written descriptions of these experiences contained a greater number of statements reflecting self-distancing (versus self-immersion) and understanding (versus attributions of blame towards self, other, or entity). Post-hoc linear regression analysis for the subcategories of psychologically immersed speech (see [Supplementary Table S.B.2](#) for model outcomes) suggests this effect was primarily driven by less usage of “what statements” and greater usage of “insight statements.” LIWC-derived linguistic signatures of other- versus self-focus and self-transcendence, along with self-reported self-transcendence, suggest that participants shifted from a self-centric perspective to one of being part of a greater whole.

5.2. Emotional Regulation, Stress Resilience, and Psychosocial Well-being

It is notable that the control group saw decreases in self-transcendence, self-acceptance, relationship quality, and community connectedness, indicating that the transition to college represents a vulnerable time, with reductions in these dimensions of personal and social well-being. This underscores the importance of targeted interventions, such as the Mindful self-reflection training + PPN course, which appears to buffer against these declines and even promote growth in these areas. Similarly, the control group saw increases in perceived stress, interpersonal distress, and depression across their first college term. This highlights the significant psychological challenges that students face during this period and the potential benefits of interventions aimed at enhancing resilience and emotional regulation to mitigate these negative outcomes. When measuring depression with the CES-D, a typical cutoff point is 16 (Weissman et al., 1977), though some suggest a clinical cutoff of 20 (Vilagut et al., 2016). Notably, the average depression score for all participants upon entering college was 16.98, within this range. This already high average score increased to 18.53 during the term, reflecting the well-documented rise in depression during the transition to college (Ibrahim et al., 2013). Our study's control group mirrored this trend, with an average increase of almost 5 points, placing them above even the higher recommended cutoff. The PPN course buffered this rise, with an average increase of only 3 points. The combination of Mindful Self-Reflection training and the PPN course led to a notable pre-to-post reduction in depression levels, with a decrease of almost 4 points.

Emotional regulation and distress tolerance are crucial for long-term stress resilience (Gross, 2015; Ochsner & Gross, 2008). Training in mentally distancing from emotionally difficult experiences can improve emotion regulation (Orvell et al., 2023; Travers-Hill et al., 2017). Participants in our mindful self-reflection training + PPN course reported reduced emotional reactivity when reflecting on difficult experiences. Baseline neuroimaging results further suggest less personal involvement, emotional intensity, and stress arousal during psychological distancing (as reflected by lower anterior insula, OFC, and posterior precuneus activity).

No significant differences were found between groups in OFC activity during psychological distancing pre- to post-intervention. The intervention aimed to improve emotion regulation through psychological distancing, not specifically emotional distancing. Participants were encouraged to view their emotions as functional indicators of underlying needs (Greenberg, 2017), possibly leading to less emotional reactivity without disengagement. Mindfulness practices teach “being with” emotional experiences without becoming enmeshed in them, consistent with reduced emotional reactivity post-intervention. Although we did not observe pre- to post-intervention changes in emotional anxiety and positive emotional tone, participants reported significant reductions in perceived stress and interpersonal distress, suggesting overall improvements in emotional regulation.

Regarding well-being, the PPN course improved interpersonal perspective-taking and, when paired with mindful self-reflection training, reduced perceived stress and interpersonal distress, though it did not increase community connectedness. Participants reported increased self-acceptance, personal growth, and a stronger sense of purpose after the combined training. These findings align with self-determination theory, emphasizing the importance of self-reflection and personal autonomy for individual growth (Ryan & Deci, 2001). Adaptive self-reflection and self-transcendence are crucial for personal growth and a sense of purpose (Ryan & Deci, 2001; Brewer & Garrison, 2014).

5.3. Intervention-driven Changes in Neural Substrates for Self-Referential Processing, Evaluative Mentalizing, Emotion Regulation, and Perspective-Taking

Reflection on emotionally difficult experiences involves dynamic self-referential, emotional, and social-cognitive processes, making the specific contributions of neural regions inconclusive. At baseline, self-distanced reflection led to lower activation in the posterior precuneus and dorsomedial prefrontal cortex (dmPFC), but higher activation in the temporoparietal junction (TPJ) compared to self-immersed reflection. This suggests differential engagement of brain regions associated with self-referential processing, evaluative mentalizing, emotion regulation, and perspective-taking. These baseline findings align with previous research on spontaneous self-distancing (Ayduk & Kross, 2010; Park et al., 2016).

5.3.1. Posterior Precuneus

At baseline, both groups showed less activation in the posterior precuneus during self-distanced reflection compared to self-immersed reflection, suggesting that self-distancing requires less cognitive effort for self-referential processing. The control group exhibited significantly lower activation in the posterior precuneus for distanced > immersed ($M = -0.75$) compared to the training group ($M = -0.29$; $t = -2.198$, $p = 0.031$), indicating that untrained individuals exert less cognitive effort on self-referential processing during self-distancing. Following the intervention, the training group showed a significant decrease in posterior precuneus activity compared to the control group, suggesting that post-training, even fewer cognitive resources were directed to self-referential processing during self-distancing.

5.3.2. Temporoparietal Junction (TPJ)

At baseline, the training group demonstrated more activation in the TPJ during self-distanced reflection compared to self-immersed reflection, suggesting that self-distancing initially demands more cognitive effort for perspective-taking and social cognition. The control group showed no significant differences in TPJ activation between the tasks, implying that untrained individuals do not require more

cognitive effort for these functions. The training group had significantly higher TPJ activation for distanced > immersed ($M = 0.43$) than the control group ($M = 0.05$; $t = -2.508$, $p = 0.014$) at baseline. Post-intervention, TPJ activity decreased significantly more in the training group compared to the control group, indicating that less cognitive effort was needed for perspective-taking and social cognition following the training.

5.3.3. Dorsomedial Prefrontal Cortex (dmPFC)

At baseline, the training group showed no significant differences in dmPFC activity between self-distanced and self-immersed reflection, suggesting that cognitive effort for emotion regulation, social cognition, and evaluative mentalizing was similar for both tasks. The control group exhibited less dmPFC activity during self-distanced reflection compared to self-immersed reflection, indicating that untrained individuals need less cognitive effort for emotion regulation and evaluative mentalizing during self-distancing. The baseline between-group difference was not significant ($t = -1.16$, $p = 0.248$). Post-intervention, dmPFC activity decreased significantly more in the training group compared to the control group, suggesting that less cognitive effort was needed for emotion regulation and social cognition, and less evaluative mentalizing occurred during self-distancing following the training.

5.4. Dynamic Nature of Self-reflection

Group differences in intervention-related changes in neural activity during the self-distanced (compared to self-immersed) reflection task were observed in the posterior precuneus, dmPFC, and TPJ. Contrary to the hypothesis that increased social cognition and empathy would result in increased activation of cortical midline regions, participants in the training group showed greater reductions in activation in all three regions when self-distancing compared to self-immersing. These reductions could indicate more efficient perspective-taking (TPJ), reduced reliance on self-referential processing (posterior precuneus), and less need for active emotion regulation (dmPFC). This was accompanied by lower subjective emotional reactivity and improvements in various well-being measures, suggesting that the training intervention made self-distancing a more efficient and less cognitively demanding strategy for emotion regulation and perspective-taking.

Intervention-related reductions in cortical midline structures must be interpreted considering the dynamic nature of self-reflection. Findings show both increased (Farb et al., 2007) and decreased (Kross et al., 2009) activation in these regions during mindfulness and self-distancing, respectively. The precuneus, a complex part of the default mode network, is involved in self-referential cognition (Brewer et al., 2013) and mind-wandering (Mason et al., 2007), as well as social cognition (Mar, 2011). The dmPFC is implicated in meta-cognitive processing and self-referential judgments (Denny et al., 2012; Frith & Frith, 2003).

Our results align with other mindfulness-based interventions where increased self-kindness was associated with reduced precuneus activity in self-blame contrasts (Williams et al., 2020). Cortical midline structures, including the medial orbital prefrontal cortex and posterior precuneus, are reliably linked with self-referential processing (Brewer et al., 2013; Northoff et al., 2006). Increased posterior precuneus activity is tied to psychological immersion and subjectivity, so post-intervention reductions in precuneus and dmPFC activity during psychological distancing could indicate reduced self-referential processing and mind-wandering. This decreased activity is consistent with meditation-related tasks that engage present-moment attention (Brewer et al., 2011; Pagnoni, 2012), suggesting reduced self-centered meta-cognition.

Following the intervention, the training group showed a relative decrease in TPJ activity during psychological distancing. This could indicate less perspective-taking, reduced cognitive effort in perspective-taking, or different mentalizing strategies post-intervention. Social cognitive research shows that strategies like rule-based versus self-referential mentalizing are used depending on context and social goals (Mitchell, 2009). Considering others' mental states involves the medial prefrontal cortex (mPFC) and TPJ (Shurz et al., 2014), which are engaged in prospective and retrospective cognition. Mindfulness practices, though focused on present-moment awareness, have been associated with TPJ activity during dis-identification and attention regulation tasks (Gundel et al., 2018). Self-transcendence has also been linked to decreased TPJ activity (Johnstone et al., 2012).

Differential findings for the posterior precuneus and TPJ in our study warrant attention. Both regions are associated with social cognition and empathy. The training group showed reduced activation during psychological distancing in both regions post-intervention. However, the posterior precuneus exhibited lower activity during distancing at baseline, while the TPJ showed higher activity. The posterior precuneus is involved in a broad range of cognitive processes, including self-referential processing, mind-wandering, mental imagery, and social cognition. It is particularly associated with first-person perspective-taking, episodic memory retrieval (Cavanna & Trimble, 2006; Vogeley & Fink, 2003), and self-attributional evaluation (Cabanis et al., 2013). In contrast, the TPJ is more specifically associated with perspective-taking and attributing mental states and emotions to oneself and others (Lombardo et al., 2010; Schurz et al., 2014). Baseline differences may reflect that participants reduced first-person perspective-taking and self-attributional evaluation while increasing mentalizing during baseline psychological distancing. Post-training, participants likely reduced engagement in all these cognitive processes during psychological distancing.

These neural findings suggest a dynamic allocation of resources across neural structures when reflecting on difficult autobiographical and interpersonal experiences. The linguistic results indicating less

immersion and self-blame support that reductions in cortical midline regions reflect decreased evaluative cognitions related to self and others.

5.5. Benefit of Pairing Positive Psychology Courses with Mindful Self-reflection Trainings

While the PPN course alone showed some improvements in our outcome measures, the combination of the Mindful Self-reflection training and the PPN course appears to be key to creating measurable impact overall. Participants in the Mindful Self-reflection training + PPN course group exhibited significant improvements compared to the control group across a variety of measures, including perceived stress, interpersonal distress, depression, sense of purpose, and personal growth, self-transcendence, self-acceptance, and relationship quality. These findings suggest that integrating mindfulness and psychological distancing practices with positive psychology education can enhance students' ability to reflect adaptively on emotionally difficult experiences, promoting greater emotional regulation and psychosocial well-being. Such combined interventions could be instrumental in supporting young adults during critical transitional periods, such as the first year of college, by not only mitigating stress and emotional distress but also fostering personal growth and social connectedness. This approach underscores the potential for mindfulness and self-distancing educational programs to address the multifaceted challenges faced by students, enhancing their overall resilience and well-being.

5.6. Limitations and Future Directions

This study is limited by the role of specific emotion type and distancing strategy. There are various psychological distancing techniques, including those implemented in the present study, which may have distinct impacts on neural, linguistic, and subjective outcomes. Future research should examine these different strategies to understand their unique effects. This study represents a small but emerging approach to adaptive mindfulness-based techniques targeting social aspects of cognitive patterns that inform well-being. Additional adaptations of mindfulness and self-reflection techniques incorporating social and contextual aspects of well-being are warranted. Further, the approach of mindful self-reflection training assumes that mindfulness enhances the impact of self-distancing by developing the attentional regulation necessary to stay engaged in meta-cognitive techniques. Future studies could explicitly test this assumption by conducting dismantling trials to examine the differential impact of combined training versus self-distancing alone.

The sample is non-representative as all participants were college students who self-selected into one of two undergraduate courses (PPN versus general psychology). About 52% of the neuroimaging subgroup (N = 224) were not eligible for participation due to exclusion criteria such as mental health risks (8%),

claustrophobia (9%), and having metal in their body (34%). This limits the generalizability of the findings. Future research should adapt these practices for individuals with PTSD and other diverse populations who might benefit from these interventions with appropriate support. Mindfully engaging with difficult past experiences, which shape cognitions and well-being more broadly (Segal et al., 2002; Williams et al., 2012), has therapeutic potential. This may be particularly valuable in therapeutic settings where past traumas or negative memories exert a substantial impact on an individual's ongoing mental health (Hajat et al., 2020). Additionally, the adaptation of the intervention across diverse samples, including different age groups, races, mental health statuses, and belief systems, is warranted. Conceptualizations of both emotions (Zhou et al., 2021) and memory (Wang & Conway, 2006) differ across cultures, and this work could be extended to increase cultural relevance and accessibility of the intervention. Further, daylong behavioral and mental health interventions (e.g., Dindo et al., 2012) show promise for addressing the need-to-access gap among underrepresented populations (Schleider et al., 2013)..

While various cortical midline structures (CMS) are particularly relevant for self-referential processing, understanding how these regions integrate during complex cognitive processes like evaluative mentalizing, self-referential processing, and social cognition is challenging. Various CMS may be particularly relevant for self (versus other) referential processing. For instance, the medial prefrontal cortex (mPFC) is particularly involved in self-referential processing (Northoff & Bermpohl, 2004), while the posterior precuneus (PostPrecun) and right temporoparietal junction (TPJ) are active in other-referential contexts (Lombardo et al., 2010; Pfeifer et al., 2007). On the other hand, aspects of self-processing may arise from an integration of activity across multiple cortical regions (Northoff & Bermpohl, 2004). Future approaches, such as neurophenomenology using experience sampling and real-time fMRI neurofeedback (e.g., Brewer et al., 2013), could provide more precise insights into the neural underpinnings of personal and social cognition.

The conceptualization of the self could be more explicitly considered. Different types of self-processing (e.g., autobiographical self, narrative self) and spatial conceptualizations of the self could influence how individuals reflect on difficult past experiences. Future research should explore these conceptualizations to better understand their impact on cognitive and emotional processes during self-reflection. The study also highlights the unique experiences related to the college student transition. Understanding how geographic or emotional distance from family influences interpersonal distress or the impact of training components could provide valuable insights for future interventions targeting this population.

The temporal recency of difficult events was not explicitly examined in this study. Future research could manipulate the content of reflection tasks to explore how the recency of events impacts self-distancing practices and their neural basis. This could reveal how recent versus distant events differently influence cognitive and emotional responses. Furthermore, understanding the role of temporal variance regarding the

events reflected on could reveal the differential impact of self-distancing practices across time. For instance, self-distancing practices may be effective for very recent events (e.g. Mischkowski et al., 2012), but disentangling recency, salience, and contextual factors could reveal the usefulness of self-distancing across various event characteristics. Additionally, while this study focused on adaptive reflection on past events due to the association of emotional distress with past-focused reflection (Killingsworth & Gilbert, 2010), future work could adapt the training to address anticipatory worry about distressing imagined interpersonal experiences. These additional directions could enhance the understanding and application of self-reflection and mindfulness techniques in diverse contexts and populations.

Over the term, both MRI subgroups experienced decreases in blame attribution moments and emotional reactivity related to reflecting on emotionally difficult memories. This decrease was more pronounced in the Mindful Self-Reflection + PPN course group, suggesting the training effectively impacted these measures. The overall trend suggests that temporal recency and having previously reflected on some of these memories during the guided reflection task contributed to the reduction in blame attribution moments and emotional reactivity. We also observed indications that the measure of blame attribution moments demonstrated high variability, highlighting substantial differences among participants. Identifying contributors to this variability will be important for future studies.

6. Conclusion

This study demonstrates the efficacy of a mindful self-reflection training, alongside a positive psychology and neuroscience course, for improving various dimensions of psychosocial well-being, including relationship quality, interpersonal distress, sense of purpose, personal growth, and depression. An important nuance in the downstream effects of social cognition on well-being is that social-cognitive processes such as self-reflection and attributions of blame can be both adaptive and maladaptive. The results of this study suggest that mindfulness and self-reflection training can reduce the negative aspects of social cognition, such as rumination about social experiences and concerns about belonging, and at the same promote more adaptive, compassionate engagement with emotions and memories. We show that pairing a positive psychology and neuroscience course for undergraduate students with a program that trains mindfulness and adaptive self-reflection focused on emotionally difficult events can increase psychological distance, self-transcendence, and interpersonal understanding. This program also has effects on the neural systems involved in self-referential processing and social cognition. We further demonstrate reduced emotional reactivity immediately following the events, as well as perceptions of stress and interpersonal distress generally. Findings demonstrate the potential value of mindfulness and self-distancing techniques, particularly when applied to reflections about difficult life experiences, in educational and therapeutic settings. Results

also underscore the need for further research on interventions that pair mindfulness with self-distancing techniques to bring insight and resolve following difficult experiences, and their potential to improve psychological, emotional, and relational well-being outcomes.

CHAPTER IV: GENERAL DISCUSSION

1. Overview of Research and Goals

This dissertation explored the efficacy of mindfulness and acceptance-based interventions in promoting health and well-being among high-risk populations. The focus was on enhancing meta-cognitive skills to increase distress tolerance and potentially mitigate the risk of developing chronic physical and mental health conditions. Meta-cognitive tendencies related to experienced or anticipated demanding life situations, such as appraisals of threat, attributions of blame, ruminative brooding, psychological immersion, experiential avoidance, or low controllability awareness, significantly impact cognitive, emotional, and physiological stress responses to those situations (e.g., Jamieson & Hangen, 2022; Wells, 2013). These responses in turn influence downstream mental and physical health. Across two studies, we investigated the impact of mindfulness and acceptance-based interventions, embedded within psychoeducational contexts, aiming to train adaptive meta-cognitive tendencies such as mindful awareness, psychological flexibility, controllability awareness, and psychological distancing.

2. Integrative Summary of Findings

2.1. Psychological Distress in Diabetes Prevention and Transition to College

Adults at risk for developing Type 2 Diabetes are also at risk of distress due to demanding self-care regimens, emotional concerns, and social stigma. This distress is both a precursor to and a significant health outcome of the condition, affecting overall well-being and adherence to preventive measures. To address the contextual and psychological factors underlying the persistent rise in Type 2 Diabetes prevalence despite evidence supporting health behavior change as a viable diabetes prevention strategy (Knowler et al., 2002), we developed an integrative and equity-informed prevention approach in Study 1. Specifically, we designed a brief and web-based intervention that can be delivered virtually post-risk assessment or following risk assessment during primary care visits. The structure of the intervention was designed to enhance accessibility and efficiency, aiming to reduce common resource barriers in primary care (Al-Badri & Hamdy, 2021; Vrkatić et al., 2022). The delivery model adheres to primary prevention principles by intervening at the earliest stages of risk (Schulze & Hu, 2005) and responds to calls for research on lifestyle interventions for screen-detected prediabetes (U.S. Preventive Services Task Force, 2021).

Adults who are transitioning into college are at risk of developing psychological distress and reduced social connection due to factors like moving away from home, increased autonomy, identity exploration, and

shifting social networks (Arnett, 2000; Fruehwirth et al., 2023; Ibrahim et al., 2013). To address the common increase in psychological stress and weakened social connections during the transition to college, we implemented a mindful self-reflection training aimed at enhancing meta-cognitive skills such as mindful awareness and self-distancing (also known as de-centering and dis-identification) in Study 1. These skills are crucial for processing adverse life experiences and improving emotional and psychological well-being.

2.2. Enhancing Meta-Cognitive Skills

In Study 1, the content of the ACT-informed diabetes prevention education program extends conventional programs with additional components to enhancing meta-cognitive skills, including present-moment awareness, psychological flexibility, controllability awareness, experiential acceptance, cognitive defusion, and values identification. The program was designed to improve distress tolerance and enhance self-regulation to promote coping effectiveness. Study 1, therefore, assessed the efficacy of a brief, computer-delivered mindfulness and acceptance-based intervention versus conventional diabetes prevention education in a high-risk adult population identified through screening.

In study 2, the intervention specifically targeted meta-cognitive tendencies that emerge when reflecting on emotionally distressing autobiographical interpersonal experiences, as the nature and frequency of these reflections can either promote distress or foster resilience. Engaging in self-referential thinking and ruminative brooding about interpersonal interactions is common (Joubert et al., 2022; Killingsworth & Gilbert, 2010), especially during the transition to college, when interpersonal relationships are highly personally and academically relevant (Allen & Bowles, 2018; Martin, 2014). Experiential avoidance of difficult thoughts and emotions drives increased ruminative brooding and maladaptive forms of self-referential thinking (Dickson et al., 2012). Therefore, Study 2 investigated the efficacy of a 4-week mindful self-reflection training combined with a 10-week positive psychology and neuroscience course, as well as the positive psychology and neuroscience course alone, compared to a general psychology course, in a group of college-transitioning adults.

2.3. Mindfulness- and Acceptance- based Practices

Study 1 assessed an intervention that extended conventional diabetes prevention education by targeting psychoemotional barriers to persistence in prevention efforts. In addition to increasing controllability awareness to discern modifiability of aspects of diabetes prevention, Study 1 applied acceptance and commitment therapy techniques to support participants in managing those aspects which are non-modifiable and distressing.

Study 2 harnessed the potential for mindful awareness practices to promote present-moment, experiential awareness and reduce ruminative brooding and excessive or maladaptive self-referential thinking (Lin et al., 2018; Mao et al., 2023). Though it is commonly mischaracterized as a state free of all thoughts, participants in our training learned tools for responding to dynamic fluctuations between present-moment awareness and mind-wandering. Specifically, participants learned to relate to memories and evaluations of difficult past events that arise as present-moment phenomena that can be approached with curiosity and compassion. Rather than avoiding reflections on difficult past experiences, participants learned mindfulness tools to apply when thoughts about distressing memories arose during contemplative practices. In particular, participants learned techniques of self-distancing, which can mitigate ruminative brooding and has the potential to generate insight, empathy, and resolution.

2.4. Novel Assessment of Neural Impact of Intervention for Promoting Psychological Distance

Study 2 extended previous investigations of neural correlates where participants were instructed in mindful awareness and self-distancing techniques, to assess the neural impact of training these skills over time. In addition to evaluating neural components, along with both proximal (i.e., emotional reactivity) and distal (e.g., psychological well-being and relationship quality) self-report measures of training effects, we evaluated spontaneous self-distancing and blame attribution in written reflections about difficult life experiences without suggesting any specific techniques.

3. General Summary of Results and Implications

3.1. Impact on Psychological and Emotional Experiences of Positive Diabetes Risk Assessment and Prevention Education

Results from Study 1 indicate that combining mindfulness and acceptance-based principles with diabetes prevention education can reduce certain aspects of psychological and emotional distress. The ACT-informed diabetes prevention education intervention significantly enhanced emotional acceptance and reduced perceptions of diabetes-related threat, emotional stress, and state anxiety, reflecting the importance of psychological flexibility and emotional regulation in self-management practices to prevent chronic diseases (Fisher et al., 2012; Lawson et al., 2013). The intervention also increased controllability awareness, representing improved skills for identifying effective self-management strategies.

Persistent goal pursuit in managing chronic diseases is crucial, and enhanced emotional acceptance skills found in the ACT-informed diabetes prevention education intervention group have the potential to promote enduring goal pursuit and influence risk-reducing behaviors and distress tolerance over time (Luoma

et al., 2007; Southward, 2014; Walton, 2014). While our methodology, which lacks longitudinal data, does not permit conclusive statements on this relationship, Fawson et al. (2023) have established that emotional acceptance skills buffer chronic illness-related distress. Although our intervention was brief, results align with prior research showing enhanced psychological flexibility following mindfulness- and acceptance-based interventions (Fledderus et al., 2013).

Despite a high prevalence (approximately 30%) of diabetes risk-related distress across both groups in our sample, the ACT-informed diabetes prevention education intervention group did not show lower distress, possibly because measuring distress immediately after intervention is premature. Longitudinal studies are needed to identify the trajectory of diabetes distress, especially among those with prediabetes. Alternatively, this finding could reflect the approach of ACT therapies, which promote psychological flexibility and engagement in meaningful behaviors despite inevitable distress.

Although modest, the intervention effects have the potential to impact important behavioral consequences, highlighting the promise of web-based approaches to influence cognitive and emotional factors in diabetes prevention. The ACT-informed diabetes prevention education intervention group experienced less diabetes risk-related threat directly following the intervention, though long-term outcomes remain unknown. Previous research suggests a complex interplay among threat perceptions, avoidance-approach motivation, risk awareness, distress, and efficacy in diabetes prevention and management (e.g., Boss et al., 2015; Carver & White, 1994). More research is needed to understand these dynamic relationships.

It is unclear why the ACT-informed diabetes prevention education intervention group promotes a higher tendency to embrace challenging emotions during goal pursuit, rather than also significantly impacting the tendency to maintain awareness of them or utilize them to motivate goal pursuit. This may reflect greater activities geared towards fostering emotional acceptance, the focus of the emotional non-avoidance scale on behavioral responses, or inconsistencies with the factor structure of the PPF (Jo et al., 2023; Figure S.A.4). The findings underscore the importance of incorporating psychological support into diabetes care frameworks at early stages of risk detection (Helitzer et al., 2007), enhancing diabetes prevention strategies by addressing psychoemotional barriers associated with lifestyle changes (Golden, 2018).

3.2. Impact on Psychological Immersion, Emotional Regulation, and Psychosocial Well-being in the Transition to College

Findings from Study 2 support previous research showing that applying meta-cognitive skills can influence attributions, enhance experiential awareness, promote perspective-taking, and facilitate reconstrual while reducing emotional and physiological distress reactivity (Roldão, 2023; Lindsay & Creswell, 2019; Sassenrath et al., 2014; Pennebaker & Chung, 2007; Ayduk & Kross, 2010). Extending previous research, our study demonstrates that a positive psychology and neuroscience course combined with a 4-week mindful

self-reflection training increases adaptive construal of emotionally difficult past experiences and benefits psychological well-being. Participants' written descriptions showed that they engaged in more self-distancing and less attribution of blame and shifted from a self-centric perspective to one of being part of a greater whole. Our results corroborate related work showing that mindfulness and self-distancing skills foster adaptive coping and health behaviors, contribute to self-transcendence and interpersonal closeness, and enhance overall psychological well-being. Findings from Study 2 support previous research showing that applying meta-cognitive skills can influence attributions, enhance experiential awareness, promote perspective-taking, and facilitate reconstrual while reducing emotional and physiological distress reactivity (Roldão, 2023; Lindsay & Creswell, 2019; Sassenrath et al., 2014; Pennebaker & Chung, 2007; Ayduk & Kross, 2010). Extending previous research, our study demonstrates that a positive psychology and neuroscience course combined with a 4-week mindful self-reflection training increases adaptive construal of emotionally difficult past experiences and benefits psychological well-being. Participants' written descriptions showed that they engaged in more self-distancing and less attribution of blame and shifted from a self-centric perspective to one of being part of a greater whole. Our results corroborate related work showing that mindfulness and self-distancing skills foster adaptive coping and health behaviors, contribute to self-transcendence and interpersonal closeness, and enhance overall psychological well-being (Riley et al., 2022; Kross & Ayduk, 2017; Petrova et al., 2021).

Beyond intervention effects, the college students in the control group showed decreases in self-transcendence, self-acceptance, relationship quality, and community connectedness, indicating that the transition to college is a vulnerable time for personal and social well-being. The control group also experienced increased stress, interpersonal distress, and depression during their first college term. These findings underscore the significant psychological challenges students face and the potential benefits of interventions, which buffer against these declines and promote stress resilience and psychological well-being (Gross, 2015; Ochsner & Gross, 2008). Results of the combined training were promising, with increased self-acceptance, personal growth, and a stronger sense of purpose; and significant reductions in depression. Intervention improvements in emotion regulation extend previous research (Orvell et al., 2023; Travers-Hill et al., 2017), where the mindful self-reflection training + PPN course reduced emotional reactivity when reflecting on difficult experiences. Baseline neuroimaging results also suggest reduced personal involvement, emotional intensity, and stress arousal during guided self-distancing, even in presumed novices, indicated by lower activity in the anterior insula, OFC, and posterior precuneus.

With a focus on psychological (rather than emotional) distancing, the intervention encouraged participants to examine emotions as functional indicators of underlying needs and values (Greenberg, 2017). The mindful self-reflection training + PPN course was successful at reducing perceived stress, interpersonal distress, and emotional reactivity. If these effects occurred without requiring emotional disengagement, this

may explain the lack of group differences in OFC activity during psychological distancing. Brain regions associated with self-referential processing, evaluative mentalizing, emotion regulation, and perspective-taking demonstrated differential activation across self-distanced and self-immersed reflection techniques.

Future research should undertake the task of developing a more nuanced understanding of the ongoing activity of brain regions involved in self-referential cognition, mind-wandering, and social cognition, as they relate to subjective experiences of distress versus mindful awareness, including in clinical populations. Additional research examining the qualities of these processes, such as evaluative or blame-oriented versus non-judgmental or growth-oriented mentalizing while reflecting on emotionally difficult past experiences, could illuminate neural activity targets for future interventions.

To the extent that reduced activation in self-referential processing regions is a substrate of adaptive self-reflection, the link between self-distancing and this reduced neural activity at baseline across groups corroborates previous research that merely instructing people to adopt a self-distanced perspective enhances adaptive self-reflection (Kross & Ayduk, 2017). That activity in this region decreased significantly more for the combined training group following the intervention suggests that regular practices of mindful self-distancing are even more adaptive. The training group showed a greater reduction in several cortical midline structures (i.e., TPJ, dmPFC, posterior precuneus), which may indicate more efficient perspective-taking (TPJ), reduced reliance on self-referential processing (posterior precuneus), and less need for active emotion regulation (dmPFC). While interpretations of neural activity in the context of subjective experiences are nuanced and complex, especially for dynamic processes like mindfulness and self-reflection, the observed reductions in emotional reactivity and significant improvements in various well-being measures validate this interpretation. While our neural measures reflect instructed (rather than spontaneous) self-distancing, written responses were not. Reductions in self-immersion, then, demonstrate that the training improves spontaneous self-distancing. Neural measures of spontaneous self-distancing would further support this training effect.

