

**"Alexa, I'm in pain!"**

**A Real-Time Mindfulness Intervention to Control Pain: Delivery Through a Conversational Agent**

**Investigators:** Saeed Abdullah, PhD, Stephanie Lanza, PhD, Sebrina Doyle, MS

**2. Keywords:** mindfulness, pain management, adherence, compliance, conversational agent

**3. Abstract**

Chronic pain is a serious public health issue affecting approximately 30-40% of the US adult population. The widespread use of opioid pain medication has contributed to a national epidemic of addiction in the US; more than 165,000 deaths occurred between 1999 and 2014 due to opioid overdose. As such, there is an urgent need to develop and deploy non-addictive chronic pain management methods. Toward this, recent studies have identified Mindfulness-Based Stress Reduction (MBSR) to be a promising alternative for long-term pain management. The efficacy of MBSR depends on regular practice and thus, longitudinal adherence is essential for effective pain management. However, ensuring adherence and engagement to MBSR is a serious challenge and remains as a key barrier in translating it from clinical settings to real-world practice. In this proposal, we aim to address this compliance and adherence issue by using a conversational agent. Specifically, we propose to leverage the Amazon Alexa ecosystem to develop an interactive, personalized virtual coach for delivering MBSR. Based on prior research, we believe that such a virtual coach will engender trust and social rapport, resulting in sustained high engagement over a long period of time. Furthermore, our proposed approach is highly scalable and can improve access to MBSR practices, including for those in rural communities. If successful, this project will lead to a viable alternative to opioid use to manage chronic pain and thus reduce the risk of opioid addiction and overdose. Results from this study will serve as preliminary findings for several external grant proposals, including an R01 to support an effectiveness trial and an NSF smart and connected health program submission to support technology development.

**4. Specific Aims and Objectives**

Fundamental to today's opioid crisis is a tension between two competing public health goals: to reduce the burden of suffering from pain and to prevent the risk of escalation of opioid use and dependence. One promising alternative to opioids to address pain is MBSR. A number of recent studies have found that MBSR techniques can be used for chronic pain management and improving a patient's quality of life [1, 20]. Effectiveness of MBSR requires that an individual, once taught in class, engages in regular home practice [2]. To facilitate this, eHealth technologies including Web and smartphone apps have been employed to deliver MBSR practices [3, 4].

However, long-term adherence to mindfulness based interventions remains a significant challenge. A recent review on web-based mindfulness interventions found that adherence ranges from 30% to 69% [4]. Given the dose-response relationship between duration of MBSR practice and its degree of effectiveness [5], low adherence can reduce its usefulness for chronic pain management. In other words, long-term engagement with MBSR practices is essential for effective pain management and subsequently reducing the risk of opioid dependence.

In this project, we aim to address these compliance and engagement issues by using smart-home conversational agents to deliver on-demand, guided mindfulness practices. Specifically, we will

develop and pilot agents using the Amazon Alexa ecosystem for individualized delivery of practices designed for pain management. We aim to extend current capabilities of Alexa to create a personalized and engaging virtual mindfulness coach. We hypothesize that our proposed approach will enable a trusting relationship between patients and a virtual mindfulness coach and therefore, resulting in high adherence to MBSR practices over a long period of time. Furthermore, our approach is highly scalable and could be used to improve access to MBSR practices for the vulnerable population of rural adults. We propose the following aims:

**Aim 1. Estimate between- and within-person associations among mindfulness practices, daily stress, and pain.** We will analyze data from the National Study of Daily Experiences (NSDE; PI: Almeida) to elucidate links between mindfulness practices, stress, and pain in adults' daily life. Results will inform the daily diary study to be conducted in the Aim 3 pilot.

**Aim 2. Adapt mindfulness practices and deploy intervention content using the Amazon Alexa conversational agent.** We will adapt clinical evidence-based practices used in MBSR to Amazon Alexa ecosystem. We will ensure interactive, engaging, and dynamic delivery of MBSR practices through conversational agents. We will also focus on smart and dynamic handling of conversations to adapt to different user-initiated scenarios and contexts ("branching"). This will enable personalized conversational agents and virtual coaches reflecting individuals' needs while remaining grounded in clinical evidence-based approaches. The resulting system will be tested on a small sample (N=10) to assess its usability and the quality of dynamic content delivery.

**Aim 3. Conduct a pilot study to assess the feasibility and acceptability of the mindfulness intervention using the conversational agent.** Informed by the results of Aims 1 and 2, we will design and conduct a pilot study (N=50) with adults who suffer from chronic pain. Participants will complete a baseline survey and attend a one-day, in-person mindfulness training. We will provide each participant an Amazon Echo Dot device with the conversational agent for MBSR (Aim 2) to use at home for regular practice and to engage during moments of need. We will also train participants to use these devices. Participants will complete a 30-day web-based diary study on pain, pain management, and substance use, and complete a follow-up survey at 3 months. We will also collect data about user engagement with the conversational agent.

## **5. Background and rationale:**

Chronic pain is a serious public health issue affecting approximately 30–40% of the US adult population [6, 7]. The direct and indirect cost associated with chronic pain has been estimated to be \$560–635 billion per year in the US [6]. Opioids are particularly effective in short-term pain management. However, opioid pain medication poses serious risk since it can lead to misuse and addiction. Indeed, the widespread use of opioids has resulted in a national epidemic of addiction in the US — more than 165,000 deaths occurred between 1999 and 2014 due to opioid pain medication overdose [8]. As a result, there has been a growing focus on developing alternative non-addictive methods for chronic pain management [19].

Toward this goal, a number of recent studies have used mindfulness based interventions (MBIs) for chronic pain management. These methods often aim to improve awareness and acceptance of moment-to-moment experiences and reduce negative emotional reactivity related to pain. Results from these studies showed that MBIs are particularly effective for long-term pain management and improving quality of life [9]. For example, MBSR has been shown to significantly reduce perception of pain intensity and functional limitations [9, 17, 18].

However, a number of challenges hinder the use of MBSR practices for chronic pain management. The MBSR program require participants to practice regularly at home on their own. This can be challenging for those new to mindfulness, leading to problems with treatment compliance and impacting outcomes for those engaged in the program [16]. Web- and mobile-based methods have aimed to address these issues, but tend to have very low long-term engagement [4]. Because the efficacy of MBSR depends on engaging in the practices, long-term and regular home practice is essential for effective pain management, and thus reduction in opioid use [16]. Achieving long-term engagement in mindfulness practice using a conversational agent would eliminate a key barrier in translating this non-medical treatment of chronic pain from the clinical settings to real-world practice.