Changes in activity in cortical midline structures following the intervention extend neuroimaging findings that these regions are associated with dis-identification and attention regulation tasks (Gundel et al., 2018) and self-transcendence (Johnstone et al., 2012), and broadly reveal a shift in mentalizing strategies post-intervention. While the posterior precuneus and TPJ are both associated with social cognition and empathy, the posterior precuneus may more specifically reflect self-referential processing, while the TPJ is associated with perspective-taking and attributing mental states (Cavanna & Trimble, 2006; Vogeley & Fink, 2003; Cabanis et al., 2013; Lombardo et al., 2010; Schurz et al., 2014). These neural changes, along with written response results showing less immersion and self-blame, suggest a dynamic allocation of neural resources, reflecting decreased evaluative cognitions related to self and others.

Various psychological distancing techniques, including those used here, can impact neural, linguistic, and subjective outcomes differently (Mitchell, 2009; Schurz et al., 2014). Future research should explore the effects of unique strategies. Different types of self-processing and spatial conceptualizations of the self could influence reflections on difficult past experiences, warranting further exploration (Northoff & Bermpohl, 2004). The current study is a step toward using adaptive mindfulness-based techniques targeting sociocognitive patterns that inform well-being. This approach helps mitigate stress and emotional distress while fostering personal growth and social connectedness, highlighting its potential to address students' multifaceted challenges and enhance their overall resilience and well-being. Additional adaptations of mindfulness and self-reflection techniques incorporating social and contextual aspects are warranted. Future studies should also examine opportunities to adapt the training to successfully promote community connectedness.

Mindful self-reflection assumes that mindfulness enhances self-distancing by developing the attentional regulation necessary for meta-cognitive techniques. Future studies could explicitly test this by comparing combined training versus self-distancing alone. Understanding how cortical midline structures (CMS) integrate during complex cognitive processes like evaluative mentalizing and social cognition is challenging. Future approaches, such as neurophenomenology using experience sampling and real-time fMRI neurofeedback, could provide more precise insights into the neural underpinnings of personal and social cognition (Brewer et al., 2013).

With participants being self-selected college students, the sample is not nationally representative, limiting generalizability. A significant number of people were excluded from the neuroimaging and training subgroup due to criteria like mental health risks, claustrophobia, and metal in the body. Future research should adapt these practices for individuals with PTSD and other populations who might benefit from these interventions (Segal et al., 2002; Williams et al., 2012). Mindfully engaging with difficult past experiences can shape cognitions and well-being more broadly, offering therapeutic potential. This is particularly valuable in therapeutic settings where past traumas or negative memories impact ongoing mental health (Hajat et al., 2020). Adapting the intervention across diverse samples, including different age groups, races, mental health statuses, and belief systems, is essential. Cultural relevance and accessibility should be increased, as emotional and memory conceptualizations differ across cultures (Zhou et al., 2021; Wang & Conway, 2006).

The temporal recency of difficult events was controlled for but not examined here. Future research could manipulate reflection task content to explore how recency impacts self-distancing practices and their neural basis. Understanding temporal variance regarding events could reveal how self-distancing practices are effective across various event characteristics. Additionally, adapting the training to address anticipatory worry about distressing imagined interpersonal experiences could enhance its application in diverse contexts and

populations (Mischkowski et al., 2012). By addressing these directions, future research can better understand and apply self-reflection and mindfulness techniques, promoting overall resilience and well-being.

4. Summary of Insights and Integration

Study 1 showed that incorporating acceptance and commitment therapy techniques into Diabetes prevention education can improve cognitive and affective outcomes. The ACT-informed diabetes prevention intervention is a brief, web-based, cost-effective, and interactive program designed following RE-AIM principles. It can be readily delivered via computer following a T2D risk assessment in primary care, community health settings, or through population-wide screening approaches. This low-cost intervention has the potential to promote widespread engagement with ongoing prevention strategies and programs for individuals at risk for T2D through common online self-assessment tools. This finding is particularly relevant in today's context, where digital health interventions are becoming increasingly important. The ability to deliver effective interventions through digital platforms broadens the reach and accessibility of these programs, making it possible to support a larger population at risk of chronic illness and persistent distress. Continued research efforts are needed to examine long-term impacts and refine and adapt these interventions for diverse populations and healthcare settings.

Study 2 demonstrates the efficacy of a mindful self-reflection training, alongside a positive psychology and neuroscience course, for improving various dimensions of psychosocial well-being, including relationship quality, interpersonal distress, sense of purpose, personal growth, and depression. The results of this study suggest that mindfulness and self-reflection training can reduce the negative aspects of social cognition, such as rumination about social experiences and concerns about belonging, while promoting more adaptive, compassionate engagement with emotions and memories. This program increased psychological distance, self-transcendence, and interpersonal understanding and also had effects on the neural systems involved in self-referential processing and social cognition. We further demonstrated reduced emotional reactivity immediately following the events, as well as perceptions of stress and interpersonal distress generally.

Findings from Study 2 highlight the potential value of mindfulness and self-distancing techniques, particularly when applied to reflections about difficult life experiences, in educational and therapeutic settings. Results also underscore the need for further research on interventions that pair mindfulness with self-distancing techniques to bring insight and resolve following difficult experiences and their potential to improve psychological, emotional, and relational well-being outcomes. The positive outcomes observed in first-year college students indicate that integrating these practices into the curriculum can provide students with essential tools to manage stress and emotional challenges during high-risk periods.

4.1. *The Gap between Knowing and Doing*

Overall, the studies underscore the importance of addressing meta-cognitive drivers of health and well-being. The incorporation of these techniques into established health and education contexts shows promise. Participant engagement with mindfulness- and acceptance- based *practices* are at the core of these interventions. The benefits derived from these techniques occur not in *learning about them*, but in the *enactment of them*. This approach reflects the assertion that addressing psychological and social drivers of distress and related health and well-being is fundamental, and that practicing techniques like present-moment awareness, experiential acceptance, distress tolerance, values and needs clarification, and self-distancing measurably enhances educational approaches. Prioritizing these practices alongside the delivery of information has the potential to address the knowledge-to-action gaps that plagues many health interventions. These improvements are seen with the incorporation of these techniques into both conventional diabetes prevention education (study 1) and college courses (study 2). However, a single-session, web-based ACT-informed diabetes prevention intervention is unlikely to provide sufficient experiential practice to impact distress related to diabetes prevention efforts, highlighting the need for sociocontextual approaches to address the structural barriers to multi-session program uptake. While the positive psychology and neuroscience course alone showed improvements, combining it with Mindful Self-reflection training created significant impact across many target outcomes. This combined group showed gains in perceived stress, interpersonal distress, depression, sense of purpose, personal growth, self-transcendence, self-acceptance, and relationship quality. Integrating mindfulness and psychological distancing with positive psychology education enhanced emotional regulation and psychosocial well-being, especially during the first year of college.

5. Conclusion

The integration of mindfulness and acceptance-based practices with psychoeducational components appears to be a promising approach for addressing the psychological and emotional components of chronic diseases and persistent distress. By targeting upstream psychological mechanisms, such as distress tolerance and psychological flexibility, these interventions can potentially mitigate the progression of chronic illnesses and enhance overall well-being. The observed reductions in emotional reactivity and improvements in various well-being measures support this interpretation, indicating that such interventions could be instrumental in supporting individuals during demanding experiences and in promoting health and well-being.

Overall, the findings from both studies support the potential of integrating mindfulness and acceptance-based practices with psychoeducational programs to enhance emotional regulation and

psychosocial well-being, with potential downstream influence on health behaviors. Such interventions could be instrumental in supporting individuals during critical transitional periods, such as initiating a diabetes prevention regimen or starting college, and in enhancing health-promoting practices, ultimately reducing the incidence and impact of chronic diseases and persistent psychological distress. By enhancing psychological flexibility and emotional regulation, these interventions address key upstream psychosocial mechanisms to achieve health benefits.

In conclusion, this dissertation has demonstrated the potential of mindfulness and acceptance-based interventions in promoting distress tolerance and preventing chronic health conditions. The findings from both studies underscore the importance of psychological flexibility and emotional regulation in achieving these outcomes. Future research should continue to explore these approaches, with a focus on enhancing accessibility, effectiveness, and cultural relevance. By integrating these practices into both digital health interventions and educational settings, it is possible to create a more integrative, accessible, and effective approach to health promotion.

APPENDIX A

STUDY 1 SUPPLEMENTARY MATERIAL

Appendix A.1

Modified Diabetes Risk-related Distress Scale (DRDS) Summary and Scoring

Lifestyle changes to prevent diabetes can sometimes be tough. There may be many problems and hassles concerning diabetes prevention and they can vary greatly in severity. Problems may range from minor hassles to major life difficulties. Listed below are potential problem areas that people working to prevent diabetes may experience. Consider the degree to which each of the items may distress or bother you in the future.

Please note that we are asking you to indicate the degree to which each item may bother you in your life, NOT whether the item may be merely true for you. If you feel that a particular item will not be a bother or a problem for you, you would circle "1". If it may be very bothersome to you, you might circle "6".

	Not a Problem	A Slight Problem	A Moderate Problem	Somewhat Serious Problem	A Serious Problem	A Very Serious Problem
1. Feeling overwhelmed by the demands of preventing diabetes.	1	2	3	4	5	6
2. Worry that I might fail with my diabetes prevention efforts.	1	2	3	4	5	6
3. Not feeling motivated to keep up my diabetes prevention self management.	1	2	3	4	5	6
4. Feeling angry, scared and/or depressed when I think about the potential of	1	2	3	4	5	6

developing and living with diabetes.						
5. Worry that I will end up with Type 2 Diabetes, no matter what I do.	1	2	3	4	5	6

Scoring: Total diabetes distress score: sum responses to all items and divide by 5 (i.e. the number of items in that scale). Thus, scores will range from 1-6, with higher scores reflecting higher diabetes risk related distress.

Appendix A.2

Tailored Brief Illness Perceptions Questionnaire (B-IPQ) Summary and Scoring

Please indicate how much you agree or disagree with the following statements about your diabetes risk (i.e. the responses you gave earlier indicating that you might be at risk for developing diabetes). For the following questions, please select the option that best corresponds to your views:

1. How much do you believe your diabetes risk will affect your life?
2. How long do you think your condition will continue?
3. How much control do you feel you have over your diabetes risk?
4. How much do you think a diabetes prevention program like this one can help your condition?
5. How much do you experience symptoms from your condition?
6. How concerned are you about your diabetes risk?
7. How well do you feel you understand your diabetes risk?
8. How much does your diabetes risk affect you emotionally? (e.g. does it make you angry, scared, upset, or depressed?)

Responses are collected a six-point Likert scale (e.g. Not affect at all (0) to Severely affect my life (10) and Not at all affected emotionally (0) to Extremely affected emotionally (10)), where higher scores reflect a more extreme illness perception (e.g. more control, longer-lasting impact, etc).

SCORING

To compute an overall score which represents the degree to which the illness is perceived as threatening or benign (if there is internal consistency) reverse score items 3, 4, and 7 and add these to items 1, 2, 5, 6, and 8. A higher score reflects a more threatening view of the illness.

Appendix A.3

Spielberger State-Trait Anxiety Inventory (STAI: Y-6 item) Summary and Scoring

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the most appropriate number to the right of the statement to indicate how you feel right now, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1. I feel calm *
2. I am tense
3. I feel upset
4. I am relaxed *
5. I feel content *
6. I am worried

Scale Not at all (1) Somewhat (2) Moderately (3) Very much (4)

To calculate the total STAI score (range 20 - 80):

1. Positive items (calm, relaxed, content) are reverse scored so 1=4, 2=3, 3=2 and 4=1;
2. Sum all six scores
3. Multiply total score by 20/6

Appendix A.4

Diabetes Prevention-Related Controllability Awareness Inventory (CAI-DP) Summary and Scoring

Please rate the extent to which you agree with the following statements.

1. Waiting to speak to a health professional about my diabetes risk is making me tense.
2. I won't worry about things related to my diabetes risk if there is nothing I can do about them.
3. I have the determination necessary to prevent diabetes.
4. I will get angry if I can't convince someone that I am right about things related to my diabetes risk.
5. I am confident that I can manage all the things related to my diabetes risk that I have to do.
6. I will try to stay objective during interpersonal discussions about my diabetes risk.

7. I worry that I won't be able to finish all the things I need to do to prevent diabetes.
8. I will get upset by the slightest sign of disapproval about my diabetes risk by others.
9. I won't be able to keep calm when a friend has a different opinion about my diabetes risk.
10. I can keep my mind off bad things that might happen regarding my health.
11. I can let others make their own health decisions without interfering.
12. When it comes to my diabetes risk, I will try not to worry when there is no way to change how things will turn out.
13. When it comes to my diabetes risk, I may get upset when someone won't cooperate with me.
14. When I feel that my diabetes risk means that I am unlucky, it may bother me for a long time.
15. I won't get discouraged when I have difficult problems to solve regarding my diabetes risk.
16. When it comes to my diabetes risk, I will try not to be impatient with inefficient healthcare administrators.
17. I can't think about other things while waiting to find out more about my diabetes risk.
18. When it comes to my health, I may lose my temper when I think other people may be trying to take advantage of me.
19. When it comes to my health, I won't let criticism bother me too much.
20. When it comes to my diabetes risk, my responsibilities are too much for me.

Personal control: 3, 5, 7(-), 15, 20 (-)

Shared control: 4 (-), 6, 9 (-), 13 (-), 19

Others in control: 1 (-), 8 (-), 11, 16, 18 (-)

Uncontrollable: 2, 10, 12, 14 (-), 17 (-)

Scoring: Anti-trait items are reversed and the responses are averaged to produce a score between 1 and 5 reflecting a single inventory with no subscales.

Appendix A.5

Modified Personalized Psychological Flexibility Index for Diabetes Prevention (PPFI) Scale Measures Summary and Scoring

For each statement below, select the rating that best describes YOUR thoughts and feelings about your top goal related to diabetes prevention.

1. I avoid the most difficult goal-related tasks.av - R
2. I put off pursuing this goal when I could be doing a more enjoyable task.av - R
3. When I feel stressed pursuing this goal, I give up.av - R

4. I get so caught up in thoughts and feelings that I am unable to pursue this goal.av - R
5. When I feel discouraged, I let my commitment for this goal slide.av - R
6. I accept the setbacks while pursuing this goal.ac
7. While pursuing this goal, I try to accept my negative thoughts and feelings rather than resist them.ac
8. I am willing to experience negative thoughts and emotions related to this goal.ac
9. I accept things I cannot change about this goal.ac
10. While pursuing this goal, I can observe unpleasant feelings without being drawn into them.ac
11. When faced with obstacles related to this goal, my frustration serves to energize me.h
12. I find worrying helpful to solving goal-related problems.h
13. When people distract me from this goal, I use any anger that arises to stay focused.h
14. I get motivated by guilt when I fail to meet my own expectations pursuing this goal.h
15. I find unpleasant emotions useful for reaching this goal.h

Items are measured on a 7 point likert scale of “strongly disagree” to “strongly agree” with the former scored as a 1 and the latter as a 7.

Scoring:

av = from 5-item Avoidance subscale

ac = from 5-item Acceptance subscale

h = from 5-item Harnessing subscale.

R = reverse-coded.

In the Avoidance subscale of the Personalized Psychological Flexibility Scale, items are reverse scored, such that higher scores indicated less avoidance.

Appendix A.6

4-item Patient Activation Measure Summary and Scoring

Below are statements that people sometimes make when they talk about their health. Please indicate how much you agree or disagree with each statement as it applies to you personally by selecting the answer. There are no right or wrong answers, just what is true for you.

Scale: Strongly disagree (1), Disagree (2), Agree (3), and Strongly Agree (4)

When it comes to preventing diabetes, taking an active role in my own health care is the most important thing that affects my health.

I know how to prevent diabetes.

I am confident that I will be able to maintain lifestyle changes to prevent diabetes, like healthy eating or exercising.

I am confident that I can maintain lifestyle changes, like healthy eating and exercising, even during times of stress.

Scoring: Total PAM score = [raw score]/[# items answered] *4; can be transformed to a scale

Appendix A.7

Treatment Expectations and Expectations to Engage Summary and Scoring

The following questions ask about your feelings and intentions specifically after completing the previous activities.

1. After completing the previous activities, how confident are you that a lifestyle change program like this one would benefit you?

Not at all confident (0) to Extremely Confident (4)

2. After completing the previous activities, how motivated are you to attend the full lifestyle change program?

Not at all motivated (0) to Extremely motivated (4)

3. After completing the previous activities, how likely do you think you would be to attend the full lifestyle change program?

Not at all likely (0) to Extremely likely (4)

4. After completing the previous activities, how confident would you be in recommending a lifestyle change program like this one to a friend who is at high risk for developing diabetes?

Not at all confident (0) to Extremely Confident (4)

5. After completing the previous activities, how effective do you think a lifestyle change program like this one would be for preventing Type 2 Diabetes?

Not at all effective (0) to Extremely effective (4)

6. After completing the previous activities, how effective do you think a lifestyle change program like this one would be for preventing distress related to your diabetes risk?

Not at all effective (0) to Extremely effective (4)

7. After completing the previous activities, how effective do you think a lifestyle change program like this one would be for helping you cope with stress related to your diabetes risk?

Not at all effective (0) to Extremely effective (4)

Scoring: Each item will be assessed independently (see below). A composite score of items 2 and 3 will be calculated as a measure of intentions to engage. A composite score of items 4,5,6 will be calculated as a measure of perceived overall program effectiveness. However, post-hoc analysis will also be performed in order to assess internal consistency between the measures and a composite score will be created for scores with high internal consistency.

Confidence in program benefit: 1

Engagement (overall): 2, 3

Credibility: 4

Effectiveness (overall): 5, 6, 7

Figure S.A.1

Correlation heatmap for the items of the modified diabetes-related Controllability Awareness Inventory

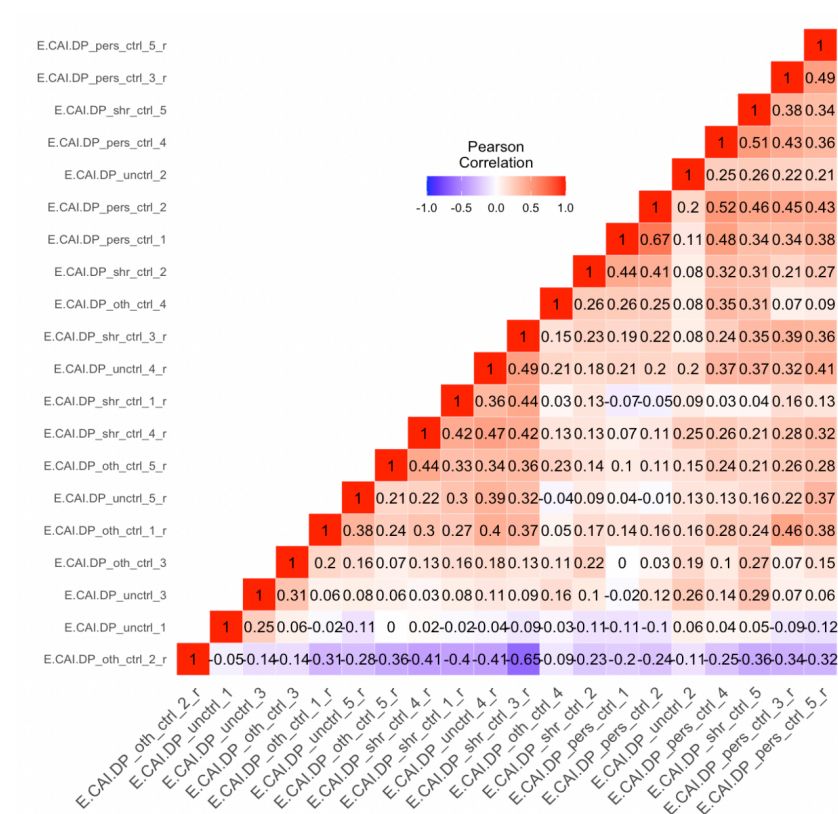


Figure S.A.2

Confidence in Treatment and Self-management (Post-intervention) by Study Group and Gender

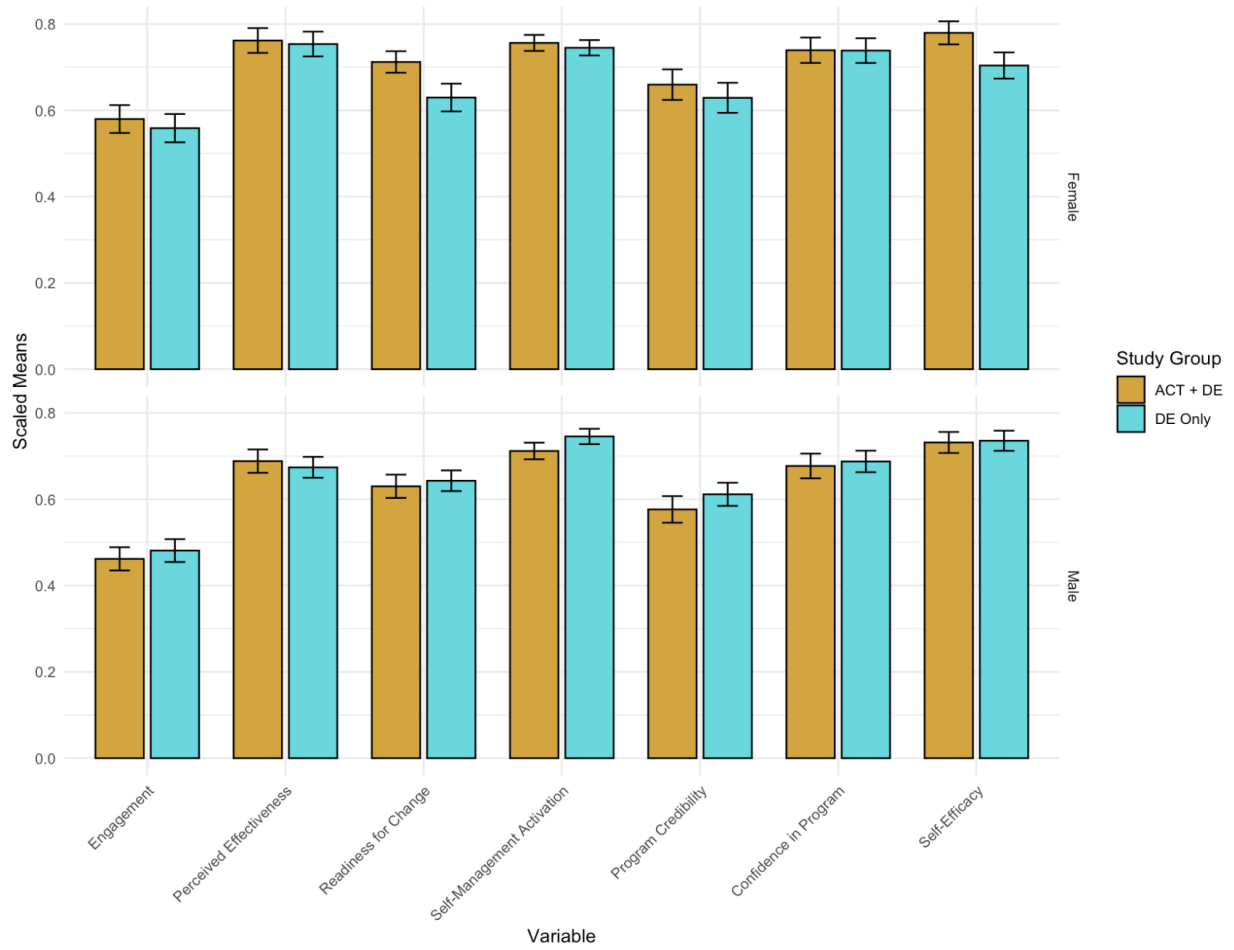
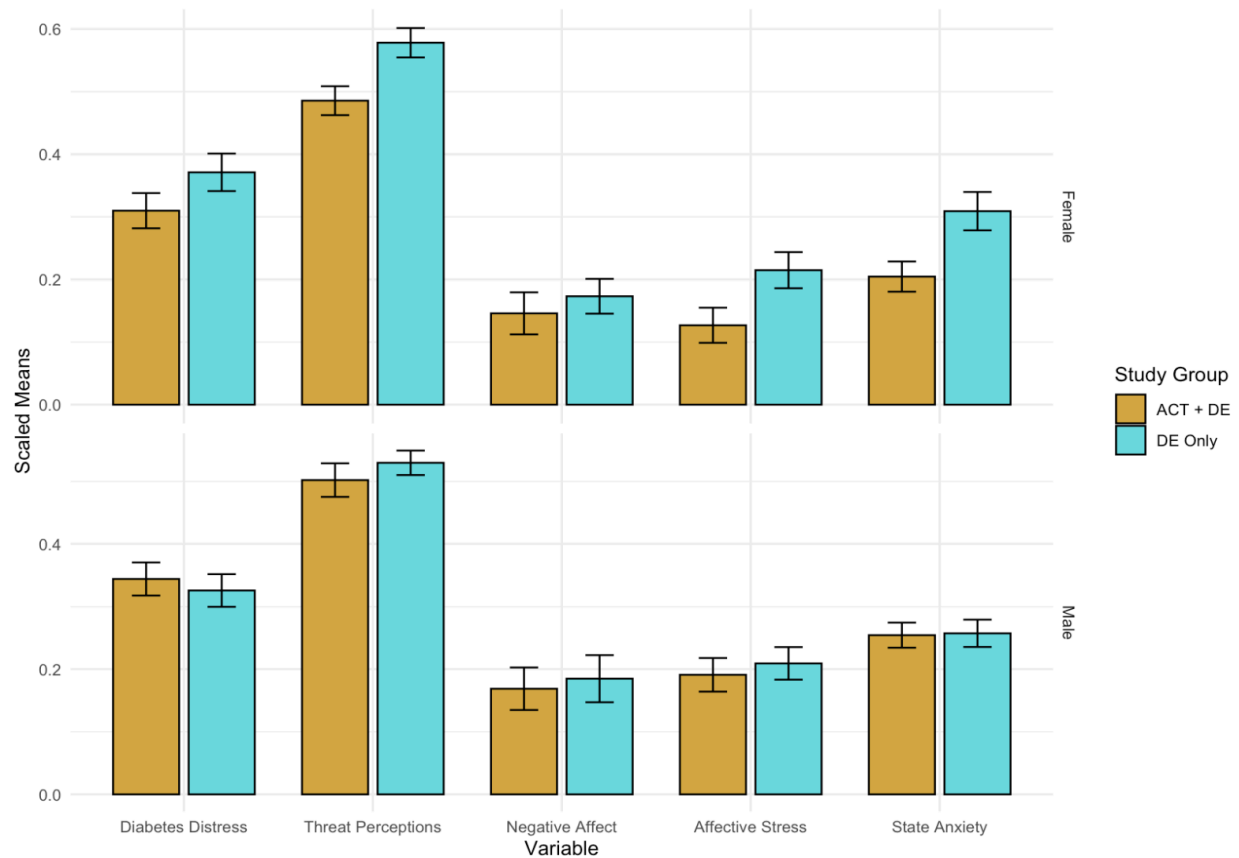


Figure S.A.3.

Psychological and Emotional Distress (Post-intervention) by Study Group and Gender



Appendix A.8

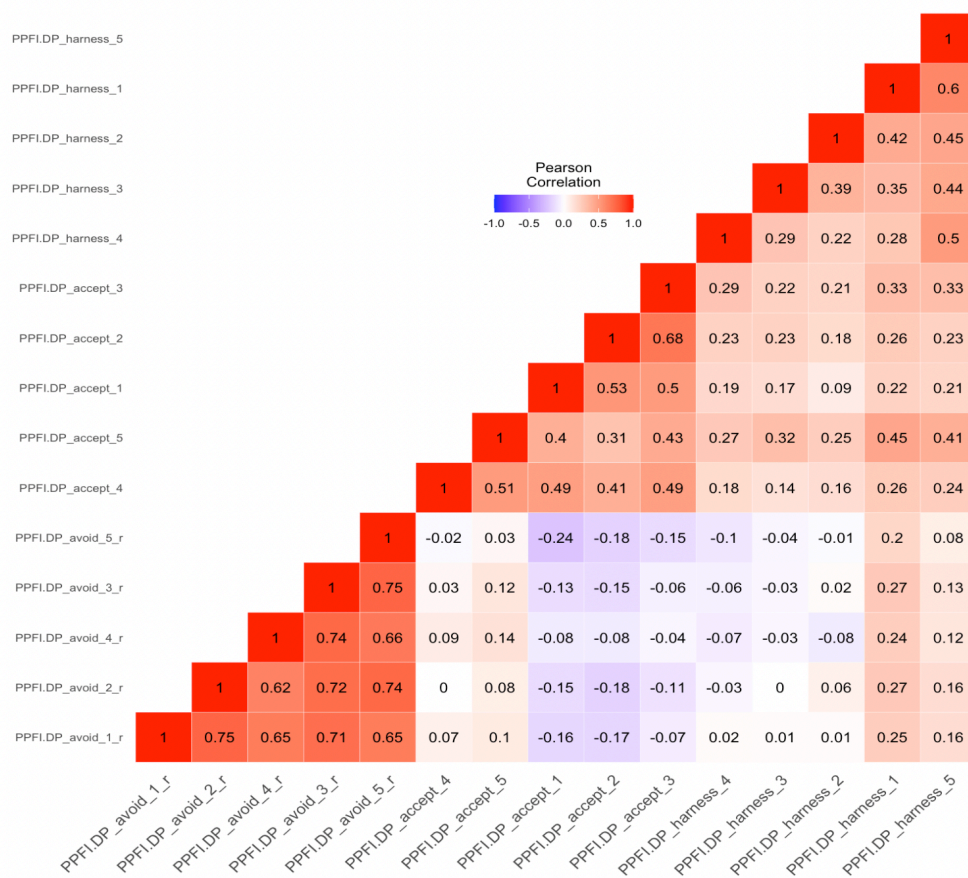
Removal of the Diabetes Risk Self-management Self-efficacy Measure

For the bespoke single-item measure derived from the General Self-Efficacy Scale (GSE-6; Romppel et al., 2013), participants were asked to respond about the degree to which they agree with the statement “When it comes to diabetes prevention, I am confident that I will be able to manage my diabetes risk to prevent Type 2 Diabetes (e.g. choose different foods and stick to a healthy eating pattern, keep my weight under control, get enough exercise, and visit my doctor once a year to monitor my diabetes risk).”, with scores ranging from Not true at all (1) to Exactly true (4). Higher scores reflect higher perceived self-efficacy.

The mean $\pm$ SD of post-intervention self-management self-efficacy scores was 3.17 ± 0.69 for the DE OnlyDPE Only group and 3.26 ± 0.64 for the ACT + DE groupDPE group. Preliminary analyses indicated a potential restriction of range in the self-management self-efficacy scores ($M = 3.214$, $SD = 0.67$, range = 1 to 4). Specifically, the distribution of self-management self-efficacy scores was notably narrow, with most participants reporting high levels of self-management self-efficacy. We performed a post hoc logistic regression to assess group differences in the binarized self-efficacy score (1 to 2: “no or low confidence”; 3 to 4: “moderate or high confidence”). We found that, controlling for significant covariates, participants in the ACT + DE groupDPE group had higher odds of reporting moderate or high self-efficacy levels compared to the DE OnlyDPE Only group ($\beta = 0.932$, $SE = 0.435$, $z = 2.141$, $p = 0.032$).

Figure S.A.4

Correlation Heatmap for the PPFI Items



Appendix A.9

Focus Group Script

[Facilitators introduce themselves]

Thank you for attending this virtual focus group to support the development of a brief diabetes prevention program. This program is designed to support people who have just learned that they are at high risk for diabetes or who have recently been told that they have prediabetes. Each of you has been asked to participate because of your lived experiences with being diagnosed with prediabetes or diabetes. Your personal experience is very valuable, and we are grateful that you are willing to share your insights and feedback today. Your feedback will be used to enhance the diabetes prevention program we are creating and will directly support the people who will go through our program and learn for the first time that they might be at risk for developing diabetes.

None of the responses that you give will be shared with anyone other than our research team, and your names will not be associated with any of your responses - your participation is completely confidential. In any future publications of this work will report your feedback in aggregate. Your participation is also completely voluntary. If there are any questions or tasks that you do not wish to complete, you are welcome to excuse yourself from them - this will have no effect on your participation or payment for your participation. Do you have any questions for us before we begin?

The general structure of our three-hours together will be the following:

[SHOW SLIDE]

1:00-1:15: Introductions and Orientation

1:15-2:00: Complete the diabetes prevention program and discuss

2:00-2:10 BREAK

2:10-2:30 Discussion of Program

2:30-3:00: Review surveys and discuss

3:00-3:10: BREAK

3:05-3:25: Review the consent and discuss

3:25-4:00: General discussion and feedback

Let's start by going around and introducing ourselves to the group. Please share your name, what motivated you to participate in this focus group, and anything you would like to share about your journey with your

health. There will be plenty of time later to talk about some of the specific challenges and insights you have regarding your diabetes status. For now, please just give us a general sense of your journey.

[Individuals share; Facilitator responds with reflective listening, appreciative inquiry, prompts, etc]

Thank you! It can be vulnerable to talk about our health, and we are so grateful for your willingness to do so. Part of the reason that we have asked you here today is to make sure that those who are impacted by diabetes get to inform the design of the study directly. You are the experts! We will be asking you to review the materials we have created so far for our study -- the surveys, the diabetes prevention program, the consent and debrief forms, and the educational information. We want to know your thoughts about how to improve these aspects of the study.

Throughout our time together please keep the following in mind - The most helpful feedback will be feedback that is relevant to the general public. While your unique experience is important, we are asking you to take your individual experience and let that inform your feedback regarding what would be helpful to the majority of people experiencing these health challenges. That may include various identities with which you have direct experience or expertise. For instance, maybe you know what it is like to be made to feel ashamed of your health behaviors, or maybe you know what it is like to feel left out of the conversation, or not to be able to afford the suggestions being made - and the diabetes programs you've seen don't seem to be created with the groups you belong to in mind. Or maybe you just hate math and get overwhelmed by some of the descriptions in the program.

Please speak from your OWN experience, but please keep in mind what others like you may benefit the most from.

For our purposes today, we would like you to imagine that you are one of the participants in the study. We will be taking you through each part of the study in the order that you would as a participant.

1:15-1:25 Review the Consent Form and discuss

During our general discussion and feedback time, we will be asking you to share more details about your opinion regarding how to improve this study, about improving the experience of learning that you are at risk for diabetes or have been told that you have prediabetes, and about encouraging individuals to engage in lifestyle changes to improve health. Our first steps though, are to go through some of the study materials that are a little less exciting, but very important.

The first thing we are going to review together is a document we call a “consent form”. A consent form is a document that is written by the researchers to tell the study participants what the study is all about, what risks they have in participating, what benefits they may receive, what they will experience, and what happens if they decide not to participate. We will read the consent form to the group out loud. While you are listening to this, please write down anything that comes up for you - specifically highlighting any notes you have about the following in the chat:

Were any parts of this difficult to understand?

Did any parts of this make you feel uncomfortable, left out, or bad about yourself?

Is there additional information that you would like to see included here?

Do you have any other feedback about this form?

[Individuals share in “notebook” and verbally in the group; Facilitator responds with reflective listening, appreciative inquiry, prompts, etc]

[Facilitator Assistant will write a note in the chat box to signal the beginning of our notes on the consent form and copy / paste the questions above for reference]

Now we will spend the remaining X minutes discussing the thoughts that came up for us. Who would like to share first?

Thank you! This information is very helpful and we will be sure to tailor the documents with your insights in mind!

1:25-1:45 Review the baseline surveys and discuss

The next thing we will be doing is reading through the surveys that participants will complete prior to seeing the diabetes prevention program. These surveys will help us understand what kinds of thoughts, emotions, and beliefs impact (and are impacted by) this diabetes prevention program. They will also help us understand if differences between our participants in how they respond have to do with things that are different about people - like their cultural background. As we read these to you, we would really like for you to put yourself in the shoes of someone who just found out that they are at risk for diabetes. Imagine how you might feel reading these as if you are a participant. But, as a reminder, your responses will not be used in our data analysis or for publications. Rather, this is for you to see through the eyes of a participant. As you are going through these questions, please write down any question or notes that you have through the chat box again,

keeping in mind that we want to make sure that people understand these questions, relate to the examples given, and do not feel excluded or bad about themselves in any way.

[Here the Facilitator Assistant will write in the chatbox: Begin survey block, followed by the title of each measure as we come to them (so that notes are associated with the correct measure.)]

[Facilitator walks the group through the powerpoint of our survey questions - members will write notes in the chat as the questions and prompts are being read. The group will spend a few minutes collectively discussing each measure after they are read.]

Let's start by going through the surveys together. When we get to a set of questions you have feedback about, put your notes in the chat box, and then we will discuss them as a group.

[Review; Individuals share in "notebook"]

Great, now let's talk about the surveys generally: Do you have feedback about improving the surveys generally?

[Individuals share in "notebook" and verbally in the group; Facilitator responds with reflective listening, appreciative inquiry, prompts, etc]

Thanks! Now, we would like to ask about the wording that is used to let people know that their responses indicate that they may be at high risk of diabetes.

Imagine you are being told for the first time that you may be at high risk for diabetes. How would you like to be told this information?

[Review wording within our program]

What improvements could be made about how we've worded this to reduce suffering and overwhelming feelings while also being straightforward and encouraging people to see this as an important opportunity for change?

[Individuals share in “notebook” and verbally in the group; Facilitator responds with reflective listening, appreciative inquiry, prompts, etc]

1:45-1:55 BREAK

1:55-2:55 Go through the diabetes prevention program and discuss

Great! Now it is time to go through the diabetes prevention program. As a reminder, this is designed to be delivered right after someone learns that they may be at high risk of diabetes or that they meet the criteria for prediabetes. Please imagine that this is the case for you. As you are viewing and engaging in the program please write down your notes in the chatbox all along the way. Please respond to the question prompts authentically, as if you were a participant. When everyone is done, we will review the components of the program together and discuss them. Facilitator Assistant will let us all know when we are halfway through our time to spend reviewing the intervention, as well as give us a 5 and 1 minute warning. At the very top of the screen, you will see a progress bar that will be a good way to gauge whether you might need to speed up or slow down your progress through the intervention. If you have any questions or technical difficulties, please send a direct message to Facilitator Assistant in the chat box, and she can direct you to a private Zoom room to address your concerns

[Facilitator Assistant will write in the chat box that we are moving to the intervention part of our focus group and provide the link - please contact researcher for link]

[Group views the program content]

Okay, let's go around and give our general impressions of the program. Your honesty about the program is very valuable. If you think certain aspects need improvement, need to be removed, or redesigned, we want to hear from you! Please also speak from your own experience (and your ideas about what others like you may experience). It is okay if people in this group have very different opinions - we want to hear them all. What are your overall impressions of the program? What stood out to you? What was helpful? What was not?

[Individuals share in “notebook” and verbally in the group; Facilitator responds with reflective listening, appreciative inquiry, prompts, etc]

Now I would like for us to discuss some specific elements of the program:

How did the program make you feel, did it bring up specific emotions?

What are the most important parts of the program?

Would most people relate to the examples given?

Would most people be able to understand the information given?

Would any elements of the program cause individuals to feel bad about themselves, or feel left out, or feel judged in any way?

What parts of the program will motivate people to engage in a full lifestyle change program the most?

[Individuals share in “notebook” and verbally in the group; Facilitator responds with reflective listening, appreciative inquiry, prompts, etc]

Great, now I would like to talk about some improvements to the program in general:

What improvements could be made that would most motivate people to take action to make lifestyle changes, seek professional support, or engage in a full diabetes prevention program?

What improvements would help people understand what diabetes is?

What improvements would help people to deal with their difficult thoughts or emotions (like overwhelm?)

What improvements would have the most lasting benefit for people working to prevent diabetes?

[Individuals share in “notebook” and verbally in the group; Facilitator responds with reflective listening, appreciative inquiry, prompts, etc]

2:55-3:05 BREAK

3:05-3:20 Review the follow-up surveys

The next thing we will be doing is reading through the surveys that participants will complete after seeing the diabetes prevention program. Again, it would be helpful if you go through the surveys and respond as if you are a participant. But, as a reminder, your responses will not be used in our data analysis or for publications. Rather, this is for you to see through the eyes of a participant. As you are going through these questions, please write down any question or notes that you have again in the chat, keeping in mind that we want to make sure that people understand these questions, relate to the examples given, and do not feel excluded or shamed in any way.

[Facilitator will read through the post measures with the group, pausing after each one to discuss]

[Facilitator Assistant will write in the chatbox: Begin survey block, followed by the title of each measure as we come to them (so that notes are associated with the correct measure.)]

Let's start by going through the surveys together. When we get to a survey you have feedback about, write down any notes in the chat box and then we will discuss them as a group after.

[Review; Individuals share in "notebook"]

Great, now let's talk about the surveys generally: Do you have feedback about improving the surveys generally?

[Individuals share in "notebook" and verbally in the group; Facilitator responds with reflective listening, appreciative inquiry, prompts, etc]

3:20-3:25 Debrief and discuss

3:25-4:00 General discussion and feedback

We are now going to have an open discussion about the process of learning that you may be at high-risk of diabetes or meet the criteria for prediabetes.

Let's start by sharing any memories of that experience that stand out for each of us. We would like to ask you to think about the time that you learned that you had insulin resistance.

How did you learn that you had prediabetes / diabetes? Or, if you learned that you were high risk, how did you learn that?

How would you like to have been told?

What emotions did you feel?

What do you wish you had been told at that time?

What resources do you wish you had been given?

Was there anything about that experience that was unhelpful, or even harmful?

What could have been done in the moment to help you manage the stress of learning this information?

What have been the most helpful aspects in motivating you to make lifestyle changes to improve your health?

[Individuals share in "notebook" and verbally in the group; Facilitator responds with reflective listening, appreciative inquiry, prompts, etc]

We have about X minutes left. We would like to invite you to have an open discussion about how to improve this study, about improving the experience of learning that you are at risk for diabetes or have been told that you have prediabetes, or about encouraging individuals to engage in lifestyle changes to improve health.

[Individuals share in “notebook” and verbally in the group; Facilitator responds with reflective listening, appreciative inquiry, prompts, etc]

Thank you so much for your participation in this focus group. We hope to develop a program that will benefit individuals like you and we are so grateful for your feedback!

Table S.A.1

Sample of Questions Posed to Focus Group and Participant Responses

Question posed to focus group	Participant responses
General feedback about the program	<i>“All the intros resonated with me of what I have gone through.”</i> <i>“Are you aware of the new patch that monitors your blood sugar? It was approved in England. This patch is part of a program on your phone that coaches the patient. I thought you might want to look at their program.”</i>
How did the program make you feel, did it bring up specific emotions?	<i>“It made me feel motivated to get healthier. But at the same time, I felt a bit overwhelmed to get started.”</i> <i>“I felt like the program was too touchy feely for me. I am a retired military officer and am pretty direct. Get an order, understand it , and then move out to accomplish it. SO I had many of the feelings talked about.”</i>
What are the most important parts of the program?	<i>“It's a very good refresher class on things I already know but some I've dismissed or forgot about.”</i> <i>“I am a little disappointed in my consistency and perseverance. SO the acknowledgment that it is a long game made me feel like I wasn't doing as bad as I felt sometimes.”</i>

Would most people relate to the examples given?	<i>"We more mature ones know the value of this information. Young people would relate and be interested in this information."</i> <i>"I believe all the information received so far is relevant and can help anyone to follow doctor's advice to lose weight, to eat less and exercise more."</i>
Would most people be able to understand the information given?	<i>"I think most would understand."</i> <i>"I really liked listening to the medical aspect of this disease. It's where I am in my better understanding of the disease. Especially how certain medication affects my other organs."</i> <i>"Yes, but some of the why's of things were left open for me. For example why does your body get insulin resistance?"</i>
Would any elements of the program cause individuals to feel bad about themselves, or feel left out, or feel judged in any way?	<i>"No, I felt that if anything it made me feel better that others were struggling as I have from time to time."</i> <i>"Maybe those who are physically handicapped would feel left out with the physical necessity of exercising."</i> <i>"No, nothing. On the contrary normally other information tends to specify races that are more prone to diabetes and your program does not do that."</i> <i>"I think that the goal of 150 minutes of movement may cause some to feel bad about themselves. Maybe just starting 30 minutes 5 days a week, like was said later."</i>
What parts of the program will motivate people to engage in a full lifestyle change program the most?	<i>"I think that all the self-reflection is motivating. And the questions about if you think about where you are in the future and looking back at today."</i> <i>"Misery loves company. I think I would need to surround myself with those who are positive and have the same health problem as I do. To encourage, not judge each other."</i>
Elements that were confusing	<i>"Will I be able to [participate in the group that I wasn't selected for] later?"</i>

	<i>“All information was very well presented.”</i>
	<i>“I believe the [consent] form could be reduced to a couple of pages.”</i>

Figure S.A.5
Thematic map of focus group feedback

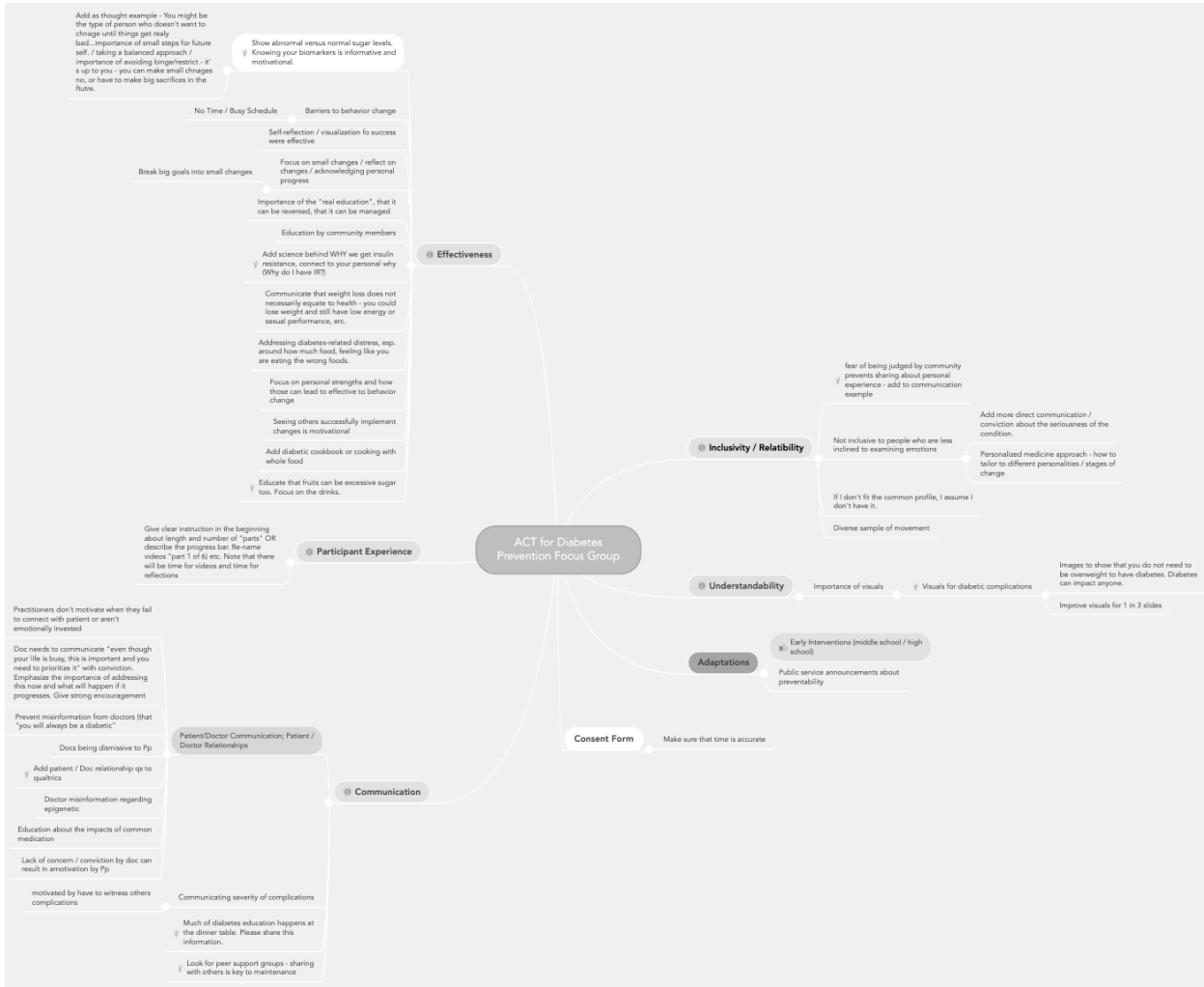


Table S.A.2

Regression model results for group predicting controllability awareness

Dependent Variable	Covariates not included							Covariates included							Significant covariates included						
	B	SE	t-value	p-value	95% CI	R2	F-stat	B	SE	t-value	p-value	95% CI	R2	F-stat	B	SE	t-value	p-value	95% CI	R2	F-stat
(Intercept)	-0.08	0.08	-1.01	0.311	[-0.2 , 0.08]	0.01	2.225	-0.261	0.078	0.938	[-0.534 , 0.494]	0.19	3.557	-0.348	0.123	-2.82	0.005	[-0.6 , -0.1]	0.16	6.103	
ACT + DPE	0.175	0.117	1.492	0.137	[-0.1 , 0.41]	0.01	2.225	0.22	0.117	1.893	0.06	[-0.009 , 0.451]			0.256	0.114	2.242	0.026	[0.03 , 0.48]		
Age: 40-49 years								0.08	0.155	0.523	0.601	[-0.224 , 0.387]			0.126	0.15	0.838	0.403	[-0.2 , 0.42]		
Age: 50-59 years								0.6	0.179	3.374	0.001	[0.251 , 0.957]			0.683	0.171	4	0	[0.35 , 1.02]		
Age: 60+ years								0.66	0.189	3.481	0.001	[0.285 , 1.028]			0.707	0.173	4.092	0	[0.37 , 1.05]		
Ethnicity: Asian								-0.5	0.199	-2.624	0.009	[-0.914 , -0.13]			-0.469	0.191	-2.46	0.015	[-0.8 , -0.1]		
Ethnicity: Hispanic and/or Latinx								0.22	0.247	0.906	0.366	[-0.263 , 0.712]			0.255	0.243	1.05	0.295	[-0.2 , 0.73]		
Ethnicity: Native America / Indigenous or								1.06	0.684	1.543	0.124	[-0.292 , 2.403]			1.01	0.667	1.514	0.131	[-0.3 , 2.32]		
Ethnicity: Black or African American								-0	0.198	-0.204	0.839	[-0.43 , 0.349]			-0.061	0.194	-0.32	0.753	[-0.4 , 0.32]		
BMI: 18.5-24.9								-0.4	0.195	-1.843	0.067	[-0.744 , 0.025]									
BMI: 25.0-29.9								-0.4	0.194	-2.235	0.026	[-0.817 , -0.052]									
BMI: 30-39.9								-0.4	0.233	-1.587	0.114	[-0.828 , 0.089]									
BMI: 40 or over								-0.5	0.351	-1.366	0.173	[-1.171 , 0.212]									
Risk status: pre diabetic								-0.2	0.125	-1.773	0.077	[-0.47 , 0.025]									
Gender: Male								0.13	0.121	1.03	0.304	[-0.114 , 0.364]									
Household income								0	0	-0.261	0.794	[0 , 0]									
Subjective Social Standing								0.04	0.034	1.176	0.241	[-0.027 , 0.108]									

Table S.A.3

Regression model results for group predicting emotional non-avoidance.

Dependent Variable	Covariates not included							Covariates included							Significant covariates included						
	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat
(Intercept)	-0.020	0.080	-0.251	0.802	[-0.179 , 0.138]	0.000	0.137	0.351	0.379	0.925	0.357	[-0.399 , 1.101]	0.126	1.066	-0.044	0.172	-0.255	0.799	[-0.383 , 0.296]	0.052	0.857
ACT + DPE	0.044	0.118	0.370	0.712	[-0.189 , 0.277]			-0.018	0.172	-0.104	0.917	[-0.359 , 0.323]			-0.029	0.166	-0.174	0.862	[-0.358 , 0.300]		
Age: 40-49 years								0.011	0.239	0.048	0.962	[-0.461 , 0.484]			0.009	0.228	0.041	0.967	[-0.441 , 0.460]		
Age: 50-59 years								0.734	0.29	2.534	0.013	[0.161 , 1.307]			0.570	0.272	2.096	0.038	[0.032 , 1.107]		
Age: 60+ years								0.15	0.254	0.588	0.558	[-0.354 , 0.653]			0.213	0.230	0.925	0.357	[-0.242 , 0.667]		
Ethnicity: Asian								0.031	0.442	0.07	0.944	[-0.844 , 0.906]			0.192	0.428	0.448	0.655	[-0.655 , 1.039]		
Ethnicity: Black or African American								-0.002	0.301	-0.005	0.996	[-0.596 , 0.593]			-0.041	0.277	-0.149	0.881	[-0.589 , 0.506]		
Ethnicity: Hispanic and/or Latinx								0.192	0.35	0.549	0.584	[-0.501 , 0.885]			0.087	0.341	0.255	0.799	[-0.588 , 0.762]		
Ethnicity: Native America / Indigenous or Alaskan Native								1.959	1.034	1.894	0.06	[-0.087 , 4.006]			1.568	1.008	1.557	0.122	[-0.424 , 3.560]		
Ethnicity: Multi-racial								-0.441	1.045	-0.421	0.674	[-2.51 , 1.628]			-0.261	1.023	-0.255	0.799	[-2.283 , 1.760]		
BMI: 18.5-24.9								-0.411	0.298	-1.378	0.171	[-1 , 0.179]									
BMI: 25.0-29.9								-0.019	0.287	-0.068	0.946	[-0.587 , 0.548]									
BMI: 30-39.9								-0.463	0.339	-1.366	0.174	[-1.133 , 0.208]									
BMI: 40 or over								0.085	0.474	0.18	0.857	[-0.852 , 1.023]									
Risk status: pre diabetic								-0.282	0.182	-1.546	0.125	[-0.642 , 0.079]									
Gender: Male								0.034	0.182	0.189	0.85	[-0.326 , 0.394]									
Household income								0	0	-0.374	0.709	[0 , 0]									
Subjective social standing								-0.007	0.052	-0.132	0.895	[-0.109 , 0.095]									

Table S.A.4

Regression model results for group predicting emotional acceptance.

Dependent Variable	Covariates not included							Covariates included							Significant covariates included						
	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat
(Intercept)	-0.099	0.081	-1.222	0.223	[-0.258 , 0.06]	0.011	3.198	-0.549	0.346	-1.588	0.115	[-1.234 , 0.135]	0.213	2.004	-0.268	0.16	-1.675	0.096	[-0.584 , 0.048]	0.147	2.681
ACT + DPE	0.212	0.118	1.788	0.075	[-0.021 , 0.444]			0.298	0.16	1.86	0.065	[-0.019 , 0.615]			0.307	0.155	1.981	0.049	[-0.001 , 0.612]		
Age: 40-49 years								-0.012	0.219	-0.055	0.956	[-0.446 , 0.422]			-0.063	0.212	-0.297	0.767	[-0.481 , 0.355]		
Age: 50-59 years								0.662	0.264	2.509	0.013	[-0.14 , 1.184]			0.752	0.249	3.019	0.003	[-0.26 , 1.244]		
Age: 60+ years								0.269	0.237	1.137	0.258	[-0.199 , 0.737]			0.205	0.214	0.959	0.339	[-0.218 , 0.628]		
Ethnicity: Asian								0.41	0.412	0.993	0.323	[-0.407 , 1.226]			0.347	0.398	0.871	0.385	[-0.441 , 1.134]		
Ethnicity: Black or African American								0.728	0.288	2.527	0.013	[-0.158 , 1.299]			0.552	0.263	2.101	0.037	[-0.033 , 1.072]		
Ethnicity: Hispanic and/or Latinx								0.246	0.34	0.724	0.471	[-0.427 , 0.92]			0.131	0.331	0.395	0.694	[-0.525 , 0.786]		
Ethnicity: Native America / Indigenous or Alaskan Native								-1.784	0.964	-1.851	0.067	[-3.691 , 0.123]			-1.832	0.937	-1.955	0.053	[-3.684 , 0.021]		
Ethnicity: Multi-racial								-0.78	0.972	-0.803	0.424	[-2.703 , 1.143]			-0.651	0.949	-0.686	0.494	[-2.528 , 1.226]		
BMI: 18.5-24.9								-0.128	0.273	-0.468	0.641	[-0.668 , 0.413]									
BMI: 25.0-29.9								-0.1	0.261	-0.383	0.702	[-0.616 , 0.416]									
BMI: 30-39.9								-0.23	0.315	-0.73	0.467	[-0.853 , 0.393]									
BMI: 40 or over								0.404	0.437	0.924	0.357	[-0.462 , 1.269]									
Risk status: pre diabetic								0.38	0.169	2.244	0.027	[-0.045 , 0.714]									
Gender: Male								-0.125	0.171	-0.731	0.466	[-0.464 , 0.214]									
Household income								0	0	1.384	0.169	[-0 , 0]									
Subjective social								0.01	0.048	0.215	0.83	[-0.084 , 0.105]									

Table S.A.5

Regression model results for group predicting emotional harnessing.

Dependent Variable	Covariates not included							Covariates included							Significant covariates included						
	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat
(Intercept)	-0.072	0.08	-0.903	0.368	[-0.229 , 0.085]	0.006	1.769	0.085	0.379	0.225	0.822	[-0.665 , 0.836]	0.131	1.137	0.134	0.176	0.761	0.448	[-0.214 , 0.483]	0.045	0.749
ACT + DPE	0.156	0.117	1.33	0.185	[-0.075 , 0.387]			-0.032	0.175	-0.184	0.854	[-0.378 , 0.314]			-0.001	0.17	-0.006	0.995	[-0.336 , 0.334]		
Age: 40-49 years								-0.014	0.241	-0.059	0.953	[-0.491 , 0.462]			-0.098	0.232	-0.422	0.673	[-0.557 , 0.361]		
Age: 50-59 years								0.525	0.29	1.814	0.072	[-0.048 , 1.099]			0.417	0.275	1.514	0.132	[-0.127 , 0.96]		
Age: 60+ years								0.039	0.26	0.15	0.881	[-0.475 , 0.553]			-0.263	0.236	-1.115	0.267	[-0.73 , 0.203]		
Ethnicity: Asian								0.057	0.452	0.127	0.899	[-0.837 , 0.951]			-0.059	0.44	-0.135	0.893	[-0.93 , 0.811]		
Ethnicity: Black or African American								0.336	0.307	1.094	0.276	[-0.272 , 0.944]			0.174	0.285	0.611	0.542	[-0.389 , 0.737]		
Ethnicity: Hispanic and/or Latinx								-0.108	0.358	-0.303	0.762	[-0.816 , 0.599]			-0.138	0.351	-0.394	0.694	[-0.832 , 0.555]		
Ethnicity: Native America / Indigenous or Alaskan Native								-0.235	1.057	-0.223	0.824	[-2.327 , 1.856]			-0.106	1.036	-0.102	0.919	[-2.153 , 1.942]		
Ethnicity: Multi-racial								-0.691	1.067	-0.648	0.518	[-2.803 , 1.42]			-0.699	1.05	-0.666	0.507	[-2.773 , 1.376]		
BMI: 18.5-24.9								-0.178	0.3	-0.592	0.555	[-0.771 , 0.416]									
BMI: 25.0-29.9								0.145	0.286	0.506	0.613	[-0.421 , 0.711]									
BMI: 30-39.9								0.027	0.341	0.08	0.936	[-0.646 , 0.701]									
BMI: 40 or over								0.271	0.48	0.565	0.573	[-0.679 , 1.222]									
Risk status: pre diabetic								0.406	0.185	2.197	0.03	[-0.04 , 0.772]									
Gender: Male								0.191	0.184	1.035	0.303	[-0.174 , 0.556]									
Household income								0	0	-1.235	0.219	[-0 , 0]									
Subjective social standing								-0.071	0.052	-1.358	0.177	[-0.174 , 0.032]									

Table S.A.6

Regression model results for group predicting Diabetes-risk Distress.