In the proposed project, we will develop an interactive and personalized virtual coach using Amazon Alexa for patients suffering from chronic pain. The scientific premise of our proposed work builds upon a decade of high quality clinical research on the efficacy of mindfulness based methods for chronic pain management [4, 9, 16, 17, 18]. While technology focusing on conversational agent is relatively new, a number of studies have found that it can provide social rapport [10] and lead to a trusting relationship with human participants [11]. Based on these findings we believe a conversational agent will be successful in sustaining user engagement over long period of time, ultimately increasing use of MBSR practices and reducing the use of opioid medication to address chronic pain. If successful, this project will lead to a viable, technology-assisted alternative to opioid use to manage chronic pain in one's naturalistic home environment in moments of greatest need.

### **Description of methods:**

Aim 1. Estimate between- and within-person associations among mindfulness practices, daily stress, and pain. Existing data from the National Study of Daily Experiences (NSDE) will be analyzed to shed light on the links between mindfulness practices, stress, and pain in adults' daily life. We will rely on multilevel modeling to separate the amount of variability in each construct between- vs. within-person. Then, we will compare the associations of mindfulness practices and stress with daily reports of pain that exist between individuals (i.e., is pain lower for individuals with greater average stress or who tend to practice mindfulness?) and within-person (i.e., on days when stress is higher than average, or on days when engaging in mindfulness practice, is pain lower than an individual's mean level of pain?). This approach accounts for the nested structure of the data (i.e., days nested within individuals), isolates within- and between-person associations, and flexibly handles missing data. Further, MLM allows us to specify random effects for the effects of daily mindfulness and stress on daily pain, indicating that these links may be stronger or weaker for certain individuals. Finally, person-level characteristics, such as age and gender, will be included as predictors of these random effects. Results from our analysis of data from NSDE will be summarized in a manuscript and submitted to a high-impact journal.

Aim 2. Adapt mindfulness practices and deploy intervention content using the Amazon Alexa conversational agent. A key expected outcome of this project is to develop and deploy an interactive conversational agent to deliver MBSR practices. We envision the conversational agent to act like a personalized virtual mindfulness coach that ensures supportive accountability. For this, we will leverage the Amazon Alexa ecosystem. Using state-of-the art audio processing and machine learning, Alexa allows the user to "converse" with it. The Alexa ecosystem provides an Application Programming Interface (API), which can be used to develop a highly-

customized and context-aware dialogue system. This system will form the basis of our virtual coach to deliver practices.

In September, Ms. Doyle, who has been trained as a teacher for other mindfulness-based programs, will attend the MBSR Teacher Training Institute. This will provide her with the appropriate knowledge to support the translation of the MBSR practices into the Alexa platform. We will adapt instruction for MBSR practices to be short, interactive, and appropriate for Alexa based dialogue system. For a virtual coach to be effective, it will be essential to handle different user-initiated scenarios and contexts. For this, we will employ Natural Language Processing techniques in the backend to infer about user intentions and contexts from dialogue data. This will allow the virtual coach to be more adaptive to user's dynamic needs. We will also leverage the mobile app accompanying Alexa ecosystem for user engagement (e.g., notifications).

A few mindfulness applications exist currently for Alexa ecosystem. However, none of these existing applications addresses the key challenges mentioned above. Specifically, these applications do not focus on chronic pain management. Moreover, these applications have not been validated through a research and as a result, there is no empirical evidence of effectiveness. Our system will address this gap by leveraging the capabilities of Alexa ecosystem while remaining grounded in evidence-based approaches to the intervention. Our multidisciplinary team with complementary expertise is ideally suited to develop and deploy such a system.

We will assess the quality of dynamic content delivery as well as the usability of the new platform through our initial pilot study (N=10). We plan to recruit users who have had some experience with chronic pain over the last 6 months, as this is the target population for the larger pilot study and the population expected to benefit most from the proposed intervention. Participants will be provided with an Echo Dot and encouraged to use it daily and when in pain for 14 days. We will collect granular usage data during the study and conduct detailed qualitative interviews afterwards. This data will be used to refine and update the system for next phase.

Aim 3. Conduct a pilot study to assess the feasibility and acceptability of the mindfulness intervention using the conversational agent. We will pilot the intervention with N=50 mindfulness-naïve individuals reporting chronic pain within the past 6 months. Participants will complete a baseline survey and attend a one-day, in-person mindfulness training. They will be trained on Alexa and instructed to use the conversational agent for mindfulness practices daily and when experiencing pain. Participants will complete a 30-day diary study to follow pain, pain management, and substance use in daily life. A follow-up survey at 3 months will assess benefits, burden, and level of engagement with the conversational agent-delivered intervention and its role in pain management. Participants will be compensated for the baseline and one-day mindfulness training with an Echo Dot, the device which will be used for the study. For the daily and follow-up surveys they will be compensated up to \$75.

The baseline survey will include demographic characteristics, history of alcohol and drug use, mental health, and history of pain. Treatment expectancy will be assessed by Credibility and Expectancy Questionnaire [12]. We will also assess overall user satisfaction with the proposed virtual coach using the Client Satisfaction Questionnaire [13]. For assessing usability, we will use System Usability Scale [14]. Furthermore, we will conduct detailed qualitative interviews to identify any potential usability issues. Engagement measures will include number of Alexa sessions initiated by users, duration of sessions, and number of successfully completed sessions. We will also use a modified version of Mobile Application Rating Scale [15]. The daily survey

will include the Positive and Negative Affect Schedule – Short Form [21], the Daily Inventory of Stressful Events [22], daily pain and daily fatigue using standard numerical scales from 0 (no pain) to 100 (bad as it can be) [23], two pain-related cognitions (catastrophizing [24] and control [25]), perceived degree of benefit of mindfulness practice to manage pain, and daily alcohol, tobacco, marijuana, opioid, and other drug use. The 3 month survey will include measures of continued engagement with Alexa, positive and negative affect, pain, pain-related cognitions, overall perceived degree of benefit of mindfulness practice to manage pain, and past-month alcohol, tobacco, marijuana, opioid, and other drug use.

*Data management and data analysis.* Data will be collected using a secure, web-based application. The data collected by the conversational agent will be uploaded to a secure server managed by the IST IT department. Online instruments will be developed for the baseline, daily diary, and follow-up surveys. Personal identifiers will be removed and data will be exported to SAS and saved in Box for data analysis. The baseline survey will be conducted during approximately one week prior to participants' scheduled one-day mindfulness workshop. The daily diary survey will be initiated each morning for 30 days by a text or email link (based on their preference) sent to participants. The 3-month follow-up survey will be sent via email to each participant. Both REDCap and Box store data securely on a server and access will be given only to key members of the team. Details on recruitment, data collection, and data management will be included in the IRB application. Similar to the analysis conducted in Aim 1, analysis of the baseline, daily diary, and follow-up pilot data will be conducted using multilevel models in SAS. Data analysis of the pilot data will include the replication of MLM analyses conducted in Aim 1 (analysis of NSDE data). This will allow us to investigate the extent to which our findings based on a larger sample of adults experiencing varying levels of pain replicate in our new sample of adults experiencing chronic pain. Additional models will be run to identify predictors of long-term engagement with Alexa, pain, alcohol and drug use, and pain management strategies at 3 months.

Community will be engaged first, through a small group of users in our N=10 piloting of the platform. Second, we plan to seek out clinicians who work with chronic pain patients so that they may offer feedback about barriers to use of mindfulness practices and barriers to use of technology. We intend to seek out this consultation from the Hershey Medical Center Pain Management Clinic. Third, we plan to seek consultation with experts in the use of mindful practices. Robert Roeser will serve as one of those experts, but we will also seek out support specifically from those who work with chronic pain patients using MBSR. This will allow us to gain additional “field level” knowledge about ways to address barriers to uptake and use of MBSR principles and practices. Additionally, we propose to consult with the CTSI Community Engagement team to gain insight into ways we may strengthen community engagement.

## **6. Anticipated Outcomes**

Anticipated outcomes include: (1) Two manuscripts, one technical and one applied, to be submitted to high-impact journals. (2) Development of an interactive and personalized conversational agent framework for chronic pain management. (3) Development of a novel MBSR based mindfulness intervention designed for deployment on a conversation agent for use by individuals suffering from chronic pain. (4) High-quality pilot data on the feasibility, engagement with, acceptability, and effectiveness of a mindfulness intervention delivery using an inexpensive, easy-to-use conversational agent; together this will provide insight into the potential for scale-up. (5) Proposal development for NIH funding.

## ADDITIONAL INFORMATION

### 1. External Funding Plans and Possible Funding Sources:

Future plans include the immediate use of pilot study results as preliminary findings in several larger grant proposals to the NIH and the NSF.

For the NIH proposal, we expect to submit an R21 titled “Embedding a Virtual Mindfulness Coach into Daily Life to Manage Chronic Pain: Delivery via a Conversational Agent” for a small community-based RCT. Lanza, Abdullah, Doyle and Roeser will be investigators on this proposal. We would also seek out a clinician at Hershey Medical Center to join on our proposal. Our plan is to submit to the National Center on Complementary and Integrative Health per recommendation by Belinda Sims from the National Institute on Drug Abuse.

### 2. Timeline:

The timeline to achieve the proposed aims (9/1/18-8/31/19) is presented in Table 1. Prior to the study start date, the PRC will support several activities in anticipation of future work in this area (see letter of support). First, Ms. Doyle will attend a 5-day silent retreat to complete prerequisites for the proposed MBSR teacher training. Second, the investigators will explore existing mindfulness skills available on the Alexa platform to determine their strengths and limitations. Third, they will prepare an IRB application for Aims 1 and 2.

<b>Table 1. Timeline of Tasks to Address Study Aims</b>	<b>Pr e</b>	<b>Q 1</b>	<b>Q 2</b>	<b>Q 3</b>	<b>Q 4</b>
Complete prerequisites for MBSR teacher training; explore existing mindfulness skills; prepare IRB application for completion of Aims 1 and 2					
Analyze existing daily diary data from NSDE study; prepare and submit manuscript ( <b>Aim 1</b> )					
Complete MBSR training to obtain teacher certification - Doyle ( <b>Aim 2</b> )					
Design initial dialogue system for Alexa ( <b>Aim 2</b> )					
Examine existing mindfulness skills available on Alexa; Adapt evidence-based MBSR content for Alexa app ( <b>Aim 2</b> )					
Design data collection strategy and build survey for baseline, daily diary, and 3-month follow-up surveys ( <b>Aim 1</b> )					
Conduct the N=10 pilot study to assess feasibility and identify any problems ( <b>Aim 2</b> )					
Analyze data from N=10 study and update Alexa app ( <b>Aim 2</b> )					
Submit IRB protocol N=50 pilot study and begin recruitment ( <b>Aim 3</b> )					
Modify protocol based on N=10 study results; begin N=50 study: participants will attend one-day workshop and complete baseline and daily diary surveys ( <b>Aim 3</b> )					
Analyze daily diary data from N=50 study; complete 3-month follow-up assessment and conduct preliminary analyses using follow-up data ( <b>Aim 3</b> )					
Prepare and submit manuscript on results of pilot study ( <b>Aim 3</b> )					
Identify potential RFAs for external grants; form writing teams to begin work on applications					

### 3. Personnel:

Interdisciplinary team. **Saeed Abdullah, Ph.D.**, assistant professor in the College of Information Sciences and Technology (IST), conducts innovative, human-centric research on ubiquitous computing, data science, and pervasive health technologies with the ultimate goal of supporting health and well-being. **Stephanie Lanza, Ph.D.**, professor of biobehavioral health and director of the Edna Bennett Pierce Prevention Research Center (PRC), seeks to advance and apply new statistical models in order to reveal dynamic and complex processes underlying health behavior and ultimately prevent maladaptive behavioral outcomes. She has extensive experience in NIH grants management and administration. *Drs. Abdullah and Lanza will serve as Co-PIs on this project.* **Sebrina Doyle, M.S.**, is a Research Associate at the PRC. Her work focuses on the development and testing of mindfulness-based interventions to support health. Most recently, she was awarded a contract to partner with the PA Bureau of Juvenile Justice Services to create a mindfulness-based self-care program for youth services workers. The team also includes two expert advisors. **Robert Roeser, Ph.D.**, Bennett Pierce Professor of Caring and Compassion and professor of human development and family studies, focuses on how practices associated with mindfulness and compassion can be integrated to reduce stress, enhance well-being, and cultivate qualities such as self-control, calmness, mental clarity and empathy. **David Almeida, Ph.D.**, professor of human development and family studies, examines the effects of biological and self-reported indicators of stress on health. His primary interest has been the role of daily stress on healthy aging.