Dependent Variable	Covariates not included							Covariates included							Significant covariates included						
	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat
(Intercept)	0.039	0.08	0.492	0.623	[-0.118 , 0.197]	0.002	0.528	-0.107	0.264	-0.404	0.687	[-0.623 , 0.356]	0.12	2.454	0.278	0.127	2.193	0.029	[0.028 , 0.529]	0.092	3.268
ACT + DPE	-0.086	0.118	-0.727	0.468	[-0.318 , 0.146]			-0.012	0.119	-0.103	0.918	[-0.257 , 0.214]			-0.056	0.118	-0.478	0.633	[-0.288 , 0.176]		
Age: 40-49								-0.291	0.158	-1.845	0.066	[-0.613 , 0.011]			-0.364	0.155	-2.357	0.019	[-0.669 , -0.06]		
Age: 50-59								-0.347	0.182	-1.911	0.057	[-0.741 , -0.03]			-0.476	0.176	-2.707	0.007	[-0.822 , -0.13]		
Age: 60+ years								-0.519	0.192	-2.709	0.007	[-0.871 , -0.12]			-0.639	0.178	-3.592	0	[-0.989 , -0.289]		
Ethnicity: Asian								0.131	0.201	0.651	0.515	[-0.206 , 0.58]			0.091	0.196	0.466	0.642	[-0.295 , 0.477]		
Ethnicity: Black or African American								0.466	0.256	1.822	0.07	[-0.015 , 1.003]			0.445	0.256	1.742	0.083	[-0.058 , 0.949]		
Ethnicity: Hispanic and/or Latinx								0.447	0.691	0.646	0.519	[-1.015 , 1.733]			0.509	0.684	0.744	0.458	[-0.839 , 1.856]		
Ethnicity: Native America / Indigenous or Alaskan Native								-0.103	0.2	-0.516	0.607	[-0.523 , 0.27]			-0.15	0.199	-0.756	0.45	[-0.542 , 0.241]		
BMI: 18.5-24.9								0.096	0.197	0.487	0.627	[-0.326 , 0.456]									
BMI: 25.0-29.9								0.323	0.197	1.643	0.102	[-0.065 , 0.72]									
BMI: 30-39.9								0.234	0.236	0.993	0.322	[-0.184 , 0.747]									
BMI: 40 or over								0.225	0.355	0.634	0.527	[-0.522 , 0.886]									
Risk status: pre diabetic								0.304	0.127	2.386	0.018	[0.018 , 0.518]									
Gender: Male								0.079	0.123	0.643	0.521	[-0.218 , 0.269]									
Household income								0	0	0.951	0.343	[0 , 0]									
Subjective Social Standing								-0.05	0.035	-1.437	0.152	[-0.118 , 0.019]									

Table S.A.7

Regression model results for group predicting perceptions of threat.

Dependent Variable	Covariates not included							Covariates included							Significant covariates included						
	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat
(Intercept)	0.13	0.08	1.651	0.1	[-0 , 0.29]	0.02	5.742	-0.182	0.285	-0.637	0.525	[-0.743 , 0.38]	0.15	2.552	1.054	0.193	5.47	0	[0.675 , 1.433]	0.114	7.435
ACT + DPE	-0.3	0.12	-2.4	0.017	[-0.5 , -0.1]			-0.196	0.124	-1.59	0.113	[-0.44 , 0.047]			-0.278	0.111	-2.509	0.013	[-0.497 , -0.06]		
Age: 40-49 years								-0.223	0.163	-1.369	0.172	[-0.544 , 0.098]			-0.17	0.144	-1.182	0.238	[-0.454 , 0.113]		
Age: 50-59 years								-0.097	0.187	-0.517	0.606	[-0.465 , 0.272]			-0.222	0.161	-1.38	0.169	[-0.538 , 0.094]		
Age: 60+ years								-0.252	0.2	-1.264	0.208	[-0.645 , 0.141]			-0.358	0.161	-2.22	0.027	[-0.676 , -0.04]		
Ethnicity: Asian								0.371	0.2	1.856	0.065	[-0.023 , 0.764]									
Ethnicity: Hispanic and/or Latinx								-0.081	0.257	-0.314	0.754	[-0.587 , 0.426]									
Ethnicity: Native America / Indigenous or Ethnicity: Black or African American								0.124	0.694	0.178	0.859	[-1.244 , 1.491]									
BMI: 18.5-24.9								0.111	0.208	0.533	0.594	[-0.299 , 0.521]									
BMI: 25.0-29.9								0.434	0.205	2.121	0.035	[0.031 , 0.838]									
BMI: 30-39.9								0.379	0.244	1.549	0.123	[-0.103 , 0.86]									
BMI: 40 or over								0.232	0.377	0.614	0.54	[-0.511 , 0.975]									
Risk status: pre diabetic								0.516	0.133	3.883	0	[0.254 , 0.778]			-0.248	0.058	-4.263	0	[-0.362 , -0.13]		
Gender: Male								-0.005	0.127	-0.041	0.968	[-0.256 , 0.245]									
Household Income								0	0	-0.546	0.585	[0 , 0]									
Subjective social standing								-0.01	0.036	-0.266	0.791	[-0.08 , 0.061]									

Table S.A.8

Regression model results for group predicting affective stress.

Dependent Variable	Covariates not included							Covariates included							Significant covariates included						
	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat
(Intercept)	0.121	0.08	1.525	0.128	[-0.035 , 0.278]	0.016	4.897	-0.117	0.288	-0.407	0.684	[-0.684 , 0.45]	0.118	1.978	0.222	0.107	2.079	0.038	[0.012 , 0.431]	0.049	3.755
ACT + DPE	-0.255	0.115	-2.21	0.028	[-0.483 , -0.028]			-0.151	0.124	-1.215	0.226	[-0.395 , 0.094]			-0.264	0.114	-2.305	0.022	[-0.489 , -0.04]		
Age: 40-49 years								-0.032	0.164	-0.197	0.844	[-0.355 , 0.29]			-0.052	0.146	-0.353	0.724	[-0.339 , 0.236]		
Age: 50-59 years								0.005	0.188	0.025	0.98	[-0.366 , 0.376]			0.027	0.163	0.163	0.871	[-0.295 , 0.348]		
Age: 60+ years								-0.498	0.201	-2.479	0.014	[-0.894 , -0.102]			-0.466	0.161	-2.892	0.004	[-0.783 , -0.15]		
Ethnicity: Asian								0.114	0.202	0.565	0.573	[-0.284 , 0.512]									
Ethnicity: Hispanic and/or Latinx								-0.548	0.26	-2.108	0.036	[-1.061 , -0.036]									
Ethnicity: Native America / Indigenous or Ethnicity: Black or African American								0.428	0.703	0.609	0.543	[-0.957 , 1.813]									
BMI: 18.5-24.9								-0.038	0.207	-0.185	0.853	[-0.445 , 0.369]									
BMI: 25.0-29.9								-0.001	0.21	-0.004	0.997	[-0.415 , 0.413]									
BMI: 30-39.9								0.35	0.207	1.688	0.093	[-0.059 , 0.758]									
BMI: 40 or over								-0.003	0.247	-0.014	0.989	[-0.491 , 0.484]									
Risk status: pre diabetic								-0.005	0.382	-0.014	0.989	[-0.758 , 0.747]									
Gender: Male								0.096	0.134	0.716	0.475	[-0.168 , 0.36]									
Household income								0.146	0.128	1.14	0.256	[-0.107 , 0.399]									
Subjective Social Status								0	0	-1.635	0.103	[0 , 0]									
								0.052	0.036	1.428	0.154	[-0.02 , 0.123]									

Table S.A.9

Regression model results for group predicting State Anxiety.

Dependent Variable	Covariates not included							Covariates included							Significant covariates included						
	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat	B	SE	t-value	p-value	95% CI	R ²	F-stat
(Intercept)	0.11	0.08	1.387	0.166	[-0.046 , 0.267]	0.014	4.068	-0.23	0.298	-0.773	0.44	[-0.817 , 0.356]	0.093	1.503	0.329	0.106	3.097	0.002	[0.12 , 0.539]	0.054	4.148
ACT + DPE	-0.234	0.116	-2.02	0.045	[-0.462 , -0.006]			-0.075	0.128	-0.584	0.56	[-0.328 , 0.178]			-0.227	0.114	-1.989	0.048	[-0.452 , -0]		
Age: 40-49 years								-0.257	0.169	-1.523	0.129	[-0.589 , 0.075]			-0.301	0.146	-2.068	0.04	[-0.588 , -0.02]		
Age: 50-59 years								-0.155	0.196	-0.791	0.43	[-0.54 , 0.231]			-0.221	0.164	-1.351	0.178	[-0.544 , 0.101]		
Age: 60+ years								-0.523	0.207	-2.526	0.012	[-0.93 , -0.115]			-0.549	0.161	-3.414	0.001	[-0.865 , -0.23]		
Ethnicity: Asian								0.193	0.208	0.926	0.355	[-0.217 , 0.602]									
Ethnicity: Hispanic and/or Latinx								-0.268	0.268	-1.002	0.318	[-0.796 , 0.26]									
Ethnicity: Native America / Indigenous or Ethnicity: Black or African American								0.05	0.724	0.069	0.945	[-1.377 , 1.477]									
BMI: 18.5-24.9								0.039	0.213	0.183	0.855	[-0.381 , 0.459]									
BMI: 25.0-29.9								0.265	0.217	1.224	0.222	[-0.162 , 0.692]									
BMI: 30-39.9								0.553	0.214	2.583	0.01	[0.131 , 0.975]									
BMI: 40 or over								0.354	0.255	1.389	0.166	[-0.148 , 0.856]									
Risk status: pre diabetic								-0.12	0.394	-0.304	0.761	[-0.895 , 0.656]									
Gender: Male								0.127	0.139	0.913	0.362	[-0.146 , 0.4]									
Household income								-0.065	0.133	-0.487	0.627	[-0.326 , 0.197]									
Subjective social standing								0	0	-0.308	0.758	[0 , 0]									
								0.031	0.037	0.827	0.409	[-0.043 , 0.104]									

APPENDIX B

STUDY 2 SUPPLEMENTARY MATERIAL

Appendix B.1.

Script for Reflection Tasks in the Neuroimaging Machine.

Adapted from Kross et al. (2012)

Participants heard the following instructions during the *self-immersed* reflection task condition:

“You may now choose to close your eyes as we ask you to reflect on this memory in a particular way. Go back to the time and place of the experience and try to see the situation as if it were happening to you all over again in your mind’s eye. Try to see the experience unfold through your own eyes as if it were occurring again. Replay the event as it unfolds in your imagination through your own eyes. Think about what occurred step-by-step. Try to re-experience the interaction as it progresses in your mind’s eye. Take some time to do this now.

As you continue to see the situation unfold through your own eyes, try to recall the sights, sounds, smells, thoughts, and feelings you had during that time. What thoughts went through your mind? You might think about the specific feelings and sensations related to the difficult emotions related to this experience. What did they feel like? Where did you experience them in your body? Take the next 60 seconds to see the details of the memory.”

Participants heard the following instructions in the *self-distanced* reflection task condition:

“You may now choose to close your eyes as we ask you to reflect on this memory in a particular way. Go back to the time and place of the experience you just recalled and see the scene in your mind’s eye. Now take a few steps back. Move away from the situation to a point where you can now watch the event unfold from a distance and see yourself in the event. As you do this, focus on what has now become the distant you. Now watch the experience unfold as if it were happening to the distant you all over again. Replay the event as it unfolds in your imagination as you observe your distant self. Take some time to do this now.

As you continue to watch the situation unfold to your distant self, try to understand his or her feelings. Why did he (she) have those feelings? What were the underlying causes and reasons? How do you understand this experience when you look at it with a greater perspective? How does reflecting upon this experience inform your understanding of things today? Take the next 60 seconds to reflect on this.”

Participants heard the following instructions in the *empathetic perspective-taking* reflection task condition:

“You may now choose to close your eyes as we ask you to reflect on this memory in a particular way. Go back to the time and place of the experience you just recalled and see the scene in your mind’s eye. Try to experience the memory from the perspective of the other person in the memory. Try to experience it from “their shoes”. As you do this, focus on the experience of the other person. Now watch the experience unfold as if it were happening to the other person. Replay the event as it unfolds in your imagination as you observe this person. Take some time to do this now.

As you continue to watch the situation unfold to the other person, try to understand their feelings and needs in this situation. Try to consider their emotional experience. Why did they have those feelings? What were the underlying causes and reasons? What might they have been needing or hoping for in that situation? Is there anything that you can relate to about what you think their experience might have been? Take a few moments to do this. We will continue in 60 seconds.”

Participants heard the following instructions in the *resilience* reflection task condition:

“You may now choose to close your eyes as we ask you to reflect on this memory in a particular way. Go back to the time and place of the experience and see the scene in your mind’s eye. As the event unfolds in your imagination, try to be curious about what about the situation was really important for you. Notice ways that your emotions were helping you respond to your experience. Watch the experience unfold as if it were reminding you of the ways that you have learned and grown from your experiences. Take some time to do this now.

As you continue to watch the situation unfold, try to understand what about that situation made you a stronger person? What skills or insights did you learn in that situation? How were you able to persevere? Take a few moments to do this. We will continue in 60 seconds.”

Appendix B.2

Interpersonal Reactivity Index (IRI)

The Interpersonal Reactivity Index (IRI; Davis, 1983) is a 28-item measure with four subscales. Responses are on a 5-point scale ranging from “Does not describe me well” (0) to “Describes me very well” (5). The measure has 4 subscales, each made up of 7 different items.

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 statement: ‘Does not describe me well,’ ‘Describes me slightly well,’ ‘Describes me moderately well,’ ‘Describes me very well,’ or ‘Describes me extremely well.’ When you have decided on your answer, fill in the letter next to the item number. **READ EACH ITEM CAREFULLY BEFORE RESPONDING.** Answer as honestly as you can.

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)

NOTE: (-) denotes item to be scored in reverse fashion

PT = perspective-taking scale

FS = fantasy scale

EC = empathic concern scale

PD = personal distress scale

Perspective Taking – the tendency to spontaneously adopt the psychological point of view of others

Fantasy – taps respondents' tendencies to transpose themselves imaginatively into the feelings and actions of fictitious characters in books, movies, and plays

Empathic Concern – assesses "other-oriented" feelings of sympathy and concern for unfortunate others

Personal Distress – measures "self-oriented" feelings of personal anxiety and unease in tense interpersonal settings

Appendix B.3

Center for Epidemiologic Studies Depression Scale (CES-D)

The Center for Epidemiological Studies-Depression (CES-D; Radloff, 1977), is a 20-item measure of symptoms associated with depression, such as restless sleep, poor appetite, and feeling lonely. Response options are on a 4-point scale ranging from “Rarely or None of the Time” (0) to “Most or Almost All the Time” (3). Scores range from 0 to 60, with high scores indicating greater depressive symptoms.

In each of the following prompts, please tell us how often you have felt this way during the past week.

1. I was bothered by things that don't usually bother me.
2. I did not feel like eating; my appetite was poor.
3. I felt that I could not shake off the blues even with help from my family or friends.
4. I was just as good as other people.
5. I had trouble keeping my mind on what I was doing.
6. I felt depressed.
7. I felt that everything I did was an effort.
8. I felt hopeful about the future.
9. I thought my life had been a failure.
10. I felt fearful.
11. My sleep was restless.
12. I was happy.
13. I talked less than usual.
14. I felt lonely.
15. People were unfriendly.

16. I enjoyed life.
17. I had crying spells.
18. I felt sad.
19. I felt that people disliked me.
20. I could not get "going"

Scoring: zero for answers in the first column, 1 for answers in the second column, 2 for answers in the third column, 3 for answers in the fourth column. The scoring of positive items is reversed. Possible range of scores is zero to 60, with the higher scores indicating the presence of more symptomatology.

Appendix B.4

Ryff Scales of Psychological Well-Being

A validated short-form of the 42-item Psychological Wellbeing (PWB) Scale (Ryff, 1989; Ryff & Keyes, 1997; Ryff & Singer, 2006), this 18-item version measures six aspects of wellbeing and happiness: autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance. For our scale, respondents rated statements on a scale of “Strongly disagree” (1) to “Strongly Agree” (6), with higher scores indicating greater well-being.

The following set of statements deals with how you might feel about yourself and your life. Please remember that there are neither right nor wrong answers.

1. In general, I feel I am in charge of the situation in which I live.
2. I live life one day at a time and don't really think about the future.
3. When I look at the story of my life, I am pleased with how things have turned out.
4. Maintaining close relationships has been difficult and frustrating for me.
5. The demands of everyday life often get me down.
6. I think it is important to have new experiences that challenge how you think about yourself and the world.
7. I am quite good at managing the many responsibilities of my daily life.
8. I like most aspects of my personality
9. I tend to be influenced by people with strong opinions.
10. I have confidence in my own opinions, even if they are contrary to the general consensus.
11. In many ways, I feel disappointed about my achievements in my life.
12. People would describe me as a giving person, willing to share my time with others.

13. For me, life has been a continuous process of learning, changing, and growth.
14. I have not experienced many warm and trusting relationships with others.
15. I gave up trying to make big improvements or changes in my life a long time ago.
16. Some people wander aimlessly through life, but I am not one of them.
17. I judge myself by what I think is important, not by the values of what others think is important.
18. I sometimes feel as if I've done all there is to do in life.

Item numbers 4, 5, 7, 9, 10, 11, 13,14,15,17,18, 22, 23, 25, 26, 27, 29, 31, 34, 36, 38, 42, 43, 44, 45, 46, 52, 53 in the above are reverse scored.

Below are the items listed by scale. Reverse-scored items are labeled “rs.”

Autonomy – the extent to which students view themselves as being independent and able to resist social pressures

15. I tend to be influenced by people with strong opinions. (rs)
17. I have confidence in my opinions, even if they are contrary to the general consensus.
18. I judge myself by what I think is important, not by the values of what others think is important.

Environmental Mastery – the extent to which students feel in control of and able to act in the environment

8. In general, I feel I am in charge of the situation in which I live.
4. The demands of everyday life often get me down. (rs)

9. I am quite good at managing the many responsibilities of my daily life.

Personal Growth – the extent to which students have a sense of continued development and self-improvement

12. I think it is important to have new experiences that challenge how you think about yourself and the world.
11. For me, life has been a continuous process of learning, changing, and growth.
14. I gave up trying to make big improvements or changes in my life a long time ago. (rs)

Positive Relations with Others – the extent to which students have satisfying, trusting relationships with other people

6. Maintaining close relationships has been difficult and frustrating for me. (rs)
13. People would describe me as a giving person, willing to share my time with others.
16. I have not experienced many warm and trusting relationships with others. (rs)

Purpose in Life – the extent to which students hold beliefs that give life meaning

7. I live one day at a time and don't really think about the future. (rs)
3. Some people wander aimlessly through life, but I am not one of them.
10. I sometimes feel as if I've done all there is to do in life. (rs)

Self-Acceptance – the extent to which students have a positive attitude about themselves

2. When I look at the story of my life, I am pleased with how things have turned out.

1. I like most aspects of my personality.

5. In many ways, I feel disappointed about my achievements in my life. (rs)

Scoring:

The Autonomy subscale items are Q15, Q17, Q18. The Environmental Mastery subscale items are Q4, Q8, Q9. The Personal Growth subscale items are Q11, Q12, Q14. The Positive Relations with Others subscale items are Q6, Q13, Q16. The Purpose in Life subscale items are Q3, Q7, Q10. The Self-Acceptance subscale items are Q1, Q2, and Q5.

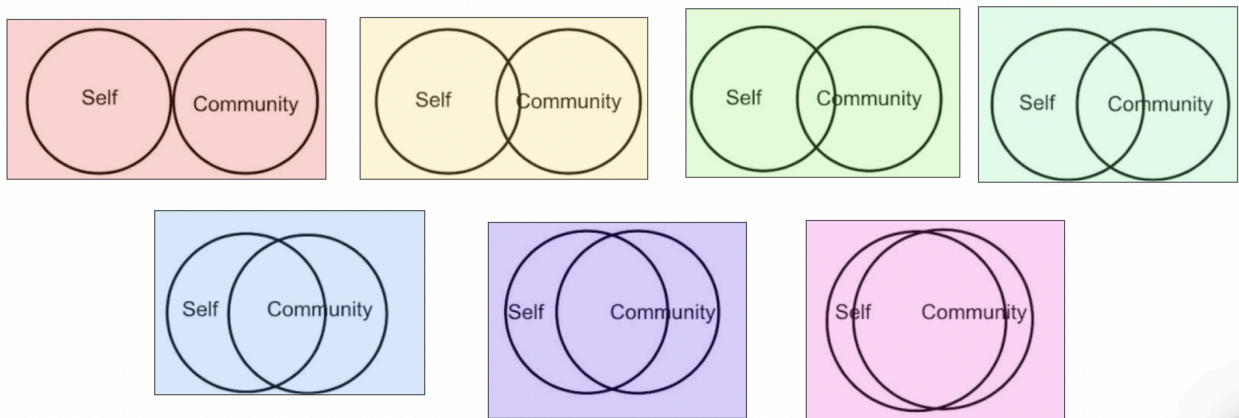
Q1, Q2, Q3, Q8, Q9, Q11, Q12, Q13, Q17, and Q18 should be reverse-scored.

To calculate subscale scores for each participant, sum respondents' answers to each subscale's items. Higher scores mean higher levels of psychological well-being.

Appendix B.5

Inclusion of Other in the Self (IOS) Scale

The Inclusion of Other in the Self (IOS) Scale (Aron et al., 1992) is a visual, single-item measure designed to assess the closeness or interconnectedness between an individual and their community. Respondents see seven pairs of circles that range from just touching to almost completely overlapping. One circle in each pair is labeled “self,” and the second circle is labeled “community.” Respondents choose one of the seven pairs to answer the question, “Please click the picture below that best describes your relationship to your community.”



To score this scale, researchers record the number of the pair (1 to 7) the respondent selected.

Response format: Respondents choose a pair of circles from seven with different degrees of overlap. 1 = no overlap; 2 = little overlap; 3 = some overlap; 4 = equal overlap; 5 = strong overlap; 6 = very strong overlap; 7 = most overlap.

Appendix B.6

Self-Transcendence Scale (STS)

The Adult Self-Transcendence Inventory (ASTI; Levenson et al., 2005) is a 15-item survey designed to measure self-transcendence. Self-transcendence refers to the process by which individuals extend their self-boundaries, transcending personal concerns, and identifying with broader aspects of life, such as community, nature, spirituality, or the universe as a whole. These items are rated on a 4-point likert-type scale ranging from “Strongly disagree” (1) to “Strongly agree” (4). Higher scores represent higher levels of self-transcendence.

Please indicate the extent to which each item below describes you. There are no right or wrong answers. I am interested in your frank opinion. As you respond to each item, think of how you see yourself at this time of your life and select the best response for you.

1. At this time of my life, I see myself as having hobbies or interests I can enjoy.
2. At this time of my life, I see myself as accepting myself as I grow older.
3. At this time of my life, I see myself as being involved with other people or my community when possible.
4. At this time of my life, I see myself as adjusting well to my present life situation.
5. At this time of my life, I see myself as adjusting to changes in my physical abilities.
6. At this time of my life, I see myself as sharing my wisdom or experience with others.
7. At this time of my life, I see myself as finding meaning in my past experiences.
8. At this time of my life, I see myself as helping others in some way.
9. At this time of my life, I see myself as having an ongoing interest in learning.
10. At this time of my life, I see myself as able to move beyond some things that once seemed so important.
11. At this time of my life, I see myself as accepting death as a part of life.
12. At this time of my life, I see myself as finding meaning in my spiritual beliefs.
13. At this time of my life, I see myself as letting others help me when I may need it.
14. At this time of my life, I see myself as enjoying my pace of life.
15. At this time of my life, I see myself as letting go of past regrets.

Scoring: The ASTI is scored by summing across items.

Appendix B.7

Perceived Stress Scale (PSS)

The 5-item Perceived Stress Scale (PSS) was adapted from Cohen's 10-item scale (Cohen et al., 1983), measuring the degree to which situations in one's life are appraised as stressful, i.e. unpredictable, uncontrollable, and overloaded. Respondents are asked how often they felt a certain way on a five-point scale from 'Never' (0) to 'Very often' (4). Higher scores indicate higher levels of perceived stress.

For each question choose the response that best relates to how you felt in the last month.

1. In the last month, how often have you felt that you were unable to control the important things in your life?
2. In the last month, how often have you felt confident about your ability to handle your personal problems? (R)
3. In the last month, how often have you felt that things were going your way? (R)
4. In the last month, how often have you been angered because of things that happened that were outside of your control?
5. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Scoring: The PSS score is then obtained by summing across all items.

Appendix B.8

Demographic Measures

Adapted based on previous item assessments (APA, 2015; Badgett et al., 2014; Diemer et al., 2013; Mahmutovic, 2021; Moody et al., 2013; Pew Research Center, 2022; Toor, 2020)

1. What is your year of birth?
2. What is the highest level of school your parents have completed or the highest degree your parents have received?
 - ☐ Less than high school degree
 - ☐ High school graduate (high school diploma or equivalent including GED)
 - ☐ Some college but no degree
 - ☐ Associate degree in college (2-year)
 - ☐ Bachelor's degree in college (4-year)
 - ☐ Master's degree
 - ☐ Doctoral degree

- o Professional degree (JD, MD)
3. What is your ethnic background? (Select all that apply)
- o Non-Hispanic Black/African-American
 - o Latinx/Hispanic/Chicano
 - o Indigenous/Native American or Native Alaskan
 - o Non-Hispanic White
 - o Native Hawaiian or other Pacific Islander
 - o Asian/Asian-American
 - o Identify with more than 1 race or ethnicity (please check the boxes of the other races/ethnicities you identify with)
 - o Unknown race/ethnicity
 - o Other: _____
 - o Decline to respond
4. How do you describe yourself (current gender identity)?
- o Female
 - o Male
 - o Transgender
 - o Do not identify with female, male, or transgender

Appendix B.9

Prompt for Memory Recall

On the following screens, we are going to ask you to recall memories from your past that involve challenging experiences you've had with other people. We will ask you to briefly describe each memory. You do not need to recall the full memory in detail here. We will ask you to think about the memory in detail once you are in the MRI brain scanner.

You should choose memories that are real things you experienced in the past and that you can remember somewhat clearly. However, please do not choose experiences that you would consider traumatic or that you feel would emotionally overwhelm you to think about now.

After you briefly describe the memory, we will ask you to create a short "cue phrase" that will help you recall that memory again while you are in the scanner.

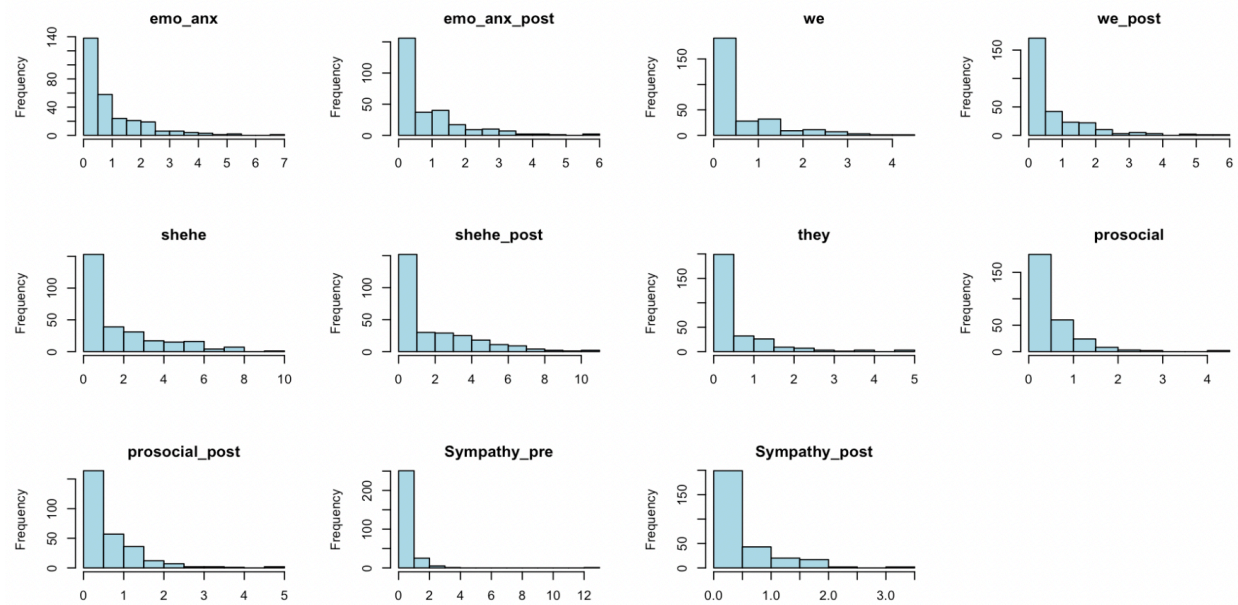
In ~5-6 sentences, please briefly describe an interpersonal experience from your past in which you felt overwhelming anger and hostility.

Please choose a short cue phrase (1-3 words) that will help you bring to mind this exact memory when you are in the scanner. For instance, if someone wrote: "I was stuck at the airport because my flight was canceled. I had to miss my best friend's wedding. The customer service attendant was being very rude and wouldn't help me find a flight", they might write a cue phrase like "Canceled flight" or "Stuck at airport".

[repeated for shame or embarrassment; sadness or grief; anxiety or worry; guilt or regret; fear; rejected, abandoned, or excluded; and judged or criticized].

Figure S.B.1

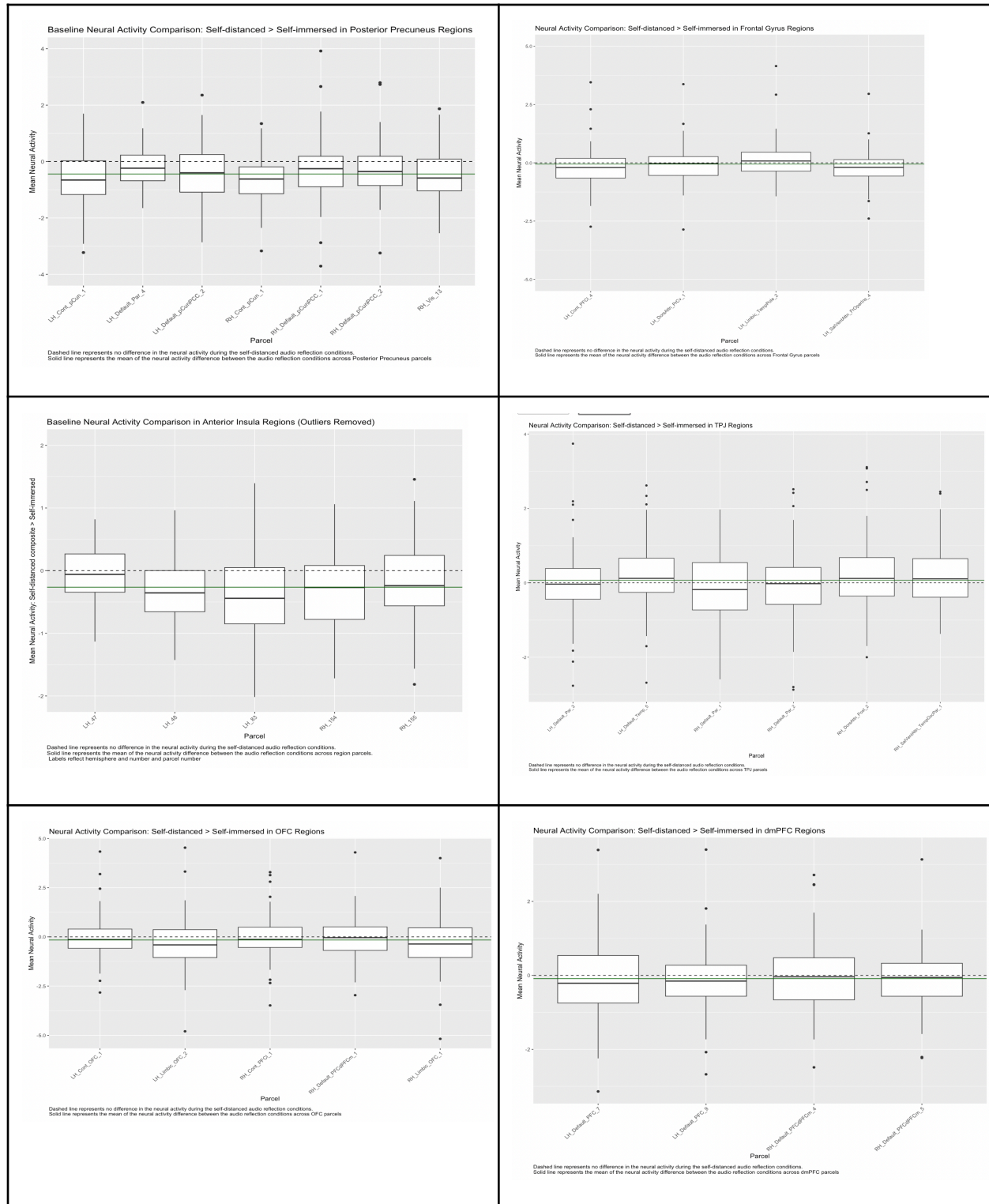
Histograms of Variables at Pre and Post that Displayed Zero-inflation



Note: Terms related to anxiety (pre and post), first person plural (pre and post), third person singular (pre and post), third person plural (pre), and prosociality (pre and post) all displayed zero-inflation.