Environment. The **PRC**, within the College of Health and Human Development, was established in 1998 to focus on developmental studies of risk and is a hub of research and program development in prevention science at Penn State. Research teams build theory-driven interventions and evaluate empirical evidence related to promoting the health and well-being of children, youth, and families and preventing outcomes such as opioid addiction. Co-PI Dr. Lanza is the newly appointed Director of the PRC. The PRC provides state-of-the-art grant management services together with the HHD College administration. The **College of IST** conducts transformative research focused on systems-level thinking, with the goal of addressing complex, emerging problems such as the current opioid epidemic. At the heart of both the PRC and IST is a deep commitment to interdisciplinary research that can change the way we think, the way we live, and the way we engage with the world.

### 4. Budget and Justification:

#### Matching Funds Committed by Other Units at Penn State:

The **Clinical and Translational Science Institute** has invited us to also submit this proposal in response to their recent CTSI- Bridges to Translation Opioid RFA (award range up to \$65,000). We hope they will consider the possibility of co-funding this proposed project along with the Social Science Research Institute. Pursuing both lines of funding will allow the Co-PIs to devote sufficient effort to ensure this project's success.

The **College of Information Sciences and Technology** has agreed to match one 20-hour graduate research assistantship to provide a student in IST the opportunity to work on this project under the guidance of Dr. Abdullah. This assistantship is for the 2018-19 academic year.

The **Department of Human Development and Family Studies** has agreed to match one 20-hour graduate research assistantship to provide a student in HDFS the opportunity to work on this project under the guidance of Drs. Almeida, Roeser, and Lanza. This assistantship is for the 2018-19 academic year.

The **Edna Bennett Pierce Prevention Research Center (PRC)** intends to commit resources required for Ms. Doyle to complete her prerequisite training for the MBSR Teacher Training certification. This includes partial salary support over the summer, plus approximately \$2500 for registration and travel to attend the 5-day silent retreat. In addition, the PRC will provide additional support over the summer for Ms. Doyle to explore existing mindfulness skills available on the Alexa platform to determine their strengths and limitations, and to prepare an IRB application for Aims 1 and 2 of the proposed project. Additionally, the PRC will provide consulting as

needed on the development of online surveys, data security, and data management. Finally, the PRC will provide food for participants and the instructor at each one-day mindfulness workshop.

**Dr. Robert Roeser**, Bennett Pierce Professor of Caring and Compassion and professor of Human Development and Family Studies, has agreed to serve as an unpaid advisor on this project. Dr. Roeser will support Ms. Doyle in the adaptation of mindfulness practices for this project. Dr. Roeser will make invaluable connections with individuals from around the country who are leading experts on mindfulness interventions, and hosts an annual Compassion Lecture at Penn State that features one of these leaders.

**Dr. David Almeida**, professor of Human Development and Family Studies, has agreed to serve as an unpaid advisor on this project. Dr. Almeida is a leading expert on the design of daily diary studies and analysis of daily diary data. Further, Dr. Almeida was PI of the NSDE study, which produced the daily diary data to be analyzed in Aim 1. He will consult with Dr. Lanza on this analysis and mentor the HDFS match graduate student in their work (see letter of support).

*Full Project Budget and Justification:*

Please note, we have provided the full budget and accompanying justification for your review, however we are only requesting ~\$20,000 from SSRI to cover the difference between the amount CTSI awards and the full cost of the project.



	09/01/2018 - 09/31/2019	Total
<b>Direct Costs</b>		
<b>Salaries (Category I)</b>		
Abdullah, Saeed M (Principal Investigator)		
15% effort/9 months AY		
Lanza, Stephanie Tree (Co-Investigator)		
~4.13% effort/9 months AY		
Doyle Fosco, Sebrina Leann (Co-Investigator)		
50% effort/12 months CY		
<b>Total Salaries</b>		
<b>Graduate Assistants (Category II)</b>		
Graduate Assistant - Match from IST		
50% effort/9 months AY; Grade 14 w/ full tuition		
Graduate Assistant - Match from HDFS		
50% effort/9 months AY; Grade 14 w/ full tuition		
<b>Total Graduate Assistants</b>		
<b>Total Salaries and Wages</b>		
<b>Fringe</b>		
Category I @ 41.60%	107	107
Category II @ 15.40%		
<b>Total Fringe</b>	1,016	1,016
<b>Total Salaries, Wages and Fringe</b>		
<b>Modified Total Direct Costs</b>		
Registrations - MBSR Training for Doyle	2,935	2,935
University of California-San Diego September 8th-14th in Sedona, Arizona. The cost for tuition is \$1520. Room and Board is \$1415		
Travel In State - to Hershey Medical Center	107	107
@ 200 miles r/t x .535/per mile		
Travel - Domestic (MBSR Training travel)	1,016	1,016
\$500 for airfare, \$258 for car rental, \$162 (allowance) for hotel, and \$48 per diem x 2 days		
Travel - Prerequisite Training for MBSR TTI	0	0
Subject Payments, Daily Survey	1,500	1,500
30 days daily survey payments, \$1/per day x 50 participants		
Subject Payments, Survey Completion Bonus	1,000	1,000
survey high completion bonus @ \$20 x 50 participants		
Subject Payments, Post-test Survey	1,500	1,500
Post-test survey payment @ \$25 x 60 participants		
IT Peripheral Devices - Amazon Alexa Echo Dots	3,000	3,000
60 @ \$50/each		
<b>Total Modified Total Direct Costs</b>	83,768	83,768
<b>Other Direct Costs</b>		
<b>Total Other Direct Costs</b>	0	0
<b>Total Requested From Sponsor</b>	83,768	83,768
<b>University Participation</b>		
Graduate Assistant - Match from IST	22,125	22,125
Graduate Assistant - Match from HDFS	22,125	22,125
Travel - Prerequisite Training for MBSR TTI	2,500	2,500
Tuition Remission	36,814	36,814
<b>Fringe</b>		
Category II @ 15.40%	6,814	6,814
<b>Total University Participation</b>	90,378	90,378
<b>Total Project Costs</b>	174,146	174,146

Proposal: 50457  
Generated by nlq4 on: 04/27/2018  
Created on 04/20/2018 and last updated on 04/27/2018

### *Faculty and Staff*

**Saeed Abdullah, Ph.D.**, Assistant Professor of Information Sciences and Technology, will be a Co-Principal Investigator for this project. Dr. Abdullah will be responsible for all aspects of the design and development of the conversational agents using the Amazon Alexa ecosystem. He will also be responsible for the collection of granular data about user interaction with the conversational agent and system performance available within the ecosystem. We have budgeted 15% of is AY effort to assure adequate time to devote to developing this new platform. (Additionally, please see IST letter of support for evidence of College matching for graduate assistant to work with Dr. Abdullah).