Figure S.B.2.

Baseline Neural Activity Comparison (Collapsed across Groups): Self-Distanced + Empathy + Resilience > Self-Immersed



Appendix B.10

Measuring Emotional Reactivity

Adapted from Kross et al. (2012)

Immediately following each reflection task while in the neuroimaging scanner, participants were asked to rate the extent to which they agreed with the following questions:

1. Thinking about the event right now made me feel upset (e.g., rejected, angry, hurt, sad).
2. As I think about the event now, my emotions and physical reactions to this experience are still intense.
3. I reexperienced the emotions I originally felt during the experience when I thought about it now.
4. This experience remains unresolved and an active source of distress for me.

Responses were collected on a scale of 1 (strongly disagree) to 5 (strongly agree).

Table S.B.1

Tailored Coding Rubric for Measures of Immersed and Distance Speech

Summary of guiding content drawn from Barbosa et al. (2017), Couto et al. (2016); and Barbosa et al. (2019)

Following previous work (Barbosa et al., 2017; Couto et al., 2016; Barbosa et al., 2019), immersion and distancing was assessed in participant's written reflections about a recent experience of distress. The coding categories, definitions, and examples are provided below. Coding instructions were to a) assign each sentence a code of immersed, distanced, or other; b) assign each sentence a code of immersed - what, immersed - attributive, distanced - insight, distanced - closure, or other, and c) assign each sentence a code of blame -self, blame - other, blame - entity, or blame - none.

Category	Definition	Examples from the data
Psychologically Immersed - general	When the primary focus of the statement is about <u>recounting</u> emotionally evocative details of a past experience (i.e., what happened - descriptions of the specific chain of events and emotions participants experienced during the event) Closeness to the first-person experience / egocentric perspective Focus on the description of the original experience; describing experiences and visualizing through their own	<i>See examples from immersed - what statements and immersed - attributive statements below.</i>

eyes; focused on the description of events, original thoughts, feelings, and behaviors as experienced them
 Considering the self who analyzes the previous emotional experience here and now as coincident with the self who experienced the event
 The original thoughts, feelings, behaviors and events repeat themselves as the person replays the event

Psychologically Immersed -
 What statements

What happened/ what did I think?

Immersed statements that reflect concrete construals describing the specific chain of events, behaviors, or emotions experienced.

I was going through sorority recruitment and got dropped by the majority of sororities

I had so many thoughts running through my mind about how I could've chosen a different path...

As we were leaving, his roommate decided to yell at us from across the street and shout passive aggressive remarks

Psychologically Immersed -
 - Attributive statements

How did I feel?

Immersed statements that reflect attributive statements

Ascribes characteristics to self or others without explaining or providing reasons to them

Describes feelings or other internal states

I felt very hollow

My boyfriend was breaking up with me and I was incredibly sad and worried and full of fear

That was so dumb, I shouldn't have done that

Psychologically Distanced -
 - general

When the primary focus of the statement is about reconstructing emotionally evocative details of a past experience (i.e. descriptions of new realizations about or changes in the way participants understood the causes underlying their feelings).

Elaborating a broader picture about experience (or an observer point of view) is defined as distanced

Focus on the exploration/explanation of the experience

Accounts experience almost as an 'observer' (or from an observer's point of view)

Considering the self who analyzes the previous emotional experience here and now as separate from the self who experienced the event

Similar to a fly on the wall that can see itself in the experience

The experience is analyzed in the third person, so that the person has a broader vision about the experience, considering the big picture rather than focusing on concrete details.

See examples from distanced - insight statements and distanced - closure statements below.

Table S.B.1 continued

Category	Definition	Examples from the data
Psychological ly Distanced - Closure statements	<i>Broader view based on past and current experiences</i> Indicates they assess a past experience from a broad perspective, taking into account past & current experiences to make sense of feelings and experiences Establishes relations (contrasts or similarities) between past, & present behaviors, feelings, or cognitions Expresses <i>present feelings or thoughts</i> about past experiences or situations	<i>All in all, despite how hard it was to grieve my friend group, it made me stronger and made me realize just how capable and lovable I actually am.</i> <i>Today, I am going to go about my day with confidence and trust that everything will work out exactly how it is supposed to.</i> <i>I have felt so much stronger, healthier, and mature since going through this that now when people ask me if I regret going to my last school, I say no because of how much it helped my happiness and personal growth</i>
Blame - entity	Attributions of blame that ascribe fault to an entity (e.g. the government, a workplace) without providing reasons.	<i>I was angry at the world for such a long time</i> <i>...the world or god was out to get me or make my life into some sick joke</i> <i>covid hit and took away the opportunity to play the lead in our school musical</i> <i>[the health care system] caused my family a great deal of stress, time, and financial burdens</i>

Table S.B.2.

All models of human-coded analysis of psychological immersion and blame attributions in writing prompts

All models for human-coded analysis of psychological immersion and blame attributions in writing prompts that statistically adjusted for all covariates can be found in [Supplementary Materials Table S.B.2.](#)

Table S.B.3

All models for human-coded analysis of Writing Prompts Using LIWC

All models for human-coded analysis of Writing Prompts Using LIWC that statistically adjusted for all covariates can be found in [Supplementary Materials Table S.B.3](#).

Table S.B.4

All models for baseline differences in neural activity between the composite of the self-distanced reflection task and the self-immersed reflection task (collapsed across intervention group) for our regions of interest

All models for baseline differences in neural activity between the composite of the self-distanced reflection task and the self-immersed reflection task (collapsed across intervention group) for our regions of interest that statistically adjusted for all covariates can be found in [Supplementary Materials Table S.B.4](#).

Table S.B.5

All models for Self-report Measures

All models for that statistically adjusted for all covariates can be found in [Supplementary Materials Table S.B.5](#).

REFERENCES CITED

- Abbott, L., Slate, E., Graven, L., Lemacks, J., & Grant, J. (2021). Fatalism, social support and self-management perceptions among rural African Americans living with diabetes and pre-diabetes. *Nursing Reports*, 11(2), 242-252.
- Abel, S., Whitehead, L. C., & Coppell, K. J. (2018). Making dietary changes following a diagnosis of prediabetes: a qualitative exploration of barriers and facilitators. *Diabetic Medicine*, 35(12), 1693-1699.
- Abraham, A., Pedregosa, F., Eickenberg, M., Gervais, P., Mueller, A., Kossaifi, J., Gramfort, A., Thirion, B., & Varoquaux, G. (2014). Machine Learning for Neuroimaging with Scikit-Learn. *Frontiers in Neuroinformatics*, 8.
- Adair, K. C., Fredrickson, B. L., Castro-Schilo, L., Kim, S., & Sidberry, S. (2018). Present with you: Does cultivated mindfulness predict greater social connection through gains in decentering and reductions in negative emotions?. *Mindfulness*, 9, 737-749.
- Adriaanse, M. C., & Snoek, F. J. (2006). The psychological impact of screening for type 2 diabetes. *Diabetes/metabolism research and reviews*, 22(1), 20-25.
- Adu, M. D., Malabu, U. H., Malau-Aduli, A. E., & Malau-Aduli, B. S. (2019). Enablers and barriers to effective diabetes self-management: A multi-national investigation. *PloS one*, 14(6), e0217771.
- Al-Badri, M., & Hamdy, O. (2021). Diabetes clinic reinvented: will technology change the future of diabetes care?. *Therapeutic advances in endocrinology and metabolism*, 12, 2042018821995368.
- Alberti, K. G. M. M., Zimmet, P., & Shaw, J. (2007). International Diabetes Federation: a consensus on Type 2 diabetes prevention. *Diabetic Medicine*, 24(5), 451-463.
- Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical psychology review*, 30(2), 217-237.
- Allen, K. A., & Bowles, T. (2018). Belonging as a guiding principle in the education of adolescents. *Educational & Child Psychology*, 35(4), 5-12.
- Alzueta, E., Podhajsky, S., Zhao, Q., Tapert, S. F., Thompson, W. K., de Zambotti, M., . . . Pohl, K. M. (2023/04/). Risk for depression tripled during the COVID-19 pandemic in emerging adults followed for the last 8 years. *Psychological Medicine*, 53(5), 2156-2163. doi: <https://doi.org/10.1017/S0033291721004062>
- American College Health Association. American College Health Association-National College Health Assessment III: Undergraduate Student Reference Group Executive Summary Spring 2022. Silver Spring, MD: American College Health Association; 2022.

- American Psychological Association. (2022). Concerned About Future Inflation: APA Survey Reveals Impact of Economic Stress on Americans' Well-being [Press release]. Retrieved from .
- American Diabetes Association. 2. Classification and diagnosis of diabetes: Standards of Medical Care in Diabetes 2018. *Diabetes Care*, 2018;41(Suppl. 1): S13–S27.
- American Diabetes Association Professional Practice Committee. 3. Prevention or delay of diabetes and associated comorbidities: Standards of Care in Diabetes—2024. *Diabetes Care*, 2024;47(Suppl. 1): S43–S51
- American Diabetes Association. (N.D.). Diabetes prevention. Retrieved June 22, 2024, from <https://diabetes.org/about-diabetes/diabetes-prevention#:~:text=Small%20changes%20to%20your%20lifestyle,goals%20that%20work%20for%20you.>
- American College Health Association. (Spring 2023). American College Health Association-National College Health Assessment III: Undergraduate Student Reference Group Data Report Spring 2023 [PDF]. Silver Spring, MD: American College Health Association.
- Ammerman, A. S., Lindquist, C. H., Lohr, K. N., & Hersey, J. (2002). The efficacy of behavioral interventions to modify dietary fat and fruit and vegetable intake: a review of the evidence. *Preventive medicine*, 35(1), 25-41.
- Andersson, J. L. R., Skare, S., & Ashburner, J. (2003). How to Correct Susceptibility Distortions in Spin-Echo Echo-Planar Images: Application to Diffusion Tensor Imaging. *NeuroImage*, 20(2), 870–888.
- Arat, S., De Cock, D., Moons, P., Vandenberghe, J., & Westhovens, R. (2018). Modifiable correlates of illness perceptions in adults with chronic somatic conditions: A systematic review. *Research in nursing & health*, 41(2), 173-184.
- 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.
- Ashrafzadeh, S., & Hamdy, O. (2019). Patient-driven diabetes care of the future in the technology era. *Cell metabolism*, 29(3), 564-575.
- Association for Contextual Behavioral Science. (n.d.). The six core processes of ACT. Retrieved from https://contextualscience.org/the_six_core_processes_of_act
- Asuzu, C. C., Walker, R. J., Williams, J. S., & Egede, L. E. (2017). Pathways for the relationship between diabetes distress, depression, fatalism and glycemic control in adults with type 2 diabetes. *Journal of Diabetes and its Complications*, 31(1), 169-174.
- Atal, S., & Cheng, C. (2016). Socioeconomic health disparities revisited: coping flexibility enhances health-related quality of life for individuals low in socioeconomic status. *Health and quality of life outcomes*, 14, 1-7.

- Avants, B. B., Epstein, C. L., Grossman, M., & Gee, J. C. (2008). Symmetric Diffeomorphic Image Registration with Cross-Correlation: Evaluating Automated Labeling of Elderly and Neurodegenerative Brain. *Medical Image Analysis*, 12(1), 26–41.
- Avdal, E. U., Uran, B. N. Ö., Pamuk, G., Yildirim, J. G., Konakçı, G., Ateş, M., & Polat, G. (2020). Investigation of the effect of web-based diabetes education on metabolic parameters in people with type 2 diabetes: a randomized controlled trial. *Journal of Infection and Public Health*, 13(12), 1892-1898.
- Ayduk, Ö., & Kross, E. (2008). Enhancing the pace of recovery: Self-distanced analysis of negative experiences reduces blood pressure reactivity. *Psychological science*, 19(3), 229-231.
- Ayduk, Ö., & Kross, E. (2010). From a distance: Implications of spontaneous self-distancing for adaptive self-reflection. *Journal of Personality and Social Psychology*, 98, 809–829. doi: 10.1037/a0019205
- Azami, G., Soh, K. L., Sazlina, S. G., Salmiah, M. S., & Aazami, S. (2018). Behavioral interventions to improve self-management in Iranian adults with type 2 diabetes: a systematic review and meta-analysis. *Journal of Diabetes & Metabolic Disorders*, 17, 365-380.
- Baker, D., & Laughlin, A. (2017). Patient-centered medical homes and their effect on diabetes outcomes. *The Journal for Nurse Practitioners*, 13(3), e125-e128.
- Balas, E. A., & Boren, S. A. (2000). Managing clinical knowledge for health care improvement. *Journal of the American Medical Informatics Association*, 9(3), 261-276.
- Balis, L. E., Strayer, T. E., Ramalingam, N., & Harden, S. M. (2019). Operationalizing the RE-AIM framework to evaluate the collective impact of autonomous community programs that promote health and well-being. *BMC Public Health*, 19, 803.
- Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & Van Ijzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: a meta-analytic study. *Psychological bulletin*, 133(1), 1.
- Barbosa, E., Amendoeira, M., Ferreira, T., Teixeira, A. S., Pinto-Gouveia, J., & Salgado, J. (2017). Immersion and distancing across the therapeutic process: relationship to symptoms and emotional arousal. *Research in Psychotherapy: Psychopathology, Process, and Outcome*, 20(2).
- Barreto, Monica. "A Single Session of Acceptance and Commitment Therapy to Promote Health-Related Behavior Change: A Randomized Controlled Trial" (2019). *Dissertations*, 3483. <https://scholarworks.wmich.edu/dissertations/3483>
- Barry, E., Roberts, S., Oke, J., Vijayaraghavan, S., Normansell, R., & Greenhalgh, T. (2017). Efficacy and effectiveness of screen and treat policies in prevention of type 2 diabetes: systematic review and meta-analysis of screening tests and interventions. *bmj*, 356.
- Baum, A., Kaboli, P. J., & Schwartz, M. D. (2021). Reduced in-person and increased telehealth outpatient visits during the COVID-19 pandemic. *Annals of internal medicine*, 174(1), 129-131.

- Bayani, A. A., Mohammad Koochekya, A., & Bayani, A. (2008). Reliability and validity of Ryff's psychological well-being scales. *Iranian journal of psychiatry and clinical psychology*, 14(2), 146-151.
- Behzadi, Y., Restom, K., Liao, J., & Liu, T. T. (2007). A Component Based Noise Correction Method (CompCor) for BOLD and Perfusion Based fMRI. *NeuroImage*, 37(1), 90-101.
<https://doi.org/10.1016/j.neuroimage.2007.04.042>
- Beike, D. R., & Wirth-Beaumont, E. T. (2005). Psychological closure as a memory phenomenon. *Memory*, 13, 574-593.
- Bener, A., OAA Al-Hamaq, A., & E Dafeeah, E. (2011). High prevalence of depression, anxiety and stress symptoms among diabetes mellitus patients. *The Open Psychiatry Journal*, 5(1).
- Benetou, V., Orfanos, P., Lagiou, P., Trichopoulos, D., Boffetta, P., & Trichopoulou, A. (2008). Vegetables and fruits in relation to cancer risk: evidence from the Greek EPIC cohort study. *Cancer Epidemiology Biomarkers & Prevention*, 17(2), 387-392.
- Bennett, J. E., Stevens, G. A., Mathers, C. D., Bonita, R., Rehm, J., Kruk, M. E., ... & Ezzati, M. (2018). NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4. *The Lancet*, 392(10152), 1072-1088.
- Bennett, K. (2017). Causal attributions and social judgments. In *Getting grounded in social psychology* (pp. 79-104). *Psychology Press*.
- Berg, S. (2006). Snowball sampling 1- Sequential estimation of the mean in finite population to Steiner's most frequent value. *Encyclopedia of Statistical Sciences*, 12. Doi: 10.1002/0471667196.ess2478.pub2
- Biener, L., & Abrams, D. B. (1991). The Contemplation Ladder: validation of a measure of readiness to consider smoking cessation. *Health Psychology*, 10(5), 360. DOI: 10.1037/0278-6133.10.5.360
- Block-Lerner, J., Wulfert, E., & Moses, E. (2009). ACT in context: an exploration of experiential acceptance. *Cognitive and Behavioral Practice*, 16(4), 443-456.
- Blüher, S., Markert, J., Herget, S., Yates, T., Davis, M., Müller, G., ... & Schwarz, P. E. (2012). Who should we target for diabetes prevention and diabetes risk reduction?. *Current diabetes reports*, 12, 147-156.
- Bohlmeijer, E., Prenger, R., Taal, E., & Cuijpers, P. (2010). The effects of mindfulness-based stress reduction therapy on mental health of adults with a chronic medical disease: a meta-analysis. *Journal of psychosomatic research*, 68(6), 539-544.
- Bonanno, G. A., & Burton, C. L. (2013). Regulatory flexibility: An individual differences perspective on coping and emotion regulation. *Perspectives on psychological science*, 8(6), 591-612.
- Bond, F. W., Hayes, S. C., Baer, R. A., Carpenter, K. M., Guenole, N., Orcutt, H. K., Waltz, T., & Zettle, R. D. (2011). Preliminary psychometric properties of the Acceptance and Action Questionnaire – II: A

- revised measure of psychological inflexibility and experiential avoidance. *Behavior Therapy*, 42, 676–688.
- Bond, F. W., Hayes, S. C., & Barnes-Holmes, D. (2006). Psychological Flexibility, ACT and Organizational Behavior. In S. C. Hayes, F. W. Bond, D. Barnes-Holmes, & J. Austin (Eds.), *Acceptance and Mindfulness at Work: Applying Acceptance and Commitment Therapy and Relational Frame Theory to Organizational Behavior Management* (pp. 25-54). Binghamton, NY: The Haworth Press.
- Boss, L. P., McConnon, A., & Brown, S. L. (2015). Threat perception and diabetes: The role of risk awareness in health behavior. *Journal of Behavioral Medicine*, 38(5), 788-798.
- Brewer, J. A., & Garrison, K. A. (2014). The posterior cingulate cortex as a plausible mechanistic target of meditation: Findings from neuroimaging. *Annals of the New York Academy of Sciences*, 1307(1), 19-27.
- Brewer, J. A., Garrison, K. A., & Whitfield-Gabrieli, S. (2013). What about the “self” is processed in the posterior cingulate cortex? *Frontiers in human neuroscience*, 7, 647.
- Brewer, J. A., Worhunsky, P. D., Gray, J. R., Tang, Y. Y., Weber, J., and Kober, H. (2011). Meditation experience is associated with differences in default mode network activity and connectivity. *Proceedings of the National Academy of Sciences*, 108, 20254–20259. doi:10.1073/pnas.1112029108
- Broadbent, E., Petrie, K. J., Main, J., & Weinman, J. (2006). The Brief Illness Perception Questionnaire. *Journal of Psychosomatic Research*, 60(6), 631–637. <https://doi.org/10.1016/j.jpsychores.2005.10.020>
- Broadbent, E., Donkin, L., & Stroh, J. C. (2011). Illness and treatment perceptions are associated with adherence to medications, diet, and exercise in diabetic patients. *Diabetes care*, 34(2), 338-340.
- Brown, B. T. (2018). The relationship between experiential avoidance and physiological reactivity. *Brigham Young University*.
- Brunisholz, K. D., Conroy, M. B., Belnap, T., Joy, E. A., & Srivastava, R. (2021). Measuring adherence to U.S. Preventive services task force diabetes prevention guidelines within two healthcare systems. *The Journal for Healthcare Quality*, 43(2), 119-125. <https://doi.org/10.1097/jhq.0000000000000281>
- Burns, C., & Francis, N. (2024). Type 2 Diabetes: Etiology, Epidemiology, Pathogenesis, and Treatment. In *Metabolic syndrome: A comprehensive textbook* (pp. 509-528). Cham: Springer International Publishing.
- Burton, C. L., & Bonanno, G. A. (2016). Regulatory flexibility and its role in adaptation to aversive events throughout the lifespan. In A. D. Ong & C. E. Löckenhoff (Eds.), *Emotion, aging, and health* (pp. 71–94). American Psychological Association. <https://doi-org.uoregon.idm.oclc.org/10.1037/14857-005>
- Cabanis, M., Pyka, M., Mehl, S., Müller, B. W., Loos-Jankowiak, S., Winterer, G., ... & Kircher, T. (2013). The precuneus and the insula in self-attributional processes. *Cognitive, Affective, & Behavioral Neuroscience*, 13, 330-345.

- Cameron, L. D., & Leventhal, H. (2012). Self-regulation, health, and illness: An overview. *The self-regulation of health and illness behaviour*, 1-15.
- Cannon, M. J., Masalovich, S., Ng, B. P., Soler, R. E., Jabrah, R., Ely, E. K., & Smith, B. D. (2020). Retention among participants in the National Diabetes Prevention Program lifestyle change program, 2012–2017. *Diabetes Care*, 43(9), 2042-2049.
- Cardoso, R., De Souza, E., Camano, L., and Leite, J. R. (2004). Meditation in health: an operational definition. *Brain Research Brain Research Protocols*, 14, 58–60. doi: 10.1016/j.brainresprot.2004.09.002
- Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology*, 67(2), 319-333.
- Cavanna, A. E., & Trimble, M. R. (2006). The precuneus: a review of its functional anatomy and behavioural correlates. *Brain*, 129(3), 564-583.
- Centers for Disease Control and Prevention. (2024). FastStats - Leading Causes of Death. Retrieved February 26, 2024, from
- Chaki, J., Ganesh, S. T., Cidham, S. K., & Theertan, S. A. (2022). Machine learning and artificial intelligence based Diabetes Mellitus detection and self-management: A systematic review. *Journal of King Saud University-Computer and Information Sciences*, 34(6), 3204-3225.
- Chavez, R. S., & Heatherton, T. F. (2015). Multimodal frontostriatal connectivity underlies individual differences in self-esteem. *Social cognitive and affective neuroscience*, 10(3), 364-370.
- Chen, L. M., Farwell, W. R., & Jha, A. K. (2009). Primary care visit duration and quality: does good care take longer?. *Archives of internal medicine*, 169(20), 1866-1872.
- Cherrington, A. L., Bebu, I., Krause-Steinrauf, H., Hoogendoorn, C. J., Crespo-Ramos, G., Presley, C., ... & Gonzalez, J. S. (2024). Does Emotional Distress Predict Worse Glycemic Control Over Time? Results From the Glycemia Reduction Approaches in Diabetes: A Comparative Effectiveness Study (GRADE). *Diabetes Care*, dc230642.
- Cherry, M. G., Brown, S. L., Purewal, R., & Fisher, P. L. (2023). Do metacognitive beliefs predict rumination and psychological distress independently of illness representations in adults with diabetes mellitus? A prospective mediation study. *British Journal of Health Psychology*, 28(3), 814-828.
- Cherry, K. M., Hoeven, E. V., Patterson, T. S., & Lumley, M. N. (2021). Defining and measuring “psychological flexibility”: A narrative scoping review of diverse flexibility and rigidity constructs and perspectives. *Clinical Psychology Review*, 84.
- Chew, B. H., Vos, R. C., Metzendorf, M. I., Scholten, R. J., & Rutten, G. E. (2017). Psychological interventions for diabetes -related distress in adults with type 2 diabetes mellitus. *Cochrane Database of Systematic Reviews*, (9).

- Chida, Y., Hamer, M., Wardle, J., & Steptoe, A. (2008). Do stress-related psychosocial factors contribute to cancer incidence and survival?. *Nature clinical practice Oncology*, 5(8), 466-475.
- Chmielewski, M., & Kucker, S. C. (2020). An MTurk crisis? Shifts in data quality and the impact on study results. *Social Psychological and Personality Science*, 11(4), 464-473.
- Choi, K., Vickers, K., & Tassone, A. (2014). Trait emotional intelligence, anxiety sensitivity, and experiential avoidance in stress reactivity and their improvement through psychological methods. *Europe's Journal of Psychology*, 10(2), 376-404.
- Christian, J. G., Bessesen, D. H., Byers, T. E., Christian, K. K., Goldstein, M. G., & Bock, B. C. (2008). Clinic-based support to help overweight patients with type 2 diabetes increase physical activity and lose weight. *Archives of Internal Medicine*, 168(2), 141-146.
- Christian, B. M., Parkinson, C., Macrae, C. N., Miles, L. K., & Wheatley, T. (2015). When imagining yourself in pain, visual perspective matters: The neural and behavioral correlates of simulated sensory experiences. *Journal of Cognitive Neuroscience*, 27(5), 866-875.
- Christiansen, J., Lund, R., Qualter, P., Andersen, C. M., Pedersen, S. S., & Lasgaard, M. (2021). Loneliness, social isolation, and chronic disease outcomes. *Annals of Behavioral Medicine*, 55(3), 203-215.
- Chu, P., Patel, A., Helgeson, V., Goldschmidt, A. B., Ray, M. K., & Vajravelu, M. E. (2023). Perception and Awareness of Diabetes Risk and Reported Risk-Reducing Behaviors in Adolescents. *JAMA Network Open*, 6(5), e2311466-e2311466.
- Ciric, R., Thompson, W. H., Lorenz, R., Goncalves, M., Macnicol, E., Markiewicz, C. J., Halchenko, Y. O., et al. (2022). TemplateFlow: FAIR-Sharing of Multi-Scale, Multi-Species Brain Models. *Nature Methods*, 19, 1568–1571.
- Coccaro, E. F., Drossos, T., Kline, D., Lazarus, S., Joseph, J. J., & de Groot, M. (2022). Diabetes distress, emotional regulation, HbA1c in people with diabetes and A controlled pilot study of an emotion-focused behavioral therapy intervention in adults with type 2 diabetes. *Primary care diabetes*, 16(3), 381-386.
- Coccaro, E. F., Lazarus, S., Joseph, J., Wyne, K., Drossos, T., Phillipson, L., & De Groot, M. (2021). Emotional regulation and diabetes distress in adults with type 1 and type 2 diabetes. *Diabetes Care*, 44(1), 20-25.
- Code of Federal Regulations. (2011). Title 45: Public Welfare. Subtitle A: Department of Health and Human Services. Subchapter B: Requirements relating to health care access. Part 147: Health insurance reform requirements for the group and individual health insurance markets. Section 130: Coverage of preventive health services. Retrieved from <https://www.govinfo.gov/app/details/CFR-2011-title45-vol1/CFR-2011-title45-vol1-sec147-130>

- Cohen, S. E., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin*, 98(2), 310–357.
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24, 385-396.
- Cohn, M. A., Mehl, M. R., & Pennebaker, J. W. (2004). Linguistic markers of psychological change surrounding September 11, 2001. *Psychological science*, 15(10), 687-693.
- Collins, R. E., Lopez, L. M., & Marteau, T. M. (2011). Emotional impact of screening: a systematic review and meta-analysis. *BMC public health*, 11, 1-10.<https://doi.org/10.1016/j.cpr.2021.101973>
- Cooper, A., Lloyd, G., Weinman, J., & Jackson, G. (1999). Why patients do not attend cardiac rehabilitation: role of intentions and illness beliefs. *Heart*, 82(2), 234-236.
- Corbin, N., Todd, N., Friston, K. J., & Callaghan, M. F. (2018). Accurate modeling of temporal correlations in rapidly sampled fMRI time series. *Human Brain Mapping*, 39(10), 3884–97.
- Cosme, D., Flournoy, J. C., & Vijayakumar, N. (2018). auto-motion-fmripreg: A tool for automated assessment of motion artifacts (v1.0). *Zenodo*.
- Cox, R. W. (1996). AFNI: software for analysis and visualization of functional magnetic resonance neuroimages. *Computers and Biomedical Research*, 29(3), 162–73.
- Crane, M. F., Searle, B. J., Kangas, M., & Nwiran, Y. (2019). How resilience is strengthened by exposure to stressors: the systematic self-reflection model of resilience strengthening. *Anxiety, Stress, & Coping*, 32(1), 1–17.
- Crouse, J. J., Chitty, K. M., Iorfino, F., Carpenter, J. S., White, D., Nichles, A., ... & Hickie, I. B. (2020). Modelling associations between neurocognition and functional course in young people with emerging mental disorders: a longitudinal cohort study. *Translational psychiatry*, 10(1), 22.
- Croyle, R. T., Smith, K. R., Botkin, J. R., Baty, B., & Nash, J. (1997a). Psychological responses to BRCA1 mutation testing: preliminary findings. *Health psychology*, 16(1), 63.
- Croyle, R. T., Sun, Y. C., & Hart, M. (1997b). Processing risk factor information: Defensive biases in health-related judgments and memory. *Perceptions of health and illness*, 267-290.
- Crum, A. J., Salovey, P., & Achor, S. (2013). Rethinking stress: the role of mindsets in determining the stress response. *Journal of personality and social psychology*, 104(4), 716.
- Curtis, S., Martin, H., DiNella, M., Lavallee, B., Chartrand, C., McLeod, L., ... & Komenda, P. (2021). Kidney check point-of-care testing—Furthering patient engagement and patient-centered care in Canada’s rural and remote indigenous communities: program report. *Canadian Journal of Kidney Health and Disease*, 8, 20543581211003744.

- Cyniak-Cieciura, M. (2021). Psychological flexibility, temperament, and perceived stress. *Current Issues in Personality Psychology*, 9(4), 306-315.
- D'Argembeau, A., Feyers, D., Majerus, S., Collette, F., Van der Linden, M., Maquet, P., et al (2008). Self-Reflection Across Time: Cortical Midline Structures Differentiate Between Present And Past Selves. *Social Cognitive and Affective Neuroscience*, 3, 244–252.
- Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, 44, 113-126.
- Dale, A. M., Fischl, B., & Sereno, M. I. (1999). Cortical Surface-Based Analysis: I. Segmentation and Surface Reconstruction. *NeuroImage*, 9(2), 179–194.
- Dall, T. (2018). The complexities of physician supply and demand: Projections from 2016 to 2030. *IHS Market Limited*.
- Davis, C., Levitan, R. D., Muglia, P., Bewell, C., & Kennedy, J. L. (2004). Decision-making deficits and overeating: A risk model for obesity. *Obesity research*, 12(6), 929-935.
- Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, 44(1), 113–126.
- DeJesus, R. S., Clark, M. M., Rutten, L. J. F., Jacobson, R. M., Croghan, I. T., Wilson, P. M., ... & Sauver, J. L. S. (2018). Impact of a 12-week wellness coaching on self-care behaviors among primary care adult patients with prediabetes. *Preventive medicine reports*, 10, 100-105.
- Delahanty, L. M., Conroy, M. B., Nathan, D. M., & Diabetes Prevention Program Research Group. (2006). Psychological predictors of physical activity in the diabetes prevention program. *Journal of the American Dietetic Association*, 106(5), 698-705.
- Denny, B. T., Kober, H., Wager, T. D., & Ochsner, K. N. (2012). A meta-analysis of functional neuroimaging studies of self-and other judgments reveals a spatial gradient for mentalizing in medial prefrontal cortex. *Journal of cognitive Neuroscience*, 24(8), 1742-1752.
- Deshpande, N., Wu, M., Kelly, C., Woodrick, N., Werner, D. A., Volerman, A., & Press, V. G. (2023). Video-based educational interventions for patients with chronic illnesses: Systematic review. *Journal of Medical Internet Research*, 25, e41092.
- Deville, G.J., & Borkovec, T.D. (2000). Psychometric properties of the credibility/ expectancy questionnaire. *Journal of Behavior Therapy and Experimental Psychiatry*, 31. <https://devilly.org/Publications/ceq.pdf>
- Diabetes Prevention Program (DPP) Research Group. (2002). The Diabetes Prevention Program (DPP) description of lifestyle intervention. *Diabetes care*, 25(12), 2165-2171.
- Diabetes Queensland. (2015). Risk Assessment Annual Report. Brisbane, Australia: Diabetes Queensland.

- Dickson, K. S., Ciesla, J. A., & Reilly, L. C. (2012). Rumination, worry, cognitive avoidance, and behavioral avoidance: Examination of temporal effects. *Behavior therapy*, 43(3), 629-640.
- Dindo, L., Recober, A., Marchman, J. N., Turvey, C., & O'Hara, M. W. (2012). One-day behavioral treatment for patients with comorbid depression and migraine: a pilot study. *Behaviour research and therapy*, 50(9), 537-543.
- Dorfman, A., Oakes, H., Santos, H. C., & Grossmann, I. (2021). Self-distancing promotes positive emotional change after adversity: Evidence from a micro-longitudinal field experiment. *Journal of Personality*, 89(1), 132-144.
- Doré, B., Ort, L., Braverman, O., & Ochsner, K. N. (2015). Sadness shifts to anxiety over time and distance from the national tragedy in Newtown, Connecticut. *Psychological science*, 26(4), 363-373.
- Drapeau, M., D'Iuso, D. A., Dunkley, D., Dobson, K. S., Azzi, M., & Beaulieu, L. (2019). Cognitions matter: The role of cognitive mediators in improving interpersonal functioning and symptoms of depression. *Journal of Psychotherapy Integration*, 29(3), 261.
- Drevets, W. C., & Raichle, M. E. (1998). Reciprocal suppression of regional cerebral blood flow during emotional versus higher cognitive processes: implications for interactions between emotion and cognition. *Cognition & Emotion*, 12(3), 353-385.
- Duan, D., Kengne, A. P., & Echouffo-Tcheugui, J. B. (2021). Screening for diabetes and prediabetes. *Endocrinology and Metabolism Clinics*, 50(3), 369-385.
- Dubé, J. J., Fleishman, K., Rousson, V., Goodpaster, B. H., & Amati, F. (2012). Exercise dose and insulin sensitivity: relevance for diabetes prevention. *Medicine and science in sports and exercise*, 44(5), 793.
- Dugdale, D. C., Epstein, R., & Pantilat, S. Z. (1999). Time and the patient-physician relationship. *Journal of general internal medicine*, 14(Suppl 1), S34.
- Dunn, N. A., & Luchner, A. F. (2022). The emotional impact of self-criticism on self-reflection and rumination. *Psychology and Psychotherapy: Theory, Research and Practice*, 95(4), 1126-1139. fMRIPrep 23.2.0. Software.
- Dörfel, D., Lamke, J. P., Hummel, F., Wagner, U., Erk, S., & Walter, H. (2014). Common and differential neural networks of emotion regulation by Detachment, Reinterpretation, Distraction, and Expressive Suppression: a comparative fMRI investigation. *NeuroImage*, 101, 298-309.
- Echouffo-Tcheugui, J. B., Perreault, L., Ji, L., & Dagogo-Jack, S. (2023). Diagnosis and management of prediabetes: a review. *JAMA*, 329(14), 1206-1216.
- Eisenberger, N. I., Inagaki, T. K., Muscatell, K. A., Byrne Haltom, K. E., & Leary, M. R. (2011). The neural sociometer: brain mechanisms underlying state self-esteem. *Journal of cognitive neuroscience*, 23(11), 3448-3455.

- Ely, E. K., Gruss, S. M., Luman, E. T., Gregg, E. W., Ali, M. K., Nhim, K., ... & Albright, A. L. (2017). A national effort to prevent type 2 diabetes: participant-level evaluation of CDC's National Diabetes Prevention Program. *Diabetes care*, 40(10), 1331-1341.
- Endler, N. S., & Kocovski, N. L. (2000). Self-regulation and distress in clinical psychology. In the *Handbook of self-regulation* (pp. 569-599). Academic Press.
- Eriksson, A. K., Ekblom, A., Granath, F., Hilding, A., Efendic, S., & Östenson, C. G. (2008). Psychological distress and risk of pre-diabetes and Type 2 diabetes in a prospective study of Swedish middle-aged men and women. *Diabetic Medicine*, 25(7), 834-842.
- Esteban, O., Markiewicz, C., Blair, R. W., Moodie, C., Isik, A. I., Aliaga, A. E., Kent, J., et al. (2019). fMRIPrep: A Robust Preprocessing Pipeline for Functional MRI. *Nature Methods*, 16, 111–116.
- Falon, S. L., Hoare, S., Kangas, M., & Crane, M. F. (2022). The coping insights evident through self-reflection on stressful military training events: Qualitative evidence from self-reflection journals. *Stress and Health*, 38(5), 902-918.
- Farb, N. A., Segal, Z. V., Mayberg, H., Bean, J., McKeon, D., Fatima, Z., & Anderson, A. K. (2007). Attending to the present: mindfulness meditation reveals distinct neural modes of self-reference. *Social Cognitive and Affective Neuroscience*, 2(4), 313-322.
- Fawson, S., Moon, Z., Novogrudsky, K., Moxham, F., Forster, K., Tribe, I., ... & Hughes, L. D. (2023). Acceptance and commitment therapy processes and their association with distress in cancer: a systematic review and meta-analysis. *Health Psychology Review*, 1-22.
- Felsman, P., Verduyn, P., Ayduk, O., & Kross, E. (2017). Being present: Focusing on the present predicts improvements in life satisfaction but not happiness. *Emotion*, 17(7), 1047.
- Fergusson, D. M., & Woodward, L. J. (2002). Mental health, educational, and social role outcomes of adolescents with depression. *Archives of General Psychiatry*, 59(3), 225-231.
- Ferrante, J. M., Balasubramanian, B. A., Hudson, S. V., & Crabtree, B. F. (2010). Principles of the patient-centered medical home and preventive services delivery. *The Annals of Family Medicine*, 8(2), 108-116.
- Fisher, E. B., Brownson, C. A., O'Toole, M. L., Shetty, G., Anwuri, V. V., & Glasgow, R. E. (2005). Ecological approaches to self-management: the case of diabetes. *American Journal of Public Health*, 95(9), 1523-1535.
- Fisher, L., Glasgow, R. E., Mullan, J. T., Skaff, M. M., & Polonsky, W. H. (2008). Development of a brief diabetes distress screening instrument. *The Annals of Family Medicine*, 6(3), 246-252.
- Fisher, L., Hessler, D. M., & Polonsky, W. H. (2012). When is diabetes distress clinically meaningful? Establishing cut-points for the Diabetes Distress Scale. *Diabetes Care*, 35, 259-264.

- Fisher, L., Hessler, D., Polonsky, W. H., Masharani, U., Guzman, S., Bowyer, V., ... & Wu, P. (2018). T1-REDEEM: a randomized controlled trial to reduce diabetes distress among adults with type 1 diabetes. *Diabetes Care*, 41(9), 1862-1869.
- Fisher, L., Skaff, M. M., Mullan, J. T., Arean, P., Mohr, D., Masharani, U., ... & Laurencin, G. (2007). Clinical depression versus distress among patients with type 2 diabetes: not just a question of semantics. *Diabetes Care*, 30(3), 542-548.
- Fledderus, M., Bohlmeijer, E. T., Fox, J. P., Schreurs, K. M., & Spinhoven, P. (2013). The role of psychological flexibility in a self-help acceptance and commitment therapy intervention for psychological distress in a randomized controlled trial. *Behaviour Research and Therapy*, 51(3), 142-151.
- Flocke, S. A., Clark, E., Antognoli, E., Mason, M. J., Lawson, P. J., Smith, S., & Cohen, D. J. (2014). Teachable moments for health behavior change and intermediate patient outcomes. *Patient Education and Counseling*, 96(1), 43-49.
- Folkman, S. (1984). Personal control and stress and coping processes: a theoretical analysis. *Journal of Personality and Social Psychology*, 46(4), 839.
- Folkman, S., Lazarus, R. S., Dunkel-Schetter, C., DeLongis, A., & Gruen, R. J. (1986). Dynamics of a stressful encounter: cognitive appraisal, coping, and encounter outcomes. *Journal of Personality and Social Psychology*, 50(5), 992.
- Fonov, V. S., Evans, A. C., McKinstry, R. C., Almli, C. R., & Collins, D. L. (2009). Unbiased Nonlinear Average Age-Appropriate Brain Templates from Birth to Adulthood. *NeuroImage*, 47(Suppl 1), S102.
- Fonseca, V. A. (2008). Identification and treatment of prediabetes to prevent progression to type 2 diabetes. *Clinical Cornerstone*, 9(2), 51-61.
- Fortune, D. G., Richards, H. L., Griffiths, C. E., & Main, C. J. (2002). Psychological stress, distress and disability in patients with psoriasis: consensus and variation in the contribution of illness perceptions, coping and alexithymia. *British Journal of Clinical Psychology*, 41(2), 157-174.
- Fox, J., & Weisberg, S. (2019). An R companion to applied regression (3rd ed.). *Sage*. Retrieved from <https://socialsciences.mcmaster.ca/jfox/Books/Companion/>
- French, D. P., Cooper, A., & Weinman, J. (2006). Illness perceptions predict attendance at cardiac rehabilitation following acute myocardial infarction: a systematic review with meta-analysis. *Journal of Psychosomatic Research*, 61(6), 757-767.
- Frith, U., & Frith, C. D. (2003). Development and neurophysiology of mentalizing. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, 358(1431), 459-473.
- Fruehwirth, J. C., Mazzolenis, M. E., Pepper, M. A., & Perreira, K. M. (2023). Perceived stress, mental health symptoms, and deleterious behaviors during the transition to college. *PLoS one*, 18(6), e0287735.

- Galaviz, K. I., Weber, M. B., Straus, A., Haw, J. S., Narayan, K. V., & Ali, M. K. (2018). Global diabetes prevention interventions: a systematic review and network meta-analysis of the real-world impact on incidence, weight, and glucose. *Diabetes Care*, 41(7), 1526-1534.
- Gan, D. Z., McGillivray, L., Han, J., Christensen, H., & Torok, M. (2021). Effect of engagement with digital interventions on mental health outcomes: a systematic review and meta-analysis. *Frontiers in Digital Health*, 3, 764079.
- Garcia-Toro, M., Rubio, J. M., Gili, M., Roca, M., Jin, C. J., Liu, S.-M., ... & Blanco, C. (2013). Persistence of chronic major depression: A national prospective study. *Journal of Affective Disorders*, 151, 306–312.
- Garland, E. L., Froeliger, B., & Howard, M. O. (2014). Mindfulness training targets neurocognitive mechanisms of addiction at the attention-appraisal-emotion interface. *Frontiers in Psychiatry*, 4, 173.
- Gaskin, D. J., Thorpe Jr, R. J., McGinty, E. E., Bower, K., Rohde, C., Young, J. H., ... & Dubay, L. (2014). Disparities in diabetes: the nexus of race, poverty, and place. *American Journal of Public Health*, 104(11), 2147-2155.
- Geiss, L. S., James, C., Gregg, E. W., Albright, A., Williamson, D. F., & Cowie, C. C. (2010). Diabetes risk reduction behaviors among US adults with prediabetes. *American Journal of Preventive Medicine*, 38(4), 403-409.
- Gibbons, M. B. C., Rothbard, A., Farris, K. D., Stirman, S. W., Thompson, S. M., & Scott, K. & Crits-Christoph, P. (2011). Changes in psychotherapy utilization among consumers of services for major depressive disorder in the community mental health system. *Administration and Policy in Mental Health and Mental Health Services Research*, 38(6), 495-503.
- Gillham, J. E., Shatté, A. J., & Freres, D. R. (2000). Preventing depression: A review of cognitive-behavioral and family interventions. *Applied and Preventive Psychology*, 9(2), 63-88.
- Glasgow, R. E., Hampson, S. E., Strycker, L. A., & Ruggiero, L. (1997). Personal-model beliefs and social-environmental barriers related to diabetes self-management. *Diabetes Care*, 20(4), 556-561.
- Gloster, A. T., Meyer, A. H., & Lieb, R. (2017). Psychological flexibility as a malleable public health target: Evidence from a representative sample. *Journal of Contextual Behavioral Science*, 6(2), 166-171.
- Glover, N. G., Sylvers, P. D., Shearer, E. M., Kane, M. C., Clasen, P. C., Epler, A. J., ... & Jakupcak, M. (2016). The efficacy of Focused Acceptance and Commitment Therapy in VA primary care. *Psychological Services*, 13(2), 156.
- Goldberg, R. B. (2009). Cytokine and cytokine-like inflammation markers, endothelial dysfunction, and imbalanced coagulation in development of diabetes and its complications. *The Journal of Clinical Endocrinology & Metabolism*, 94(9), 3171-3182.

- Golden, S. H., Brown, A., Cauley, J. A., Chin, M. H., Gary-Webb, T. L., Kim, C., ... & Anton, B. (2012). Health disparities in endocrine disorders: biological, clinical, and nonclinical factors—an Endocrine Society scientific statement. *The Journal of Clinical Endocrinology & Metabolism*, 97(9), E1579-E1639.
- Goldin, P., Ramel, W., & Gross, J. (2009). Mindfulness meditation training and self-referential processing in social anxiety disorder: Behavioral and neural effects. *Journal of Cognitive Psychotherapy*, 23(3), 242-257.
- Golovaty, I., Ritchie, N. D., Tuomilehto, J., Mohan, V., Ali, M. K., Gregg, E. W., ... & Moin, T. (2023). Two decades of diabetes prevention efforts: A call to innovate and revitalize our approach to lifestyle change. *Diabetes Research and Clinical Practice*, 198, 110195.
- Gomez-Peralta, F., Pérez, J. A. F., Molinero, A., Barrancos, I. M. S., Martínez, E. A., Martínez-Pérez, P., ... & Andrés-Rodríguez, N. F. (2021). Adherence to antidiabetic treatment and impaired hypoglycemia awareness in type 2 diabetes mellitus assessed in Spanish community pharmacies: the ADHIFAC study. *BMJ Open Diabetes Research and Care*, 9(2), e002148.
- Gonzalez, J. S., Peyrot, M., Mccarl, L. A., Collins, E. M., Serpa, L., Mimiaga, M. J., & Safren, S. A. (2008). Depression and diabetes treatment nonadherence: a meta-analysis. *Diabetes Care*, 31(12), 2398-2403.
- Gorgolewski, K., Burns, C. D., Madison, C., Clark, D., Halchenko, Y. O., Waskom, M. L., & Ghosh, S. (2011). Nipype: A Flexible, Lightweight and Extensible Neuroimaging Data Processing Framework in Python. *Frontiers in Neuroinformatics*, 5, 13. <https://doi.org/10.3389/fninf.2011.00013>
- Gorgolewski, K. J., Esteban, O., Markiewicz, C. J., Ziegler, E., Ellis, D. G., Notter, M. P., Jarecka, D., et al. (2018). *Nipype*. Software.
- Gotlib, I. H., & Joormann, J. (2010). Cognition and depression: current status and future directions. *Annual Review of Clinical Psychology*, 6, 285-312.
- Graham, C. D., Gouick, J., Krahe, C., & Gillanders, D. (2016). A systematic review of the use of Acceptance and Commitment Therapy (ACT) in chronic disease and long-term conditions. *Clinical Psychology Review*, 46, 46–58.
- Greenberg, L. S. (2017). *Emotion-focused therapy*. American Psychological Association.
- Gregg, J. A. (2004). A randomized controlled effectiveness trial comparing patient education with and without acceptance and commitment therapy for type 2 diabetes self-management. *University of Nevada, Reno*.
- Greve, D. N., & Fischl, B. (2009). Accurate and Robust Brain Image Alignment Using Boundary-Based Registration. *NeuroImage*, 48(1), 63–72.
- Gross, J., & Ligges, U. (2015). nortest: Tests for normality. *R package version 1.0-4*. Retrieved from <https://CRAN.R-project.org/package=nortest>
- Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry*, 26(1), 1-26.

- Gulley, T., Boggs, D., Mullins, R., & Brock, E. (2014). Diabetes screening in the workplace. *Workplace Health & Safety*, 62(11), 444-446.
- Gulliver, A., Calcar, A. L., Sunderland, M., Kay-Lambkin, F., Farrer, L. M., Banfield, M., & Batterham, P. J. (2020). Consumer-guided development of an engagement-facilitation intervention for increasing uptake and adherence for self-guided web-based mental health programs: focus groups and online evaluation survey. *JMIR Formative Research*, 4(10), e22528.
- Gundel, F., von Spee, J., Schneider, S., Haeussinger, F. B., Hautzinger, M., Erb, M., ... & Ehlis, A. C. (2018). Meditation and the brain—Neuronal correlates of mindfulness as assessed with near-infrared spectroscopy. *Psychiatry Research: Neuroimaging*, 271, 24-33.
- Gusnard, D. A., & Raichle, M. E. (2001). Searching for a baseline: functional imaging and the resting human brain. *Nature Reviews Neuroscience*, 2(10), 685-694.
- Gómez, C. A., Kleinman, D. V., Pronk, N., Gordon, G. L. W., Ochiai, E., Blakey, C., ... & Brewer, K. H. (2021). Addressing health equity and social determinants of health through healthy people 2030. *Journal of Public Health Management and Practice*, 27(Supplement 6), S249-S257.
- Hackett, R. A., & Steptoe, A. (2017). Type 2 diabetes mellitus and psychological stress—a modifiable risk factor. *Nature Reviews Endocrinology*, 13(9), 547-560.
- Hajat, A., Nurius, P., & Song, C. (2020). Differing trajectories of adversity over the life course: Implications for adult health and well-being. *Child Abuse & Neglect*, 102, 104392.
- Halliday, J. A., Speight, J., Bennet, A., Beeney, L. J., & Hendrieckx, C. (2020). The diabetes and emotional health handbook and toolkit for health professionals supporting adults with type 1 and type 2 diabetes: formative evaluation. *JMIR Formative Research*, 4(2), e15007.
- Hampson, S. E., Glasgow, R. E., & Toobert, D. J. (1990). Personal models of diabetes and their relations to self-care activities. *Health Psychology*, 9(5), 632.
- Hanley, A. W., Dorjee, D., & Garland, E. L. (2020). Mindfulness training encourages self-transcendent states via decentering. *Psychology of Consciousness: Theory, Research, and Practice*.
- Harrell, F. E. Jr. (2022). Hmisc: Harrell Miscellaneous. R package version 4.7-1. Retrieved from <https://CRAN.R-project.org/package=Hmisc>
- Harvey, J. N., & Lawson, V. L. (2009). The importance of health belief models in determining self-care behaviour in diabetes. *Diabetic Medicine*, 26(1), 5-13.
- Hasan, S. S., Clavarino, A. M., Mamun, A. A., & Kairuz, T. (2014). Incidence and risk of diabetes mellitus associated with depressive symptoms in adults: evidence from longitudinal studies. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 8(2), 82-87.

- Hasenkamp, W., Wilson-Mendenhall, C. D., Duncan, E., And Barsalou, L. W. (2012). Mind wandering and attention during focused meditation: a fine-grained temporal analysis of fluctuating cognitive states. *Neuroimage*, 59, 750–760. doi: 10.1016/j.neuroimage.2011.07.008
- Hawes, M. T., Szenczy, A. K., Klein, D. N., Hajcak, G., & Nelson, B. D. (2022). Increases in depression and anxiety symptoms in adolescents and young adults during the COVID-19 pandemic. *Psychological Medicine*, 52(14), 3222-3230.
- Hayes, S. C., Luoma, J. B., Bond, F. W., Masuda, A., & Lillis, J. (2006). Acceptance and commitment therapy: Model, processes and outcomes. *Behaviour Research and Therapy*, 44(1), 1-25.
- Healey, M. L., & Grossman, M. (2018). Cognitive and affective perspective-taking: evidence for shared and dissociable anatomical substrates. *Frontiers in Neurology*, 9, 372314.
- Helitzer, D. L., Peterson, A. B., Sanders, M., & Thompson, J. (2007). Relationship of Stages of Change to Attendance in a Diabetes Prevention Program. *American Journal of Health Promotion*, 21(6), 517–520. doi:10.4278/0890-1171-21.6.517
- Heth, J. T., & Somer, E. (2002). Characterizing stress tolerance: “Controllability awareness” and its relationship to perceived stress and reported health. *Personality and Individual Differences*, 33(6), 883-895.
- Hibbard, J. H., Stockard, J., Mahoney, E. R., & Tusler, M. (2004). Development of the Patient Activation Measure (PAM): Conceptualizing and measuring activation in patients and consumers. *Health Services Research*, 39, 1005-1026.
- Hibbard, J. H., Mahoney, E. R., Stockard, J., & Tusler, M. (2005). Development and testing of a short form of the patient activation measure. *Health Services Research*, 40(6p1), 1918-1930.
- Hill, C. E., Thompson, B. J., & Williams, E. N. (1997). A guide to conducting consensual qualitative research. *The Counseling Psychologist*, 25(4), 517-572.
- Hill-Briggs, F., Adler, N. E., Berkowitz, S. A., Chin, M. H., Gary-Webb, T. L., Navas-Acien, A., ... & Haire-Joshu, D. (2021). Social determinants of health and diabetes: A scientific review. *Diabetes Care*, 44(1), 258.
- Hing, E. (2010). Visits to primary care delivery sites: United States, 2008 (No. 47). US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.
- Hobbs, C., Armitage, J., Hood, B., & Jelbert, S. (2022). A systematic review of the effect of university positive psychology courses on student psychological wellbeing. *Frontiers in Psychology*, 13, 1023140.
- Hobbs, C., Jelbert, S., Santos, L. R., & Hood, B. (2024). Long-term analysis of a psychoeducational course on university students’ mental well-being. *Higher Education*, 1-13.

- Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T., & Stephenson, D. (2015). Loneliness and social isolation as risk factors for mortality: A meta-analytic review. *Perspectives on Psychological Science*, 10(2), 227-237.
- Holtzman, N. S. (2017). A meta-analysis of correlations between depression and first person singular pronoun use. *Journal of Research in Personality*, 68, 63-68.
- Hood, B., Jelbert, S., & Santos, L. R. (2021). Benefits of a psychoeducational happiness course on university student mental well-being both before and during a COVID-19 lockdown. *Health Psychology Open*, 8, 2055102921999291.
- Hurt, C. S., Burn, D. J., Hindle, J., Samuel, M., Wilson, K., & Brown, R. G. (2014). Thinking positively about chronic illness: An exploration of optimism, illness perceptions and well-being in patients with Parkinson's disease. *British Journal of Health Psychology*, 19(2), 363-379.
- Iacoboni, M., et al. (2004). Watching social interactions produces dorsomedial prefrontal and medial parietal BOLD fMRI signal increases compared to a resting baseline. *NeuroImage*, 21, 1167-1173.
- International Diabetes Federation. (2019). IDF Diabetes Atlas (9th ed.). International Diabetes Federation.
- Irons, B. K., Mazzolini, T. A., & Greene, R. S. (2004). Delaying the onset of type 2 diabetes mellitus in patients with prediabetes. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*, 24(3), 362-371.
- Jain, F. A., & Fonagy, P. (2020). Mentalizing Imagery Therapy: Theory and case series of imagery and mindfulness techniques to understand self and others. *Mindfulness*, 11(1), 153-165.
<https://doi.org/10.1007/s12671-018-0969-1>
- Jalkanen, K., Järvenpää, R., Tilles-Tirkkonen, T., Martikainen, J., Aarnio, E., Männikkö, R., ... & Stopdia Study Group. (2021). Comparison of communication channels for large-scale type 2 diabetes risk screening and intervention recruitment: empirical study. *JMIR Diabetes*, 6(3), e21356.
- Jamieson, J. P., & Hangen, E. J. (2022). The roles of appraisal and perception in stress responses, and leveraging appraisals and mindsets to improve stress responses. In *Biopsychosocial Factors of Stress, and Mindfulness for Stress Reduction* (pp. 105-129). Cham: Springer International Publishing.
- Jenkinson, M., Bannister, P., Brady, M., & Smith, S. (2002). Improved optimization for the robust and accurate linear registration and motion correction of brain images. *NeuroImage*, 17(2), 825-841.
- Jo, D., Im, S., Suh, D. E., Spencer, S. D., & Masuda, A. (2023). The personalized psychological flexibility index (PPFI): An item response theory analysis with racially diverse college students. *Journal of Psychopathology and Behavioral Assessment*, 45(3), 829-843.
- Johnstone, B., Bodling, A., Cohen, D., Christ, S. E., & Wegrzyn, A. (2012). Right parietal lobe-related “selflessness” as the neuropsychological basis of spiritual transcendence. *International Journal for the Psychology of Religion*, 22(4), 267-284.

- Jones, H., Edwards, L., Vallis, T. M., Ruggiero, L., Rossi, S. R., Rossi, J. S., ... & Zinman, B. (2003). Changes in diabetes self-care behaviors make a difference in glycemic control: the Diabetes Stages of Change (DiSC) study. *Diabetes Care*, 26(3), 732-737.
- Joormann, J., Dkane, M., & Gotlib, I. H. (2006). Adaptive and maladaptive components of rumination? Diagnostic specificity and relation to depressive biases. *Behavior Therapy*, 37(3), 269-280.
- Joubert, A. E., Moulds, M. L., Werner-Seidler, A., Sharrock, M., Popovic, B., & Newby, J. M. (2022). Understanding the experience of rumination and worry: A descriptive qualitative survey study. *British Journal of Clinical Psychology*, 61(4), 929-946.
- Jung, F. U., Bae, Y. J., Kratzsch, J., Riedel-Heller, S. G., & Luck-Sikorski, C. (2020). Internalized weight bias and cortisol reactivity to social stress. *Cognitive, Affective, & Behavioral Neuroscience*, 20, 49-58.
- Kabat-Zinn, J. (1990). *Full Catastrophe Living: Using the Wisdom of Your Body and Mind to Face Stress, Pain, and Illness*. New York: Delacorte Press.
- Kan, C., Silva, N., Golden, S. H., Rajala, U., Timonen, M., Stahl, D., & Ismail, K. (2013). A systematic review and meta-analysis of the association between depression and insulin resistance. *Diabetes Care*, 36(2), 480-489.
- Kane, M. J., & McVay, J. C. (2012). What mind wandering reveals about executive-control abilities and failures. *Current Directions in Psychological Science*, 21(5), 348-354.
- Kashdan, T. B., Disabato, D. J., Goodman, F. R., Doorley, J. D., & McKnight, P. E. (2020). Understanding psychological flexibility: A multimethod exploration of pursuing valued goals despite the presence of distress. *Psychological Assessment*, 32(9), 829. DOI: 10.1037/pas0000834
- Kashdan, T. B., & Rottenberg, J. (2010). Psychological flexibility as a fundamental aspect of health. *Clinical Psychology Review*, 30(7), 865-878.
- Kashdan, T. B., Barrios, V., Forsyth, J. P., & Steger, M. F. (2006). Experiential avoidance as a generalized psychological vulnerability: Comparisons with coping and emotion regulation strategies. *Behaviour Research and Therapy*, 44(9), 1301-1320.
- Kassambara, A. (2023). rstatix: Pipe-friendly framework for basic statistical tests. *R package version 1.1.0*. Retrieved from <https://CRAN.R-project.org/package=rstatix>
- Kawahara, T., Takahashi, K., Inazu, T., Arao, T., Kawahara, C., Tabata, T., ... & Tanaka, Y. (2008). Reduced progression to type 2 diabetes from impaired glucose tolerance after a 2-day in-hospital diabetes educational program: the Joetsu Diabetes Prevention Trial. *Diabetes Care*, 31(10), 1949-1954.
- Keech, J. J., Hagger, M. S., O'Callaghan, F. V., & Hamilton, K. (2018). The influence of university students' stress mindsets on health and performance outcomes. *Annals of Behavioral Medicine*, 52(12), 1046-1059.