**Stephanie Lanza, Ph.D.**, Professor of Biobehavioral Health and Director of the Edna Bennett Pierce Prevention Research Center, will serve as a Co-Principal Investigator on this project and will collaborate with Dr. Abdullah and Ms. Doyle on all aspects of the proposed project. She will mentor Dr. Abdullah on project and grants management, and will lead innovative data analysis of the NSDE data and the pilot data to be collected. Stephanie will devote approximately 4% of her AY effort on this project.

**Sebrina Doyle, M.S.**, Assistant Research Professor in the Prevention Research Center, will serve as the project manager and a co-investigator for this project. Ms. Doyle will be responsible for adapting and modularizing mindfulness practices in order for them to be delivered via a virtual conversational agent. She also will coordinate the collection of baseline data, 30-day diary data, and 3-month follow-up data, organize monthly project meetings, and create and monitor the human subjects protocols. Ms. Doyle is budgeted for 50% FTE, with fringe included at the current rate of 41.6%.

### *Participant Payments*

**Amazon Alexa Echo Dots-** Participants will receive payment for their first survey and attendance to the one-day mindfulness training in the form of an Echo Dot. We have budgeted for purchase of 60 Dots for the initial community engagement pilot (N=10) and the larger pilot (N=50) @ \$50.00 each.

**Daily Survey Payments-** For the larger pilot, participants will receive a dollar for each daily survey completed (30 days @ \$1= \$30 X 50 participants).

**High Completion Bonus-** In addition to the daily survey payments, participants will receive a “high completion” bonus payment each week (\$5 X 4 weeks) that they complete at least 5 out of 7 daily surveys. Participants can earn up to \$20 additional dollars (\$20 X 50 participants).

**Post-Test Survey Payment-** Participants from both pilot studies will receive \$25 for completing a post-test survey (\$25 X 60 participants).

### *Travel*

**In-State Travel to Hershey Medical Center-**Staff will travel to meet with clinicians at the Hershey Pain Management Clinic. (200 miles R/T @ .535 per mile)

**Travel for MBSR training-** Funds for travel are being requested for Ms. Doyle to attend the MBSR Training in Sedona, AZ. This includes \$500 for round-trip airfare to Flagstaff, Arizona (closest airport), \$258 for a rental car (required due to the distance between Flagstaff and Sedona), one night hotel stay before the training at \$162, and 2 days of per diem (At  $\frac{2}{3}$  because of being 1st and last day of travel) @ \$48 per day.

### *Other*

**Registration fees for MBSR Teacher Training-** Sebrina Doyle will attend the Mindfulness-Based Stress Reduction (MBSR) Teacher Training Intensive Program offered through University of California-San Diego September 8th-14th in Sedona, Arizona. The cost for tuition is \$1520. Room and Board is \$1415.

**Department budget coordinator:** Alicia Fetzer [uxk4@psu.edu](mailto:uxk4@psu.edu) or 814-865-2618.

**Budget and fund number:** 423-24-1001 **Administrative area number:** 023

## **5. SSRI Services to be Used:**

We do not plan to use any SSRI services, but do plan to consult with the Survey Research Center prior to designing and implementing our daily diary study to ensure that the best software and practices are employed.

## **6. Investigator information:**

### **Lead Investigators**

*Name:* Stephanie Lanza

*Title:* C. Eugene Bennett Chair in Prevention Research, Director, Professor

*Department/Organization:* Edna Bennett Pierce Prevention Research Center and Biobehavioral Health

*College/Campus:* Health and Human Development/University Park

*Phone:* 814-863-0167

*Email:* SLanza@psu.edu

*Tenure Track:* Yes, Biobehavioral Health

*Name:* Saeed Abdullah

*Title:* Assistant Professor

*Department/Organization:* Information Sciences and Technology

*College/Campus:* Information Sciences and Technology/University Park

*Phone:* 814-867-0270

*Email:* saeed@psu.edu

*Tenure Track* - Yes, Informations Sciences and Technology

### **Collaborating Investigator**

*Name:* Sebrina Doyle

*Title:* Assistant Research Professor

*Department/Organization:* Bennett Pierce Prevention Research Center

*College/Campus:* Health and Human Development

*Email:* sld40@psu.edu

*Tenure Track* - No

### **Additional Collaborators**

*Name:* Robert Roeser

*Title:* Bennett Pierce Professor of Caring and Compassion

*Department/Organization:* Human Development and Family Studies

*College/Campus:* Health and Human Development

*Phone:* 814-863-7005

*Email:* rwr15@psu.edu

*Tenure Track* - Yes; Human Development and Family Studies

*Name:* David Almeida

*Title:* Professor

*Department/Organization:* Human Development and Family Studies

*College/Campus:* Health and Human Development

*Phone:* 814-865-2656

*Email:* dalmeida@psu.edu

*Tenure Track* - Yes; Human Development and Family Studies

## 7. Pre-Submission Checklist

*1. Which agency or foundation officials (e.g., project officer) have you spoken with to determine their interest in this project or project area? What feedback did you receive on your concept and approach?*

(a) We have shared a one-page concept sheet with Dr. Belinda Sims of NIH/NIDA and Dr. Lanza met with her in person to discuss the project. Dr. Sims' feedback was extremely positive, and she encouraged us to consider submitting an R01 proposal to either the National Institute on Drug Abuse (NIDA) or the National Center on Complementary and Integrative Health (NCCIH). She also mentioned the possibility of the institute and the center co-funding the larger trial.

(b) Dr. Lanza has a new, promising dialogue with the Hillman Family Foundations, which are interested in investing in opioid use prevention programming with individuals in southwestern Pennsylvania. Along with other concept sheets, she has submitted a two-page concept sheet on this project to use Amazon Alexa as a virtual mindfulness coach to aid in chronic pain management. We are awaiting their feedback on this idea.

*2. Are you responding to a specific request for proposal (RFP/RFA), program announcement, or other special funding initiative? If yes, which one and how is your Level 2 a good match for it?*

We anticipate submitting several grant proposals that build directly from this proposed Level 2 project, however no specific request for proposals have been identified at this time. Our planned grant proposals include (a) the R01 mentioned above during 2019, to request funding from NIDA or NCCIH to conduct a clinical trial using Amazon Alexa to deliver components of MBSR training in individuals' homes in daily life, (b) a proposal to NSF Smart and Connected Health in December 2019 titled "Conversational Agents in Mental Health Care: Leveraging Smart-Home Devices for Behavior Change and Improving Adherence," and (c) an R21 application to NIH in early 2020 titled "Talking to Machines: Enabling Couple Therapy in PTSD Using Conversational Agents."

*3. Is this Level 2 being undertaken in response to feedback from a prior external proposal? If so, how does this project address reviewer concerns?*

No. This is an original submission.

*4. How does your study compare with projects in similar domains that have been funded by your targeted agency? In particular, how does the scope of your methodology appear similar to other funded projects (in terms of the size and representativeness of the sample, measurement strategies, design and planned analytic approach, etc.)?*

We have not yet done a thorough investigation of other NIH- and NSF-funded projects related to mindfulness interventions to address chronic pain management without the use of opioids. However, the program officers with whom we have spoken to date have all indicated that our project to embed MBSR practices in daily life using a conversational agent such as Amazon Alexa is the first of its kind. Prior to beginning any larger grant proposals, we will complete an exhaustive search of funded applications to ensure that our applications highlight innovations beyond what is already funded by the agencies.

*5. What criteria will be used to evaluate your proposal and what do you know about the likely reviewers?*

We anticipate the NIH and NSF grant proposals to follow standard review processes, with an interdisciplinary group of scientists enlisted to review each application. We will plan for experts in conversational agent technologies, analysis of intensive longitudinal data, mindfulness/MBSR interventions, and chronic pain management to be involved in the review process for each proposal.

We have just begun our conversations with the Hillman Family Foundation, and do not yet know how their review process works. However, Dr. Lanza is planning a trip this summer to meet with several program officers at Hillman who are interested in funding work on opioid use prevention, and will learn more at that time.

## 8. Letters of support

PENNSTATE



Department of Human Development and Family Studies  
College of Health and Human Development  
The Pennsylvania State University  
211 Henderson Building South  
University Park, PA 16802-6505  
814-863-8000

May 1, 2018

Saeed Abdullah, Ph.D.  
College of Information Sciences and Technology  
E329 Westgate Building  
The Pennsylvania State University  
University Park, PA 16802

Dear Saeed,

Thank you for the invitation to participate in your pilot application, "*Alexa, I'm in pain!*" *A Real-Time Mindfulness Intervention Delivered through a Conversational Agent*, to be submitted to the Penn State CTSI. I am enthusiastic about serving as an advisor on the project. My long-standing interest in the link between stress and health among adults is pertinent to the ongoing opioid epidemic, most notably in terms of the challenges associated with suffering pain in everyday life. I am excited to turn my focus to this public health challenge as part of this team.

Given my expertise in the design and analysis for daily diary studies, I would be happy to advise your team on the collection and analysis of daily data under the proposed pilot study. Additionally, I look forward to working with Dr. Lanza and a graduate research assistant on the analysis of data from the National Study of Daily Experiences, on which I served as the PI. This study has some information on experience with mindfulness practice, as well as experiences of pain and daily stress. I look forward to working with this team to figure out the potential for conversational agents like Amazon Alexa to deliver intervention content in daily life.

Sincerely,

David M. Almeida, Ph.D.  
Professor, Department of Human Development and Family Studies  
The Pennsylvania State University  
403 Biobehavioral Health Building  
[dma18@psu.edu](mailto:dma18@psu.edu)



Robert W. Roeser  
 Bennett-Pierce Professor of Care and Compassion  
 Department of Human Development and Family Studies  
 College of Health and Human Development  
 The Pennsylvania State University  
 119 Health and Human Development Building  
 University Park, PA 16802-6505  
 814-863-7005  
[rwr15@psu.edu](mailto:rwr15@psu.edu)

May 1, 2018

Saeed Abdullah, Ph.D.  
 College of Information Sciences and Technology  
 E329 Westgate Building  
 The Pennsylvania State University  
 University Park, PA 16802

Dear Saeed and Stephanie,

I am happy to serve as a consultant on your CTSI pilot application, *"Alexa, I'm in pain!" A Real-Time Mindfulness Intervention Delivered through a Conversational Agent*. Your proposed use of the Amazon Alexa platform to help individuals with regular mindfulness practice, as well as their ability to receive help on-demand in moments of pain, has the potential to serve many individuals.

I have known Sebrina Doyle for some time and look forward to providing advice as she works to adapt Mindfulness-Based Stress Reduction practices for this type of delivery. I also can help to make connections with individuals from around the country who are leading experts on mindfulness interventions, in hopes that they also may be of service. Additionally, I host the annual Compassion Lecture at Penn State each April; during that week, a national expert visits Penn State to conduct a morning workshop, give several lectures, and meet with interested researchers. I anticipate that the Spring 2019 lecturer will be eager to learn from this group about their truly innovative project.

It is wonderful to see the application of mindfulness practice at the center of the proposed project, with the ultimate goal of reducing opioid use. I am happy to advise the team and look forward to learning about how the community of adults suffering from chronic pain engage with this type of intervention.

Warmly,

Robert Roeser, Ph.D.  
 Bennett Pierce Professor of Caring and Compassion  
 Professor, Human Development and Family Studies  
 The Pennsylvania State University  
 111 HHD Building  
[rwr15@psu.edu](mailto:rwr15@psu.edu)

**BIOGRAPHICAL SKETCH**

Provide the following information for the Senior/key personnel and other significant contributors.  
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Abdullah, Saeed

POSITION TITLE: Assistant Professor

**EDUCATION**

INSTITUTION AND LOCATION	DEGREE	Completion Date MM/YYYY	FIELD OF STUDY
Bangladesh University of Engineering & Technology, Dhaka	BS	01/2008	Computer Science & Engineering
University of Vermont, Burlington, VT	MS	10/2011	Computer Science
Cornell University, Ithaca, NY	MS	01/2015	Information Science
Cornell University, Ithaca, NY	PhD	08/2017	Information Science

**A. Personal Statement**

My research aims to develop novel data-driven technologies to improve health and well-being. My work has introduced assessment and intervention tools across a number of health related domains including sleep, cognitive performance, bipolar disorder, and schizophrenia. These systems leverage smartphone and wearable sensors to continuously collect granular behavioral and contextual data, which can lead to better clinical decision making and just-in-time interventions. My work also explores data-driven tools to sustain long-term user engagement and adherence in the context of mHealth. My research has been recognized through several accolades, including the \$100,000 Heritage Open mHealth Challenge winner and an Agile Research Project award from the Robert Wood Johnson Foundation.