- Kemp, S., Morley, S., & Anderson, E. (1999). Coping with epilepsy: Do illness representations play a role? *British Journal of Clinical Psychology*, 38(1), 43-58.
- Kestemont, J., Ma, N., Baetens, K., Clément, N., Van Overwalle, F., & Vandekerckhove, M. (2015). Neural correlates of attributing causes to the self, another person and the situation. *Social Cognitive and Affective Neuroscience*, 10(1), 114-121.
- Khakshour Shandiz, F., Sodagar, S., Annani Sarab, G., Malihi Al-zakerini, S., & Zarban, A. (2021). Effectiveness of mindfulness-based cognitive therapy on cognitive fusion and positive and negative affect in women with type II diabetes. *Journal of Diabetes Nursing*, 9(2), 1419-1430.
- Kiecolt-Glaser, J. K., Derry, H. M., & Fagundes, C. P. (2015). Inflammation: Depression fans the flames and feasts on the heat. *American Journal of Psychiatry*, 172(11), 1075-1091.
- Kiecolt-Glaser, J. K., Renna, M. E., Shrout, M. R., & Madison, A. A. (2020). Stress reactivity: What pushes us higher, faster, and longer—and why it matters. *Current Directions in Psychological Science*, 29(5), 492-498.
- Killingsworth, M. A., & Gilbert, D. T. (2010). A wandering mind is an unhappy mind. *Science*, 330(6006), 932-932.
- Klein Woolthuis, E. P., De Grauw, W. J., Cardol, M., van Weel, C., Metsemakers, J. F., & Biermans, M. C. (2013). Patients' and partners' illness perceptions in screen-detected versus clinically diagnosed type 2 diabetes: partners matter! *Family Practice*, 30(4), 418-425.
- Klein, A., Ghosh, S. S., Bao, F. S., Giard, J., Häme, Y., Stavsky, E., Lee, N., et al. (2017). Mindboggling morphometry of human brains. *PLOS Computational Biology*, 13(2), e1005350.
- Kleinman, K. E., Asselin, C., & Henriques, G. (2014). Positive consequences: The impact of an undergraduate course on positive psychology. *Psychology*, 5(18), 2033.
- Koenigsberg, H. W., Fan, J., Ochsner, K. N., Liu, X., Guise, K., Pizzarello, S., ... & Siever, L. J. (2010). Neural correlates of using distancing to regulate emotional responses to social situations. *Neuropsychologia*, 48(6), 1813-1822.
- Kogler, L., Müller, V. I., Werminghausen, E., Eickhoff, S. B., & Derntl, B. (2020). Do I feel or do I know? Neuroimaging meta-analyses on the multiple facets of empathy. *Cortex*, 129, 341-355.
- Komsta, L., & Novomestky, F. (2022). moments: Moments, cumulants, skewness, kurtosis and related tests. R package version 0.15. Retrieved from <https://CRAN.R-project.org/package=moments>
- Korytkowski, M. T., Muniyappa, R., Antinori-Lent, K., Donihi, A. C., Drincic, A. T., Hirsch, I. B., ... & Umpierrez, G. E. (2022). Management of hyperglycemia in hospitalized adult patients in non-critical care settings: an Endocrine Society clinical practice guideline. *The Journal of Clinical Endocrinology & Metabolism*, 107(8), 2101-2128.

- Kretchy, I. A., Koduah, A., Ohene-Agyei, T., Boima, V., & Appiah, B. (2020). The association between diabetes-related distress and medication adherence in adult patients with type 2 diabetes mellitus: A cross-sectional study. *Journal of Diabetes Research*, 2020(1), 4760624.
- Kross, E. (2009). When the self becomes other: Toward an integrative understanding of the processes distinguishing adaptive self-reflection from rumination. *Annals of the New York Academy of Sciences*, 1167(1), 35-40.
- Kross, E., Ayduk, O., & Mischel, W. (2005). When asking “why” does not hurt: Distinguishing rumination from reflective processing of negative emotions. *Psychological Science*, 16(9), 709-715.
- Kross, E., & Ayduk, O. (2017). Self-distancing: Theory, research, and current directions. In *Advances in experimental social psychology* (Vol. 55, pp. 81-136). Academic Press.
- Kross, E., Duckworth, A., Ayduk, O., Tsukayama, E., & Mischel, W. (2011). The effect of self-distancing on adaptive versus maladaptive self-reflection in children. *Emotion*, 11(5), 1032.
- Kross, E., Gard, D., Deldin, P., Clifton, J., & Ayduk, Ö. (2012). “Asking why” from a distance: Its cognitive and emotional consequences for people with major depressive disorder. *Journal of Abnormal Psychology*, 121, 559–569. doi:10.1037/a0028808
- Laitinen, J., Ek, E., & Sovio, U. (2002). Stress-related eating and drinking behavior and body mass index and predictors of this behavior. *Preventive Medicine*, 34(1), 29-39.
- Lawal, Y., Bello, F., & Kaoje, Y. S. (2020). Prediabetes deserves more attention: A review. *Clinical Diabetes*, 38(4), 328-338.
- Lazarus, R. S. (1993). Coping theory and research: Past, present, and future. *Psychosomatic Medicine*, 55(3), 234-247.
- Lazarus, R. S., & Launier, R. (1978). Stress-related transactions between person and environment. In *Perspectives in interactional psychology* (pp. 287-327). Boston, MA: Springer US.
- LeBron, A. M., Valerio, M. A., Kieffer, E., Sinco, B., Rosland, A. M., Hawkins, J., ... & Spencer, M. (2014). Everyday discrimination, diabetes-related distress, and depressive symptoms among African Americans and Latinos with diabetes. *Journal of Immigrant and Minority Health*, 16, 1208-1216.
- LeMoult, J., Arditte, K. A., D'Avanzato, C., & Joormann, J. (2013). State rumination: Associations with emotional stress reactivity and attention biases. *Journal of Experimental Psychopathology*, 4(5), 471-484.
- Lean, M. E. J., Leslie, W. S., Barnes, A. C., Brosnahan, N., Thom, G., McCombie, L., ... & Taylor, R. (2018). Durability of a primary care-led weight-management intervention for remission of type 2 diabetes: 2-year results of the DiRECT open-label, cluster-randomised trial. *Lancet Diabetes & Endocrinology*, 7(5), 344-355.

- Lee, R. M., & Robbins, S. B. (1995). Measuring belongingness: The Social Connectedness and Social Assurance scales. *Journal of Counseling Psychology*, 42(2), 232-241.
<https://doi.org/10.1037/0022-0167.42.2.232>
- Lemos, M. (2015). Changes in illness perceptions after cognitive behavior therapy in depressed cardiac patients. *Annals of Behavioral Medicine*.
- Levenson, M. R., Jennings, P. A., Aldwin, C. M., & Shiraishi, R. W. (2005). Self-transcendence: Conceptualization and measurement. *The International Journal of Aging and Human Development*, 60(2), 127-143
- Leventhal, H. (1984). Rewards and adolescent health behavior: Promise or promise missed. *Health Psychology*, 3(4), 347-349. <https://doi.org/10.1037/h0090263>
- Leventhal, H., Benyamini, Y., Brownlee, S., Diefenbach, M., Leventhal, E. A., Patrick-Miller, L., & Robitaille, C. (1997). Illness representations: Theoretical foundations. *Perceptions of Health and Illness*, 2, 19-46.
- Leventhal, H., Diefenbach, M., & Leventhal, E. A. (1992). Illness cognition: Using common sense to understand treatment adherence and affect cognition interactions. *Cognitive Therapy and Research*, 16, 143-163.
- Leventhal, H., Nerenz, D. R., & Steele, D. J. (2020). Illness representations and coping with health threats. In *Handbook of Psychology and Health, Volume IV* (pp. 219-252). Routledge.
- Levy, N. K., Park, A., Solis, D., Hu, L., Langford, A. T., Wang, B., & Rogers, E. S. (2022). Social determinants of health and diabetes-related distress in patients with insulin-dependent type 2 diabetes: Cross-sectional, mixed methods approach. *JMIR Formative Research*, 6(10), e40164.
- Lewinsohn, P. M., Seeley, J. R., Roberts, R. E., & Allen, N. B. (1997). Center for Epidemiologic Studies Depression Scale (CES-D) as a screening instrument for depression among community-residing older adults. *Psychology and Aging*, 12(2), 277.
- Li, G., Zhang, J., Van Spall, H. G., Douglas, P. S., Wang, Y., Sun, X., & Thabane, L. (2022). Exploring ethnic representativeness in diabetes clinical trial enrolment from 2000 to 2020: A chronological survey. *Diabetologia*, 65(9), 1461-1472.
- Lieberman, N., & Trope, Y. (2008). The psychology of transcending the here and now. *Science*, 322(5905), 1201-1205.
- Light, R. S., Chilcot, J., & McBride, E. (2021). Psychological distress in women living with polycystic ovary syndrome: The role of illness perceptions. *Women's Health Issues*, 31(2), 177-184.
- Lin, Y., Callahan, C. P., & Moser, J. S. (2018). A mind full of self: Self-referential processing as a mechanism underlying the therapeutic effects of mindfulness training on internalizing disorders. *Neuroscience & Biobehavioral Reviews*, 92, 172-186.

- Lin, K., Park, C., Li, M., Wang, X., Li, X., Li, W., & Quinn, L. (2017). Effects of depression, diabetes distress, diabetes self-efficacy, and diabetes self-management on glycemic control among Chinese population with type 2 diabetes mellitus. *Diabetes Research and Clinical Practice*, 131, 179-186.
- Lindsay, E. K., & Creswell, J. D. (2019). Mindfulness, acceptance, and emotion regulation: Perspectives from Monitor and Acceptance Theory (MAT). *Current Opinion in Psychology*, 28, 120-125.
- Lipsett, M., & Berkman, E. (in preparation). Psychological risk and protective factors related to diabetes distress and diabetes self-management.
- Lipsett, M., & Berkman, E. (in review). A randomized controlled trial of an ACT-informed diabetes prevention program reduces body shame and distress. *Health Psychology. Special issue on Social Influences on Physical Health - Patterns, Mechanisms, and Solutions*.
- Lombardo, M. V., Chakrabarti, B., Bullmore, E. T., Wheelwright, S. J., Sadek, S. A., Suckling, J., ... & Baron-Cohen, S. (2010). Shared neural circuits for mentalizing about the self and others. *Journal of Cognitive Neuroscience*, 22(7), 1623-1635.
- Lu, A. D., Gunzburger, E., Glorioso, T. J., Smith, W. B., Kenney, R. R., Whooley, M. A., & Ho, P. M. (2021). Impact of longitudinal virtual primary care on diabetes quality of care. *Journal of General Internal Medicine*, 1-8.
- Luoma, J. B., Hayes, S. C., & Walser, R. D. (2007). *Learning ACT: An Acceptance & Commitment Therapy Skills-Training Manual for Therapists*. New Harbinger Publications.
- Lustman, P. J., Freedland, K. E., Griffith, L. S., & Clouse, R. E. (2000). Fluoxetine for depression in diabetes: a randomized double-blind placebo-controlled trial. *Diabetes Care*, 23(5), 618-623.
- Madison, A. A. (2021). Boosting stress resilience using flexibility as a framework to reduce depression risk. *Brain, Behavior, & Immunity-Health*, 18, 100357.
- Magee, M. F., Baker, K. M., Bardsley, J. K., Wesley, D., & Smith, K. M. (2021). Diabetes to go-inpatient: pragmatic lessons learned from implementation of technology-enabled diabetes survival skills education within nursing unit workflow in an urban, tertiary care hospital. *The Joint Commission Journal on Quality and Patient Safety*, 47(2), 107-119.
- Magliano, D. J., & Boyko, E. J. (2021). IDF Diabetes Atlas (10th ed.). Brussels: International Diabetes Federation. Retrieved from <https://diabetesatlas.org>.
- Mainous, A. G., Rooks, B. J., Wright, R. U., Sumfest, J. M., & Carek, P. J. (2022). Diabetes prevention in a U.S. healthcare system: A portrait of missed opportunities. *American Journal of Preventive Medicine*, 62(1), 50-56. <https://doi.org/10.1016/j.amepre.2021.06.018>
- Mangoulia, P., Milonis, C., Vlachou, E., & Ilias, I. (2024, July). The interrelationship between diabetes mellitus and emotional well-being: Current concepts and future prospects. In *Healthcare (Vol. 12, No. 14, p. 1457)*. MDPI.

- Mann, D. M., Chen, J., Chunara, R., Testa, P. A., & Nov, O. (2020). COVID-19 transforms health care through telemedicine: Evidence from the field. *Journal of the American Medical Informatics Association*, 27(7), 1132-1135.
- Mann, D. M., & Lin, J. J. (2012). Increasing efficacy of primary care-based counseling for diabetes prevention: Rationale and design of the ADAPT (Avoiding Diabetes Thru Action Plan Targeting) trial. *Implementation Science*, 7, 1-11.
- Mao, L., Li, P., Wu, Y., Luo, L., & Hu, M. (2023). The effectiveness of mindfulness-based interventions for ruminative thinking: A systematic review and meta-analysis of randomized controlled trials. *Journal of Affective Disorders*, 321, 83-95.
- Mar, R. A. (2011). The neural bases of social cognition and story comprehension. *Annual Review of Psychology*, 62(1), 103-134.
- Marais, G. A., Lantheaume, S., Fiault, R., & Shankland, R. (2020). Mindfulness-based programs improve psychological flexibility, mental health, well-being, and time management in academics. *European Journal of Investigation in Health, Psychology and Education*, 10(4), 1035-1050.
- Maresh, E. L., & Andrews-Hanna, J. R. (2021). Putting the “Me” in “Mentalizing”: Multiple constructs describing self versus other during mentalizing and implications for social anxiety disorder. In *The neural basis of mentalizing* (pp. 629-658). Cham: Springer International Publishing.
- Margola, D., Travagin, G., & Dennis, J. L. (2018). Taking a step back: Self-distancing dynamics in adolescent writing about peer problems. *Journal of Adolescence*, 65, 6-15.
- Mariano, B. (2020). Towards a global strategy on digital health. *Bulletin of the World Health Organization*, 98(4), 231.
- Marteau, T. M., & Bekker, H. (1992). The development of a six-item short-form of the state scale of the Spielberger State-Trait Anxiety Inventory (STAI). *British Journal of Clinical Psychology*, 31(3), 301-306. <https://doi.org/10.1111/j.2044-8260.1992.tb00997>.
- Martin, A. (2014). Interpersonal relationships and students' academic and non-academic development. In D. Zandvliet, P. Den Brook, T. Mainhard, & J. Van Tartwijk (Eds.), *Interpersonal relationships in education: From theory to practice* (pp. 8-24). Rotterdam, The Netherlands: Sense Publishers.
- Mashek, D., Cannaday, L. W., & Tangney, J. P. (2007). Inclusion of community in self scale: A single-item pictorial measure of community connectedness. *Journal of Community Psychology*, 35(2), 257-275. <https://doi.org/10.1002/jcop.20146>
- Mason, M. F., Norton, M. I., Van Horn, J. D., Wegner, D. M., Graffon, S. T., & Macrae, C. N. (2007). Wandering minds: The default network and stimulus-independent thought. *Science*, 315, 393. doi:10.1126/science.1131295

- Masoud, K. (2023). Implementing a Prediabetes Screening Algorithm to Improve Identification and Referrals in Primary Care (Doctoral dissertation, Yale University).
- McGovern, A., Hinton, W., Correa, A., Munro, N., Whyte, M., & de Lusignan, S. (2016). Real-world evidence studies into treatment adherence, thresholds for intervention and disparities in treatment in people with type 2 diabetes in the UK. *BMJ Open*, 6(11).
- Mehl, M. R., Robbins, M. L., & Holleran, S. E. (2012). How taking a word for a word can be problematic: Context-dependent linguistic markers of extraversion and neuroticism. *Journal of Methods and Measurement in the Social Sciences*, 3(2), 30-50.
- Mehl, M. R., & Conner, T. S. (Eds.). (2012). *Handbook of Research Methods for Studying Daily Life*. Guilford Press.
- Mehta, S., Mocarski, M., Wisniewski, T., Gillespie, K., Narayan, K. V., & Lang, K. (2017). Primary care physicians' utilization of type 2 diabetes screening guidelines and referrals to behavioral interventions: A survey-linked retrospective study. *BMJ Open Diabetes Research and Care*, 5(1), e000406.
- Mennin, D. S., Ellard, K. K., Fresco, D. M., & Gross, J. J. (2013). United we stand: Emphasizing commonalities across cognitive-behavioral therapies. *Behavior Therapy*, 44(2), 234-248.
- Mercado, C. I., McKeever Bullard, K., Gregg, E. W., Ali, M. K., Saydah, S. H., & Imperatore, G. (2021). Differences in US rural-urban trends in diabetes ABCs, 1999–2018. *Diabetes Care*, 44(8), 1766-1773.
- Messina, I., Grecucci, A., & Viviani, R. (2021). Neurobiological models of emotion regulation: A meta-analysis of neuroimaging studies of acceptance as an emotion regulation strategy. *Social Cognitive and Affective Neuroscience*, 16(3), 257-267.
- Michalak, J., Hölz, A., & Teismann, T. (2011). Rumination as a predictor of relapse in mindfulness-based cognitive therapy for depression. *Psychology and Psychotherapy: Theory, Research and Practice*, 84(2), 230-236.
- Mitchell, J. P. (2009). Inferences about mental states. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364(1521), 1309-1316.
- Mooy, J. M., De Vries, H., Grootenhuis, P. A., Bouter, L. M., & Heine, R. J. (2000). Major stressful life events in relation to prevalence of undetected type 2 diabetes: The Hoorn Study. *Diabetes Care*, 23(2), 197-201.
- Moss-Morris, R., Petrie, K. J., & Weinman, J. (1996). Functioning in chronic fatigue syndrome: Do illness perceptions play a regulatory role? *British Journal of Health Psychology*, 1(1), 15-25.
<https://doi.org/10.1111/j.2044-8287.1996.tb00488.x>
- Moss-Morris, R., Weinman, J., Petrie, K., Horne, R., Cameron, L., & Buick, D. (2002). The revised illness perception questionnaire (IPQ-R). *Psychology & Health*, 17(1), 1-16.
<https://doi.org/10.1080/08870440290001494>

- Murdoch, E. M., Chapman, M. T., Crane, M., & Gucciardi, D. F. (2023). The effectiveness of self-distanced versus self-immersed reflections among adults: Systematic review and meta-analysis of experimental studies. *Stress and Health*, 39(2), 255-271.
- Müller, K., & Wickham, H. (2023). tibble: Simple data frames. *R package version 3.1.6*. Retrieved from <https://CRAN.R-project.org/package=tibble>
- Nasarudin, A., Moeck, E. K., & Koval, P. (2023). Re-appraising stressors from a distance: Effects of linguistic distancing on cognitive appraisals and emotional responses to interpersonal conflict. *Cognition and Emotion*, 37(7), 1281-1289.
- Neimeyer, R. A., Kazantzis, N., Kassler, D. M., Baker, K. D., & Fletcher, R. (2008). Group cognitive behavioural therapy for depression outcomes predicted by willingness to engage in homework, compliance with homework, and cognitive restructuring skill acquisition. *Cognitive Behaviour Therapy*, 37(4), 199-215.
- Nepon, T., Flett, G. L., Hewitt, P. L., & Molnar, D. S. (2011). Perfectionism, negative social feedback, and interpersonal rumination in depression and social anxiety. *Canadian Journal of Behavioral Science/Revue Canadienne des Sciences du Comportement*, 43(4), 297.
- Neprash, H. T., Everhart, A., McAlpine, D., Smith, L. B., Sheridan, B., & Cross, D. A. (2021). Measuring primary care exam length using electronic health record data. *Medical Care*, 59(1), 62-66.
- Neprash, H. T., Mulcahy, J. F., Cross, D. A., Gaugler, J. E., Golberstein, E., & Ganguli, I. (2023). Association of primary care visit length with potentially inappropriate prescribing. In *JAMA Health Forum (Vol. 4, No. 3, pp. e230052-e230052)*. American Medical Association.
- Neuwirth, E. (2014). RColorBrewer: ColorBrewer palettes. *R package version 1.1-2*. Retrieved from <https://CRAN.R-project.org/package=RColorBrewer>
- Ng, D. M., & Jeffery, R. W. (2003). Relationships between perceived stress and health behaviors in a sample of working adults. *Health Psychology*, 22(6), 638.
- Ngan, H. Y., & Jeffery, R. W. (2003). Effects of mindfulness-and acceptance-based interventions on diabetes distress and glycaemic level in people with type 2 diabetes: Systematic review and meta-analysis. *Diabetic Medicine*.
- Ngan, H. Y., Chong, Y. Y., Loo, K. M., & Chien, W. T. (2023). Preliminary efficacy of an acceptance-based diabetes education (ACT-DE) programme for people with type 2 diabetes on diabetes distress and self-care behaviours: A pilot randomised controlled trial. *Journal of Contextual Behavioral Science*, 30, 50-60.
- Nicolucci, A., Kovacs Burns, K., Holt, R. I., Comaschi, M., Hermanns, N., Ishii, H., ... & DAWN2 Study Group. (2013). Diabetes Attitudes, Wishes and Needs second study (DAWN2™): Cross-national

- benchmarking of diabetes -related psychosocial outcomes for people with diabetes. *Diabetic Medicine*, 30(7), 767-777.
- Nielsen, K. K., Damm, P., Bygbjerg, I. C., & Kapur, A. (2018). Barriers and facilitators for implementing programmes and services to address hyperglycemia in pregnancy in low and middle income countries: A systematic review. *Diabetes Research and Clinical Practice*, 145, 102-118
- Nigro, G., & Neisser, U. (1983). Point of view in personal memories. *Cognitive Psychology*, 15(4), 467-482.
- Nishina, M., Nishina, K., Ohira, T., Makino, K., & Iso, H. (2011). Associations of psychological distress with metabolic syndrome among Japanese urban residents. *Journal of Atherosclerosis and Thrombosis*, 18(5), 396-402.
- Nook, E. C., Schleider, J. L., & Somerville, L. H. (2017). A linguistic signature of psychological distancing in emotion regulation. *Journal of Experimental Psychology: General*, 146(3), 337.
- Northoff, G., & Bermpohl, F. (2004). Cortical midline structures and the self. *Trends in Cognitive Sciences*, 8(3), 102-107.
- Northoff, G., Heinzl, A., De Greck, M., Bermpohl, F., Dobrowolny, H., & Panksepp, J. (2006). Self-referential processing in our brain—a meta-analysis of imaging studies on the self. *NeuroImage*, 31(1), 440-457.
- Nouwen, A., Urquhart Law, G., Hussain, S., McGovern, S., & Napier, H. (2009). Comparison of the role of self-efficacy and illness representations in relation to dietary self-care and diabetes distress in adolescents with type 1 diabetes. *Psychology and Health*, 24(9), 1071-1084.
- Novak, M., Björck, L., Giang, K. W., Heden-Ståhl, C., Wilhelmsen, L., & Rosengren, A. (2013). Perceived stress and incidence of type 2 diabetes: A 35-year follow-up study of middle-aged Swedish men. *Diabetic Medicine*, 30(1), e8-e16.
- Nutter, S., Eggerichs, L. A., Nagpal, T. S., Ramos Salas, X., Chin Chea, C., Saiful, S., ... & Yusop, S. (2023). Changing the global obesity narrative to recognize and reduce weight stigma: A position statement from the World Obesity Federation. *Obesity Reviews*, e13642.
- Núñez, E. I. (2016). General fatalism and diabetes fatalism as predictors of diabetes treatment adherence.
- O'Brien, M. J., Moran, M. R., Tang, J. W., Vargas, M. C., Talen, M., Zimmermann, L. J., ... & Kandula, N. R. (2016). Patient perceptions about prediabetes and preferences for diabetes prevention. *The Diabetes Educator*, 42(6), 667-677.
- Ochsner, K. N., & Gross, J. J. (2008). Cognitive emotion regulation: Insights from social cognitive and affective neuroscience. *Current Directions in Psychological Science*, 17(2), 153-158.

- Oggioni, C., Lara, J., Wells, J. C. K., Soroka, K., & Siervo, M. (2014). Shifts in population dietary patterns and physical inactivity as determinants of global trends in the prevalence of diabetes: an ecological analysis. *Nutrition, Metabolism and Cardiovascular Diseases*, *24*(10), 1105-1111.
- Orvell, A., Bruhlman-Senecal, E., Vickers, B., Kross, E., & Ayduk, Ö. (2023). From the laboratory to daily life: Preliminary evidence that self-distancing training buffers vulnerable individuals against daily rumination and depression over time. *Psychology of Consciousness: Theory, Research, and Practice*, *10*(2), 164.
- Ottaviani, C., Thayer, J. F., Verkuil, B., Lonigro, A., Medea, B., Couyoumdjian, A., & Brosschot, J. F. (2016). Physiological concomitants of perseverative cognition: A systematic review and meta-analysis. *Psychological Bulletin*, *142*(3), 231–259.
- Oyedemi, A. D., Ullah, I., Weich, S., Bentall, R., & Booth, A. (2022). Effectiveness of non-specialist delivered psychological interventions on glycemic control and mental health problems in individuals with type 2 diabetes: A systematic review and meta-analysis. *International Journal of Mental Health Systems*, *16*(1), 9. <https://doi.org/10.1186/s13033-022-00521-2>
- Pagnoni, G. (2012). Dynamical properties of BOLD activity from the ventral posteromedial cortex associated with meditation and attentional skills. *Journal of Neuroscience*, *32*(16), 5242–5249. doi:10.1523/JNEUROSCI.4135-11.2012
- Pal, G., & Nanda, N. (2017). Transition from prediabetes to diabetes is preventable. *International Journal of Clinical and Experimental Physiology*, *4*(4), 163-163.
- Papageorgiou, C., & Wells, A. (2001). Metacognitive beliefs about rumination in recurrent major depression. *Cognitive and Behavioral Practice*, *8*(2), 160-164.
- Park, J., Ayduk, O., & Kross, E. (2016). Stepping back to move forward: Expressive writing promotes self-distancing. *Emotion*, *16*(3), 349–364. <http://dx.doi.org/10.1037/emo0000121>.
- Patriat, R., Reynolds, R. C., & Birn, R. M. (2017). An improved model of motion-related signal changes in fMRI. *NeuroImage*, *144*, 74–82.
- Pennebaker, J. W., & Chung, C. K. (2007). Expressive writing, emotional upheavals, and health. In *Foundations of health psychology* (pp. 263-284).
- Pennebaker, J. W., & Graybeal, A. (2001). Patterns of natural language use: Disclosure, personality, and social integration. *Current Directions in Psychological Science*, *10*(3), 90-93.
- Pennebaker, J. W., Booth, R. J., Boyd, R. L., & Francis, M. E. (2015). Linguistic inquiry and word count: LIWC2015. Pennebaker Conglomerates (www.LIWC.net).
- Perrin, N. E., Davies, M. J., Robertson, N., Snoek, F. J., & Khunti, K. (2017). The prevalence of diabetes-specific emotional distress in people with Type 2 diabetes: A systematic review and meta-analysis. *Diabetic Medicine*, *34*(11), 1508-1520.

- Peters, G. J. Y., Ruiter, R. A., & Kok, G. (2013). Threatening communication: A critical re-analysis and a revised meta-analytic test of fear appeal theory. *Health Psychology Review*, 7(sup1), S8-S31.
- Petrie, K. J., Jago, L. A., & Devcich, D. A. (2007). The role of illness perceptions in patients with medical conditions. *Current Opinion in Psychiatry*, 20(2), 163-167.
- Petrie, K., & Weinman, J. (2006). Why illness perceptions matter. *Clinical Medicine*, 6(6), 536.
- Petrova, K., Nevarez, M. D., Waldinger, R. J., Preacher, K. J., & Schulz, M. S. (2021). Self-distancing and avoidance mediate the links between trait mindfulness and responses to emotional challenges. *Mindfulness*, 12, 947-958.
- Pfeifer, J. H., Lieberman, M. D., & Dapretto, M. (2007). "I know what you are but what am I!": Neural bases of self- and social knowledge retrieval in children and adults. *Journal of Cognitive Neuroscience*, 19(8), 1323-1337.
- Polello, J. M., Woodard, L. J., & Weeks, D. L. (2009). The impact of rural community-based diabetes screenings to motivate clients to action. *Washington State Journal of Public Health Practice*, 2(2), 47-68.
- Polonsky, W. H., Fisher, L., Esarles, J., Dudl, R. J., Lees, J., Mullan, J. T., & Jackson, R. (2005). Assessing psychosocial distress in diabetes: Development of the Diabetes Distress Scale. *Diabetes Care*, 28(3), 626-631.
- Porter, J., Boyd, C., Skandari, M. R., & Laiteerapong, N. (2023). Revisiting the time needed to provide adult primary care. *Journal of General Internal Medicine*, 38(1), 147-155.
- Power, J. D., Mitra, A., Laumann, T. O., Snyder, A. Z., Schlaggar, B. L., & Petersen, S. E. (2014). Methods to detect, characterize, and remove motion artifact in resting state fMRI. *NeuroImage*, 84(Suppl C), 320-341.
- Powers, M. A., Bardsley, J., Cypress, M., Duker, P., Funnell, M. M., Fischl, A. H., ... & Vivian, E. (2017). Diabetes self-management education and support in type 2 diabetes: A joint position statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics. *The Diabetes Educator*, 43(1), 40-53.
- Powers, J. P., & Labar, K. S. (2019). Regulating emotion through distancing: A taxonomy, neurocognitive model, and supporting meta-analysis. *Neuroscience & Biobehavioral Reviews*, 96, 155-173.
- Prey, J. E., Woollen, J., Wilcox, L., Sackeim, A. D., Hripcsak, G., Bakken, S., ... & Vawdrey, D. K. (2014). Patient engagement in the inpatient setting: A systematic review. *Journal of the American Medical Informatics Association*, 21(4), 742-750.
- Prochaska, J. O., & DiClemente, C. C. (2005). The transtheoretical approach. In *Handbook of psychotherapy integration* (2nd ed., pp. 147-171). Oxford University Press.
<https://doi.org/10.1093/med:psych/9780195165791.003.0007>

- Qin, P., & Northoff, G. (2011). How is our self related to midline regions and the default-mode network? *NeuroImage*, 57(4), 1221–1233. doi: 10.1016/j.neuroimage.2011.05.028
- Qualtrics. (2024). Qualtrics [Computer software]. Qualtrics. <https://www.qualtrics.com>
- R Core Team. (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Retrieved from <https://www.R-project.org/>
- Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, 1(3), 385-401.
- Raghupathi, W., & Raghupathi, V. (2018). An empirical study of chronic diseases in the United States: A visual analytics approach to public health. *International Journal of Environmental Research and Public Health*, 15(3), 431.
- Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, 1(3), 385–401. <https://doi.org/10.1177/014662167700100306>
- Rao, A., Shi, Z., Ray, K. N., Mehrotra, A., & Ganguli, I. (2019). National trends in primary care visit use and practice capabilities, 2008-2015. *The Annals of Family Medicine*, 17(6), 538-544.
- Razzoli, M., Pearson, C., Crow, S., & Bartolomucci, A. (2017). Stress, overeating, and obesity: Insights from human studies and preclinical models. *Neuroscience & Biobehavioral Reviews*, 76(Part A), 154-162.
- Rehman, A. U., You, X., Wang, Z., & Kong, F. (2023). The link between mindfulness and psychological well-being among university students: The mediating role of social connectedness and self-esteem. *Current Psychology*, 42(14), 11772-11781.
- Reiter, J. T., Dobmeyer, A. C., & Hunter, C. L. (2018). The primary care behavioral health (PCBH) model: An overview and operational definition. *Journal of Clinical Psychology in Medical Settings*, 25(2), 109-126.
- Renehan, A. G., Zwahlen, M., & Egger, M. (2015). Adiposity and cancer risk: New mechanistic insights from epidemiology. *Nature Reviews Cancer*, 15(8), 484-498.
- Reuter, M., Rosas, H. D., & Fischl, B. (2010). Highly accurate inverse consistent registration: A robust approach. *NeuroImage*, 53(4), 1181–1196.
- Revelle, W. (2022). *psych: Procedures for psychological, psychometric, and personality research*. R package version 2.2.4. Retrieved from <https://CRAN.R-project.org/package=psych>
- Richardson, K. M., Schembre, S. M., da Silva, V., Blew, R. M., Behrens, N., Roe, D. J., ... & Hingle, M. (2024). Adding a brief continuous glucose monitoring intervention to the National Diabetes Prevention Program: A multimethod feasibility study. *Journal of Diabetes Research*, 2024(1), 7687694.