**B. Selected Peer-Reviewed Publications**

1. **Abdullah, S.**, & Choudhury, T. (2018). Sensing Technologies for Monitoring Serious Mental Illnesses. *IEEE MultiMedia*, 25(1), 61-75.
2. **Abdullah, S.**, Murnane, E. L., Matthews, M., & Choudhury, T. (2017). Circadian Computing: Sensing, Modeling, and Maintaining Biological Rhythms. In *Mobile Health* (pp. 35-58). Springer, Cham.
3. Choe, E. K., **Abdullah, S.**, Rabbi, M., Thomaz, E., Epstein, D. A., Cordeiro, F., ... & Lee, B. (2017). Semi-automated tracking: A balanced approach for self-monitoring applications. *IEEE Pervasive Computing*, 16(1), 74-84.
4. **Abdullah, S.**, Matthews, M., Frank, E., Doherty, G., Gay, G., & Choudhury, T. (2016). Automatic detection of social rhythms in bipolar disorder. *Journal of the American Medical Informatics Association*, 23(3), 538-543.
5. Matthews, M., **Abdullah, S.**, Murnane, E., Volda, S., Choudhury, T., Gay, G., & Frank, E. (2016). Development and evaluation of a smartphone-based measure of social rhythms for bipolar disorder. *Assessment*, 23(4), 472-483.
6. Matthews, M., Volda, **S., Abdullah, S.**, Doherty, G., Choudhury, T., Im, S., & Gay, G. (2015, August). In situ design for mental illness: considering the pathology of bipolar disorder in mHealth design. In *Proceedings of the 17th International Conference on Human-Computer Interaction with Mobile Devices and Services* (pp. 86-97). ACM.
7. Ben-Zeev, D., Wang, R., **Abdullah, S.**, Brian, R., Scherer, E. A., Mistler, L. A., ... & Choudhury, T. (2015). Mobile behavioral sensing for outpatients and inpatients with schizophrenia. *Psychiatric services*, 67(5), 558-561.
8. Wang, R., Aung, M. S., **Abdullah, S.**, Brian, R., Campbell, A. T., Choudhury, T., ... & Tseng, V. W. (2016, September). CrossCheck: Toward passive sensing and detection of mental health changes in

people with schizophrenia. In Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing (pp. 886-897). ACM.

OMB No. 0925-0001 and 0925-0002 (Rev. 11/16 Approved Through 10/31/2018)

### BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.  
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Lanza, Stephanie Trea

eRA COMMONS USER NAME (credential, e.g., agency login): SLANZA

POSITION TITLE: Professor of Biobehavioral Health and Human Development; C. Eugene Bennett Chair in Prevention Research; Director, Edna Bennett Prevention Research Center

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
University of North Carolina at Chapel Hill	B.S.	05/1992	Mathematical Science
University of North Carolina at Chapel Hill	B.A.	05/1992	Psychology
The Pennsylvania State University	M.S.	08/1998	Human Development & Family Studies
The Pennsylvania State University	M.A.S.	12/2002	Applied Statistics
The Pennsylvania State University	Ph.D.	05/2003	Human Development & Family Studies

#### A. Personal Statement

Serving from 2004-217 as Scientific Director of The Methodology Center, I developed and disseminated innovative analysis methods for health research. I have pursued a productive line of funded research on the development and application of methods, including LCA and TVEM. My work on LCA and related methods has resulted in dozens of peer-reviewed publications and invited talks, as well as the release and continuous extension of the major SAS software product, PROC LCA, and the Stata LCA plug-in. I also co-authored the first comprehensive book on LCA and LTA, *Latent Class Analysis and Latent Transition Analysis: With Applications in the Social, Behavioral, and Health Sciences* (Collins & Lanza, 2010). My applied work using these methods has focused on the etiology of health behavior across adolescence and young adulthood, with papers published in journals such as *Addiction*, *Drug Abuse and Dependence*, *Addictive Behaviors*, and *Child Development*. More recently, I have focused on new methods for analyzing longitudinal and intensive longitudinal data. I currently serve as PI of a NIDA-funded project to apply TVEM to national data to elucidate age-varying processes related to substance use. This project has resulted in numerous published studies, including an article describing differences in the links between combustible cigarette use and electronic cigarette use across adolescence and how these links vary by biological sex and racial/ethnic group. In 2014 I was awarded the Society for Prevention Research top mentoring award and now serve on the society's board of directors. In August 2017, I began the new role of Director of the Edna Bennett Pierce Prevention Research Center at Penn State.

1. **Lanza**, S. T., & Collins, L. M. (2008). A new SAS procedure for latent transition analysis: Transitions in dating and sexual risk behavior. *Developmental Psychology*, 44(2), 446-456. PMID: PMC2846549
2. **Lanza**, S. T., Collins, L. M., Lemmon, D. R., & Schafer, J. L. (2007). PROC LCA: A SAS procedure for latent class analysis. *Structural Equation Modeling*, 14(4), 671-694. PMID: PMC2785099
3. **Lanza**, S. T., Piper, M. E., & Shiffman, S. (2014). New methods for advancing research on tobacco dependence using ecological momentary assessments. *Nicotine and Tobacco Research*, 16 Suppl 2, S71-S72. PMID: PMC4085886



4. **Lanza, S. T., Vasilenko, S. A., & Russell, M. A. (2016).** Time-varying effect modeling to address new questions in behavioral research: Examples in marijuana use. *Psychology of Addictive Behaviors*. <http://dx.doi.org/10.1037/adb0000208>. PMCID: PMC5222706

## B. Positions and Honors

### Positions

2001-2004	Project Statistician, Tobacco Etiology Research Network (TERN)
2003-2004	Research Assistant Professor, Department of Psychology, University of North Carolina at Chapel Hill
2003-2004	Investigator, Frank Porter Graham Child Development Institute, University of North Carolina at Chapel Hill
2004-2009	Research Associate and Scientific Director, The Methodology Center, Pennsylvania State University
2009-	Scientific Director, The Methodology Center, Pennsylvania State University
2010-2015	Research Associate Professor, Health and Human Development, Pennsylvania State University
2015-	Professor of Biobehavioral Health, Pennsylvania State University

### Honors

2008	Society for Prevention Research ECPN Early Career Award
2010-2012	Editorial Board, <i>Prevention Science</i>
2012-	Associate Editor, <i>Prevention Science</i>
2014	Invited presenter, NIH Big Data to Knowledge (BD2K) Data Integration Meeting
2014	Society for Prevention Research Friend of ECPN Award (top mentoring award)
2015-	Board of Directors, Society for Prevention Research
2017-	C. Eugene Bennett Chair in Prevention Research

## C. Contributions to Science

**1. Innovations in Latent Class Analysis (LCA).** My early quantitative research focused on developing and disseminating methodological innovations for latent class analysis (LCA), an important approach to identify hidden population subgroups, by improving methods for identifying antecedents—and, in fact, determinants—of latent class membership. In addition, I proposed a new model-based approach to estimating the association between latent classes and a distal outcome. During my first ten years of research, I co-authored the first comprehensive book on the methodological topic as part of the Wiley Series in Probability and Statistics (*Latent Class and Latent Transition Analysis: With Applications in the Social, Behavioral, and Health Sciences*), led the development of a new SAS procedure (PROC LCA) for implementing the latest advances in latent class analysis for cross-sectional and longitudinal data, received several NIH grants to fund this research, published dozens of peer-reviewed articles on the topic in both quantitative and health/behavior outlets, presented many national and international invited talks, and regularly taught this material at hands-on workshops for health-oriented researchers. In 2008 I received the Early Career Award from the Society for Prevention Research for early contributions in this area.