- Riley, K. E., Park, C. L., Wong, C. C. Y., & Russell, B. S. (2022). Mindfulness, self-distancing, and self-compassion as buffers of the effects of rumination on health behaviors: A daily diary study. *International Journal of Cognitive Therapy*, 15(1), 22-34.
- Ritchie, N. D., & Swigert, T. J. (2016). Establishing an effective primary care provider referral network for the National Diabetes Prevention Program. *AADE in Practice*, 4(4), 20-25.
- Robinson, D., Hayes, A., & Couch, S. (2023). broom: Convert statistical objects into tidy tibbles. R package version 1.0.5. Retrieved from <https://CRAN.R-project.org/package=broom>
- Rogers, R. W. (1975). A protection motivation theory of fear appeals and attitude change. *Journal of Psychology*, 91(1), 93-114.
- Roldão, A. J. F. D. C. D. A. (2023). The influence of mindfulness meditation on the attributions we make about situations (Doctoral dissertation).
- Rommel, M., Herrmann-Lingen, C., Wachter, R., Edelmann, F., Düngen, H. D., Pieske, B., & Grande, G. (2013). A short form of the General Self-Efficacy Scale (GSE-6): Development, psychometric properties and validity in an intercultural non-clinical sample and a sample of patients at risk for heart failure. *GMS Psycho-Social-Medicine*, 10, Doc01.
- Rony, M., Quintero-Arias, C., Osorio, M., Ararso, Y., Norman, E. M., Ravenell, J. E., ... & Lee, D. C. (2023). Perceptions of the healthcare system among Black men with previously undiagnosed diabetes and prediabetes. *Journal of Racial and Ethnic Health Disparities*, 10(6), 3150-3158.
- Rosenberg, H. M. (2020). Attention and decentering across focused attention and open monitoring mindfulness practices. (Doctoral dissertation, Palo Alto University).
- Rothenberger, C. D. (2011). Chronic illness self-management in prediabetes: A concept analysis. *Journal of Nursing and Healthcare of Chronic Illness*, 3(2), 77-86.
- Rude, S., Gortner, E. M., & Pennebaker, J. (2004). Language use of depressed and depression-vulnerable college students. *Cognition & Emotion*, 18(8), 1121-1133.
- Ruiter, R. A., Kessels, L. T., Peters, G. J. Y., & Kok, G. (2014). Sixty years of fear appeal research: Current state of the evidence. *International Journal of Psychology*, 49(2), 63-70.
- Ryan, R. M., & Deci, E. L. (2001). On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology*, 52(1), 141-166.
- Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, 57, 1069-1081.
- Ryff, C. D. & Keyes, C. L. M. (1995). The structure of psychological well-being revisited. *Journal of Personality and Social Psychology*, 69, 719-727.

- Ryff, C. D. & Singer, B. H. (2006). Best news yet on the six-factor model of well-being. *Social Science Research*, 35, 1103–1119.
- Saaristo, T., Moilanen, L., Korpi-Hyövähti, E., Vanhala, M., Saltevo, J., Niskanen, L., ... & Keinänen-Kiukaanniemi, S. (2010). Lifestyle intervention for prevention of type 2 diabetes in primary health care: One-year follow-up of the Finnish National Diabetes Prevention Program (FIN-D2D). *Diabetes Care*, 33(10), 2146-2151.
- San Diego, E. R. N., & Merz, E. L. (2022). Diabetes knowledge, fatalism, and type 2 diabetes-preventive behavior in an ethnically diverse sample of college students. *Journal of American College Health*, 70(2), 385-394.
- Sassenrath, C., Sassenberg, K., & Scholl, A. (2014). From a distance... the impact of approach and avoidance motivational orientation on perspective taking. *Social Psychological and Personality Science*, 5(1), 18-26.
- Satterthwaite, T. D., Elliott, M. A., Gerraty, R. T., Ruparel, K., Loughead, J., Calkins, M. E., Eickhoff, S. B., et al. (2013). An improved framework for confound regression and filtering for control of motion artifact in the preprocessing of resting-state functional connectivity data. *NeuroImage*, 64(1), 240–256. <https://doi.org/10.1016/j.neuroimage.2012.08.052>
- Schaefer, A., Kong, R., Gordon, E. M., Laumann, T. O., Zuo, X. N., Holmes, A. J., ... & Yeo, B. T. (2018). Local-global parcellation of the human cerebral cortex from intrinsic functional connectivity MRI. *Cerebral Cortex*, 28(9), 3095-3114.
- Scharloo, M. K. A. A., Kaptein, A. A., Weinman, J., Hazes, J. M., Willems, L. N. A., Bergman, W., & Rooijmans, H. G. M. (1998). Illness perceptions, coping and functioning in patients with rheumatoid arthritis, chronic obstructive pulmonary disease and psoriasis. *Journal of Psychosomatic Research*, 44(5), 573-585.
- Schilbach, L. et al. (2006). Being with virtual others: Neural correlates of social interaction. *Neuropsychologia*, 44(5), 718–730.
- Schleider, J. L., & Beidas, R. S. (2022). Harnessing the single-session intervention approach to promote scalable implementation of evidence-based practices in healthcare. *Frontiers in Health Services*, 2, 997406.
- Schleider, J. L., Dobias, M. L., Sung, J. Y., & Mullarkey, M. C. (2020). Future directions in single-session youth mental health interventions. *Journal of Clinical Child & Adolescent Psychology*, 49(2), 264-278.
- Schmidt, C. B., Van Loon, B. P., Vergouwen, A. C. M., Snoek, F. J., & Honig, A. (2018). Systematic review and meta-analysis of psychological interventions in people with diabetes and elevated diabetes-distress. *Diabetic Medicine*, 35(9), 1157-1172.

- Schneiderman, N., Ironson, G., & Siegel, S. D. (2005). Stress and health: Psychological, behavioral, and biological determinants. *Annual Review of Clinical Psychology*, 1, 607– 628. doi:10.1146/annurev.clinpsy.1.102803.144141
- Schulenberg, J. E., Sameroff, A. J., & Cicchetti, D. (2004). The transition to adulthood as a critical juncture in the course of psychopathology and mental health. *Development and Psychopathology*, 16(4), 799-806.
- Schulze, M. B., & Hu, F. B. (2005). Primary prevention of diabetes: What can be done and how much can be prevented?. *Annual Review of Public Health*, 26(1), 445-467.
- Schurz, M., Radua, J., Aichhorn, M., Richlan, F., & Perner, J. (2014). Fractionating theory of mind: A meta-analysis of functional brain imaging studies. *Neuroscience & Biobehavioral Reviews*, 42, 9-34.
- Seery, M. D., Leo, R. J., Lupien, S. P., Kondrak, C. L., & Almonte, J. L. (2013). An upside to adversity? Moderate cumulative lifetime adversity is associated with resilient responses in the face of controlled stressors. *Psychological Science*, 24(7), 1181–1189. doi:10.1177/0956797612469210.
- Segal, Z. V., Williams, J. M. G., & Teasdale, J. D. (2002). *Mindfulness-based cognitive therapy for depression: A new approach to preventing relapse*. Guilford Press.
- Serido, J., Almeida, D. M., & Wethington, E. (2004). Chronic stressors and daily hassles: Unique and interactive relationships with psychological distress. *Journal of Health and Social Behavior*, 45(1), 17-33.
- Shen, Z., Xu, J., Yin, W., Liu, Q., Fan, M., & Luo, C. (2022). Common Sense Model program on illness perceptions in patients with impaired awareness of hypoglycemia. *Contemporary Nurse*, 58(2-3), 171-191.
- Sheridan, S. L., Viera, A. J., Krantz, M. J., Ice, C. L., Steinman, L. E., Peters, K. E., ... & Lungelow, D. (2010). The effect of giving global coronary risk information to adults: A systematic review. *Archives of Internal Medicine*, 170(3), 230-239.
- Sherwani, S. I., Khan, H. A., Ekhzaimy, A., Masood, A., & Sakharkar, M. K. (2016). Significance of HbA1c test in diagnosis and prognosis of diabetic patients. *Biomarker Insights*, 11, BMI-S38440.
- Shibib, L., Al-Qaisi, M., Ahmed, A., Miras, A. D., Nott, D., Pelling, M., ... & Guess, N. (2022). Reversal and remission of T2DM—An update for practitioners. *Vascular Health and Risk Management*, 18, 417-443.
- Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice-friendly meta-analysis. *Journal of Clinical Psychology*, 65(5), 467-487.
- Skaff, M. M., Mullan, J. T., Almeida, D. M., Hoffman, L., Masharani, U., Mohr, D., & Fisher, L. (2009). Daily negative mood affects fasting glucose in type 2 diabetes. *Health Psychology*, 28(3), 265.
- Smith, K. J., Béland, M., Clyde, M., Gariépy, G., Page, V., Badawi, G., & Schmitz, N. (2014). Association of diabetes with anxiety: A systematic review and meta-analysis. *Journal of Psychosomatic Research*, 77(3), 174-181.

- Southward, M. W. (2014). The impact of expressive flexibility and context sensitivity on distress (Master's thesis, The Ohio State University).
- Stafford, L., Jackson, H. J., & Berk, M. (2008). Illness beliefs about heart disease and adherence to secondary prevention regimens. *Psychosomatic Medicine*, 70(8), 942-948.
- Steinhardt, M. A., Mamerow, M. M., Brown, S. A., & Jolly, C. A. (2009). A resilience intervention in African American adults with type 2 diabetes. *The Diabetes Educator*, 35(2), 274-284.
- Stiglic, G., & Pajnkihar, M. (2015). Evaluation of major online diabetes risk calculators and computerized predictive models. *PloS One*, 10(11), e0142827. <https://doi.org/10.1371/journal.pone.0142827>
- Stringhini, S., Tabak, A. G., Akbaraly, T. N., Sabia, S., Shipley, M. J., Marmot, M. G., ... & Kivimäki, M. (2012). Contribution of modifiable risk factors to social inequalities in type 2 diabetes: Prospective Whitehall II cohort study. *BMJ*, 345, e5452.
- Strosahl, K., Robinson, P., & Gustavsson, T. (2012). *Brief interventions for radical change: Principles & practice of focused acceptance & commitment therapy*. Oakland, CA: New Harbinger Publications.
- Sweeney, P. D., Anderson, K., & Bailey, S. (1986). Attributional style in depression: A meta-analytic review. *Journal of Personality and Social Psychology*, 50(5), 974-991.
- Tabák, A. G., Herder, C., Rathmann, W., Brunner, E. J., & Kivimäki, M. (2012). Prediabetes: A high-risk state for diabetes development. *The Lancet*, 379(9833), 2279-2290.
- Tan, M., & Singh, S. (2022). Drivers of prosocial behaviour: Exploring the role of mindset and perceived cost. *Current Research in Social Psychology*, 31(1), 28-38.
- Tang, F., Wang, G., & Lian, Y. (2017). Association between anxiety and metabolic syndrome: A systematic review and meta-analysis of epidemiological studies. *Psychoneuroendocrinology*, 77, 112-121.
- Tanner, J. L., & Arnett, J. J. (2016). The emergence of emerging adulthood: The new life stage between adolescence and young adulthood. In *Routledge handbook of youth and young adulthood* (pp. 50-56). Routledge.
- Tausczik, Y. R., & Pennebaker, J. W. (2010). The psychological meaning of words: LIWC and computerized text analysis methods. *Journal of Language and Social Psychology*, 29(1), 24-54.
- Tedeschi, R. G., & Calhoun, L. G. (2004). Posttraumatic growth: Conceptual foundations and empirical evidence. *Psychological Inquiry*, 15(1), 1-18.
- Teixeira, P. J., Carraça, E. V., Marques, M. M., Rutter, H., Oppert, J., Bourdeaudhuij, I. D., ... & Brug, J. (2015). Successful behavior change in obesity interventions in adults: A systematic review of self-regulation mediators. *BMC Medicine*, 13(84). doi: 10.1186/s12916-015-0323-6

- Thatcher, R., Gregory, N., Cheung, W. Y., Dunseath, G. J., Parsons, S. N., Goodwin, M., & Luzio, S. D. (2022). Brief lifestyle interventions for prediabetes in primary care: A service evaluation. *BMC Primary Care*, 23(1), 45.
- Thomas, J. J., Moring, J. C., Baker, S., Walker, M., Warino, T., Hobbs, T., ... & Emerson, T. (2017). Do words matter? Health care providers' use of the term prediabetes. *Health, Risk & Society*, 19(5-6), 301-315.
- Timm, L., Harcke, K., Karlsson, I., Sidney Annerstedt, K., Alveusson, H. M., Stattin, N. S., ... & Daivadanam, M. (2020). Early detection of type 2 diabetes in socioeconomically disadvantaged areas in Stockholm—comparing reach of community and facility-based screening. *Global Health Action*, 13(1), 1795439.
- Timmermans, I., Versteeg, H., Meine, M., Pedersen, S. S., & Denollet, J. (2017). Illness perceptions in patients with heart failure and an implantable cardioverter defibrillator: Dimensional structure, validity, and correlates of the brief illness perception questionnaire in Dutch, French, and German patients. *Journal of Psychosomatic Research*, 97, 1-8. doi:10.1016/j.jpsychores.2017.03.014
- Tov, W., Ng, K. L., Lin, H., & Qiu, L. (2013). Detecting well-being via computerized content analysis of brief diary entries. *Psychological Assessment*, 25(4), 1069-1078.
- Travers-Hill, E., Dunn, B. D., Hoppitt, L., Hitchcock, C., & Dalgleish, T. (2017). Beneficial effects of training in self-distancing and perspective broadening for people with a history of recurrent depression. *Behaviour Research and Therapy*, 95, 19-28.
- Troy, A. S. (2012). Cognitive reappraisal ability as a protective factor: Resilience to stress across time and context (Doctoral dissertation, University of Denver).
- Troy, A. S., Shallcross, A. J., & Mauss, I. B. (2013). A person-by-situation approach to emotion regulation: Cognitive reappraisal can either help or hurt, depending on the context. *Psychological Science*, 24(12), 2505-2514.
- Tu, K., Kristiansson, R. S., Gronsbell, J., De Lusignan, S., Flottorp, S., Goh, L. H., ... & Stephenson, E. (2022). Changes in primary care visits arising from the COVID-19 pandemic: An international comparative study by the International Consortium of Primary Care Big Data Researchers (INTRePID). *BMJ Open*, 12(5), e059130.
- Tucker, M. S. (2015). Interpersonal decentering in relationship breakups: Social cognitive maturity and distress recovery in young adults (Doctoral dissertation, University of North Texas).
- Tustison, N. J., Avants, B. B., Cook, P. A., Zheng, Y., Egan, A., Yushkevich, P. A., & Gee, J. C. (2010). N4ITK: Improved N3 bias correction. *IEEE Transactions on Medical Imaging*, 29(6), 1310–1320. <https://doi.org/10.1109/TMI.2010.2046908>

- Twenge, J. M., Cooper, A. B., Joiner, T. E., Duffy, M. E., & Binau, S. G. (2019). Age, period, and cohort trends in mood disorder indicators and suicide-related outcomes in a nationally representative dataset, 2005–2017. *Journal of Abnormal Psychology, 128*(3), 185–199.
- Twohig, M. P., & Levin, M. E. (2017). Acceptance and commitment therapy as a treatment for anxiety and depression: A review. *Psychiatric Clinics of North America, 40*(4), 751-765.
- U.S. Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation. (2024). Poverty guidelines. Retrieved from <https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines>
- U.S. Preventive Services Task Force. (2021). Screening for prediabetes and type 2 diabetes: U.S. Preventive Services Task Force recommendation statement. Retrieved from <https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/diabetes-screening>
- Uddin, L. Q., Iacoboni, M., Lange, C., & Keenan, J. P. (2007). The self and social cognition: the role of cortical midline structures and mirror neurons. *Trends in Cognitive Sciences, 11*(4), 153-157.
- Vago, D. R., & Silbersweig, D. A. (2012). Self-awareness, self-regulation, and self-transcendence (S-ART): a framework for understanding the neurobiological mechanisms of mindfulness. *Frontiers in Human Neuroscience, 6*, 296.
- Van Cleave, J., Kuhlthau, K. A., Bloom, S., Newacheck, P. W., Nozzolillo, A. A., Homer, C. J., & Perrin, J. M. (2012). Interventions to improve screening and follow-up in primary care: a systematic review of the evidence. *Academic Pediatrics, 12*(4), 269-282.
- Van Ommen, B., Wopereis, S., Van Empelen, P., Van Keulen, H. M., Otten, W., Kasteleyn, M., ... & Pijl, H. (2018). From diabetes care to diabetes cure—the integration of systems biology, eHealth, and behavioral change. *Frontiers in Endocrinology, 8*, 381.
- Vanderveren, E., Bijttebier, P., & Hermans, D. (2019). Autobiographical memory coherence and specificity: Examining their reciprocal relation and their associations with internalizing symptoms and rumination. *Behaviour Research and Therapy, 116*, 30-35.
- Verdecias, N., McQueen, A., Von Nordheim, D. A., Broussard Jr, D. J., Smith, R. E., & Kreuter, M. W. (2023). Diabetes distress in a Medicaid sample: The role of psychosocial and health-related factors. *Journal of Diabetes and its Complications, 37*(7), 108495.
- Vilagut, G., Forero, C. G., Barbaglia, G., & Alonso, J. (2016). Screening for depression in the general population with the Center for Epidemiologic Studies Depression (CES-D): a systematic review with meta-analysis. *PloS one, 11*(5), e0155431.

- Virtanen, M., Ferrie, J. E., Tabak, A. G., Akbaraly, T. N., Vahtera, J., Singh-Manoux, A., & Kivimäki, M. (2014). Psychological distress and incidence of type 2 diabetes in high-risk and low-risk populations: the Whitehall II Cohort Study. *Diabetes Care*, 37(8), 2091-2097.
- Vitaliano, P. P., Dewolfe, D. J., Maiuro, R. D., Russo, J., & Katon, W. (1990). Appraised changeability of a stressor as a modifier of the relationship between coping and depression: a test of the hypothesis of fit. *Journal of Personality and Social Psychology*, 59(3), 582.
- Vivekananda, S. (2022). *Patanjali's Yoga Sutras: Bestseller Book by Swami Vivekananda: Patanjali's Yoga Sutras*. Prabhat Prakashan.
- Vogeley, K., & Fink, G. R. (2003). Neural correlates of the first-person-perspective. *Trends in Cognitive Sciences*, 7(1), 38-42.
- Vrkatić, A., Grujičić, M., Jovičić-Bata, J., & Novaković, B. (2022). Nutritional knowledge, confidence, attitudes towards nutritional care and nutrition counseling practice among general practitioners. In *Healthcare* (Vol. 10, No. 11, p. 2222). MDPI.
- Vähäsarja, K., Kasila, K., Kettunen, T., Rintala, P., Salmela, S., & Poskiparta, M. (2015). 'I saw what the future direction would be...': Experiences of diabetes risk and physical activity after diabetes screening. *British Journal of Health Psychology*, 20(1), 172-193. <https://doi.org/10.1111/bjhp.12088>
- Waldron, C. A., Van Der Weijden, T., Ludd, S., Gallacher, J., & Elwyn, G. (2011). What are effective strategies to communicate cardiovascular risk information to patients? A systematic review. *Patient Education and Counseling*, 82(2), 169-181.
- Wall, C. S., Mason, K. L., Smout, S. A., O'Neill, K. A., Carrico, M. A., & Benotsch, E. G. (2022). Having a community helps: Environmental context influences the relationship between outness and psychological distress in transgender and gender diverse populations. *Stigma and Health*, 7(4), 414.
- Walthouwer, M. J. L., Oenema, A., Lechner, L., & de Vries, H. (2015). Comparing a video and text version of a web-based computer-tailored intervention for obesity prevention: a randomized controlled trial. *Journal of Medical Internet Research*, 17(10), e236.
- Walton, G. M. (2014). The new science of wise psychological interventions. *Current Directions in Psychological Science*, 23(1), 73-82.
- Wang, L., Li, X., Wang, Z., Bancks, M. P., Carnethon, M. R., Greenland, P., ... & Zhong, V. W. (2021). Trends in prevalence of diabetes and control of risk factors in diabetes among US adults, 1999-2018. *Jama*, 326(8), 704-716.
- Wang, Q., & Conway, M. A. (2006). Autobiographical memory, self, and culture. In L.-G. Nilsson & N. Ohta (Eds.), *Memory and society: Psychological perspectives* (pp. 18–36). Psychology Press.
- Warnes, G. R., Bolker, B., & Lumley, T. (2023). *gtools: Various R programming tools*. R package version 3.9.2. Retrieved from <https://CRAN.R-project.org/package=gtools>

- Watkins, E. D., Teasdale, J. D., & Williams, R. M. (2000). Decentring and distraction reduce overgeneral autobiographical memory in depression. *Psychological Medicine*, 30(4), 911-920.
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of personality and social psychology*, 54(6), 1063.
- Webb, J. R., Hirsch, J. K., Visser, P. L., & Brewer, K. G. (2013). Forgiveness and health: Assessing the mediating effect of health behavior, social support, and interpersonal functioning. *The Journal of Psychology*, 147(5), 391-414.
- Wei, T., & Simko, V. (2021). *corrplot: Visualization of a correlation matrix*. R package version 0.92. Retrieved from <https://CRAN.R-project.org/package=corrplot>
- Weissman M, Sholomskas D, Pottenger M, Prusoff B, Locke B. Assessing depressive symptoms in five psychiatric populations: a validation study. *Am J Epidemiol* 1977; 106(3):203–14. PMID: 900119
- Wells, A. (2013). Advances in metacognitive therapy. *International Journal of Cognitive Therapy*, 6(2), 186-201.
- Westphal, M., Seivert, N. H., & Bonanno, G. A. (2010). Expressive flexibility. *Emotion*, 10(1), 92.
- Wexler, D. J., Beauharnais, C. C., Regan, S., Nathan, D. M., Cagliero, E., & Larkin, M. E. (2012). Impact of inpatient diabetes management, education, and improved discharge transition on glycemic control 12 months after discharge. *Diabetes Research and Clinical Practice*, 98(2), 249-256.
- Wickham, H. (2016). *ggplot2: Elegant graphics for data analysis*. Springer-Verlag New York. Retrieved from <https://ggplot2.tidyverse.org>
- Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L. D., François, R., ... & Dunnington, D. (2019). Welcome to the tidyverse. *Journal of Open Source Software*, 4(43), 1686. Retrieved from <https://doi.org/10.21105/joss.01686>
- Wickham, H., François, R., Henry, L., & Müller, K. (2023). *dplyr: A grammar of data manipulation*. R package version 1.0.8. Retrieved from <https://CRAN.R-project.org/package=dplyr>
- Wickham, H., & Henry, L. (2023). *purrr: Functional programming tools*. R package version 0.4.5. Retrieved from <https://CRAN.R-project.org/package=purrr>
- Wickham, H., & Vaughan, D. (2023). *tidyr: Tidy messy data*. R package version 1.2.4. Retrieved from <https://CRAN.R-project.org/package=tidyr>
- Wickramaratne, P. J., Yangchen, T., Lepow, L., Patra, B. G., Glicksberg, B., Talati, A., ... & Weissman, M. M. (2022). Social connectedness as a determinant of mental health: A scoping review. *PLoS One*, 17(10), e0275004.

- Williams, I. C., Clay, O. J., Ovalle, F., Atkinson, D., & Crowe, M. (2020). The role of perceived discrimination and other psychosocial factors in explaining diabetes distress among older African American and white adults. *Journal of Applied Gerontology*, 39(1), 99-104.
- Williams, S. L., To, Q., & Vandelanotte, C. (2022). What is the effectiveness of a personalised video story after an online diabetes risk assessment? A Randomised Controlled Trial. *Plos One*, 17(3), e0264749.
- Williams, K., Elliott, R., McKie, S., Zahn, R., Barnhofer, T., & Anderson, I. M. (2020). Changes in the neural correlates of self-blame following mindfulness-based cognitive therapy in remitted depressed participants. *Psychiatry Research: Neuroimaging*, 304, 111152.
- Williams, M., Teasdale, J., Segal, Z., & Kabat-Zinn, J. (2012). *The mindful way through depression: Freeing yourself from chronic unhappiness*. Guilford Press.
- Wilson, H. K., Castillo-Hernandez, I. M., Evans, E. M., Williams, E. R., & Berg, A. C. (2023). Diet Quality Outcomes of a Cooperative Extension Diabetes Prevention Program. *Journal of Nutrition Education and Behavior*, 55(10), 734-742.
- Winchester, R. J., Williams, J. S., Wolfman, T. E., & Egede, L. E. (2016). Depressive symptoms, serious psychological distress, diabetes distress and cardiovascular risk factor control in patients with type 2 diabetes. *Journal of Diabetes and its Complications*, 30(2), 312-317.
- Witte, K. (1992). Putting the fear back into fear appeals: The Extended Parallel Process Model. *Communication Monographs*, 59(4), 329-349.
- Wolin, K. Y., Carson, K., & Colditz, G. A. (2010). Obesity and cancer. *The Oncologist*, 15(6), 556-565.
- Wolkin, J. R. (2015). Cultivating multiple aspects of attention through mindfulness meditation accounts for psychological well-being through decreased rumination. *Psychology Research and Behavior Management*, 171-180.
- Wondra, J. D., & Ellsworth, P. C. (2015). An appraisal theory of empathy and other vicarious emotional experiences. *Psychological Review*, 122(3), 411.
- World Health Organization. (2011, October 21). *Rio Political Declaration on Social Determinants of Health*. Rio de Janeiro, Brazil. Retrieved from <https://www.who.int/sdhconference/declaration/en/>
- World Health Organization. (2016). *Global report on diabetes*. World Health Organization. <https://apps.who.int/iris/handle/10665/204871>.
- World Population Review. (2024). *Average family income by state 2024*. Retrieved from <https://worldpopulationreview.com/state-rankings/average-family-income>.
- Wright, D., Muirhead, V., Weston-Price, S., & Fortune, F. (2014). Type 2 diabetes risk screening in dental practice settings: a pilot study. *British Dental Journal*, 216(7), E15-E15.

- Xiang, X. (2016). Chronic disease diagnosis as a teachable moment for health behavior changes among middle-aged and older adults. *Journal of Aging and Health*, 28(6), 995-1015.
- Xie, Y. (2023). *knitr: A general-purpose package for dynamic report generation in R*. R package version 1.38. Retrieved from <https://CRAN.R-project.org/package=knitr>
- Yaden, D. B., Haidt, J., Hood Jr, R. W., Vago, D. R., & Newberg, A. B. (2017). The varieties of self-transcendent experience. *Review of General Psychology*, 21(2), 143-160.
- Yates, T., Davies, M., & Khunti, K. (2009). Preventing type 2 diabetes: can we make the evidence work?. *Postgraduate Medical Journal*, 85(1007), 475-480.
- Young, R. P., Hopkins, R. J., Smith, M., & Hogarth, D. K. (2010). Smoking cessation: the potential role of risk assessment tools as motivational triggers. *Postgraduate Medical Journal*, 86(1011), 26-33.
- Young-Hyman, D., de Groot, M., Hill-Briggs, F., Gonzalez, J. S., Hood, K., & Peyrot, M. (2016). Psychosocial care for people with diabetes: A position statement of the American Diabetes Association. *Diabetes Care*, 39(12), 2126-2140. <https://doi.org/10.2337/dc16-2053>
- Zeng, B., Rivadeneira, N. A., Wen, A., Sarkar, U., & Khoong, E. C. (2022). The impact of the COVID-19 pandemic on internet use and the use of digital health tools: secondary analysis of the 2020 health information national trends survey. *Journal of Medical Internet Research*, 24(9), e35828.
- Zhang, Y., Brady, M., & Smith, S. (2001). Segmentation of brain MR images through a hidden Markov random field model and the expectation-maximization algorithm. *IEEE Transactions on Medical Imaging*, 20(1), 45-57.
- Zhong, A., Amat, M. J., Anderson, T. S., Shafiq, U., Sternberg, S. B., Salant, T., ... & Phillips, R. S. (2023). Completion of recommended tests and referrals in telehealth vs in-person visits. *JAMA Network Open*, 6(11), e2343417-e2343417.
- Zhou, P., Critchley, H., Garfinkel, S., & Gao, Y. (2021). The conceptualization of emotions across cultures: a model based on interoceptive neuroscience. *Neuroscience & Biobehavioral Reviews*, 125, 314-327.
- Zhu, H. (2021). *kableExtra: Construct complex table with 'kable' and pipe syntax*. R package version 1.5.2. Retrieved from <https://CRAN.R-project.org/package=kableExtra>
- Żurawska-Żyła, R., Tokarska, U., & Knopik, T. (2022). Self-distancing and narrative wisdom in older adults' autobiographical reflection. *Journal of Constructivist Psychology*, 35(3), 1013-1036.