- a. Collins, L. M., & **Lanza, S. T. (2010).** *Latent class and latent transition analysis: With applications in the social, behavioral, and health sciences*. New York: Wiley.
- b. **Lanza, S. T., Coffman, D. L., & Xu, S. (2013).** Causal inference in latent class analysis. *Structural Equation Modeling: A Multidisciplinary Journal*, 20, 361-383. PMCID: PMC4240500
- c. **Lanza, S. T., Tan, X., & Bray, B. C. (2013).** Latent class analysis with distal outcomes: A flexible model-based approach. *Structural Equation Modeling*, 20, 1-20. doi: 10.1080/10705511.2013.742377. PMCID: PMC4240499
- d. **Lanza, S. T., Collins, L. M., Schafer, J. L., & Flaherty, B. P. (2005).** Using data augmentation to obtain standard errors and conduct hypothesis tests in latent class and latent transition analysis. *Psychological Methods*, 10, 84-100.

**2. Mixture Models to Elucidate Complex Health Risk Behaviors.** Stemming both from my research in LCA and my commitment to disseminate new methods to behavioral researchers, I applied LCA to

model complex, multidimensional behavior in new ways. Each manuscript includes an accessible introduction to LCA, emphasizing the new research questions that could be addressed by researchers in that field using the approach. Behaviors that have been the focus of such studies include substance use initiation (including tests of the gateway hypothesis of drug use), drug use and abuse, use of tobacco products (including hookah), smoking cessation withdrawal, adolescent delinquency, sexual risk behavior, and weight loss strategies.

- a. **Lanza, S. T., & Bray, B. C. (2010).** Transitions in drug use among high-risk women: An application of latent class and latent transition analysis. *Advances and Applications in Statistical Sciences*, 3, 203-235. PMID: PMC3171700
- b. **Lanza, S. T., Patrick, M. E., & Maggs, J. L. (2010).** Latent transition analysis: Benefits of a latent variable approach to modeling transitions in substance use. *Journal of Drug Issues*, 40(1), 93-120. PMID: PMC2909684
- c. Piper, M. E., Vasilenko, S. A., Cook, J. W., & **Lanza, S. T. (2016).** What a difference a day makes: Differences in initial abstinence response during a smoking cessation attempt. *Addiction*. <http://doi.org/10.1111/add.13613>. PMID: PMC5233552.
- d. Vasilenko, S. A., Kugler, K. C., Butera, N. M. & **Lanza, S. T. (2014).** Patterns of adolescent sexual behavior predicting young adult sexually transmitted infections: A latent class analysis approach. *Archives of Sexual Behavior*. doi: 10.1007/s10508-014-0258-6. PMID: PMC4107199

**3. Time-Varying Effect Modeling (TVEM) to Examine the Etiology of Substance Use.** The development of a new statistical approach, time-varying effect modeling (TVEM), was funded as part of The Methodology Center's NIDA-funded Center on Complex Data to Knowledge (P50 DA039838). Despite being developed for the analysis of intensive longitudinal data (see Contribution to Science #4 below), TVEM holds great promise to advance understanding of the etiology of health risk behaviors and their correlates across age. My original NIDA R01 focused on the innovative application of TVEM to existing data from complementary national studies of health risk behaviors. This approach flexibly estimates behavior prevalences and associations between covariates and behaviors as continuous, nonparametric functions of age. Along with my collaborators, I applied TVEM to examine age-related changes across young adulthood in associations between reasons for alcohol use and high-intensity drinking, age-varying associations between student status and excessive alcohol use, age-varying links across adolescence between combustible and electronic cigarette use, age-varying associations between marijuana use and friends' use across young adulthood, age-varying implications of violence exposure for health through young adulthood, and age-varying disparities in rates of cigarette, alcohol, and marijuana use.

- a. Patrick, M. E., Evans-Polce, R., Kloska, D. D., Maggs, J. L., & **Lanza, S. T. (2017).** Age-related changes in associations between reasons for alcohol use and high-intensity drinking across young adulthood. *Journal of Studies on Alcohol and Drugs*, 78, 558-570. PMID – In Process
- b. Russell, M. A., Vasilenko, S. A., & **Lanza, S. T. (2016).** Age-varying links between violence exposure and behavioral, mental, and physical health. *Journal of Adolescent Health*. doi: 10.1016/j.jadohealth.2016.03.038. PMID: PMC4958611
- c. **Lanza, S. T., Russell, M. A., & Braymiller, J. (2017).** Emergence of electronic cigarette use in us adolescents and the link to traditional cigarette use. *Addictive Behaviors*, 67, 38-43. PMID: PMC5250583
- d. **Lanza, S. T., Vasilenko, S. A., & Russell, M. A. (2016).** Time-varying effect modeling to address new questions in behavioral research: Examples in marijuana Use. *Psychology of Addictive Behaviors*. <http://dx.doi.org/10.1037/adb0000208>. PMID: PMC5222706

**4. New Methods for the Analysis of Intensive Longitudinal Data.** More recently, my research has given sharp focus to new methods for the analysis of intensive longitudinal data, including ecological momentary assessments (EMA). My primary research in this area is on the advancement and innovative application of time-varying effect modeling (TVEM), developed at the Methodology Center. This exciting work is progressing quickly, in part due to the rapid growth of research in this field and the emphasis on mobile health (mHealth) at NIH. My NCI-funded R01 allowed us to pursue these methods to study dynamics in smoking behavior and cessation. After organizing a popular pre-conference workshop on EMA methods for the 2012 Society for Research on Nicotine and Tobacco conference, I served as lead editor (along with Drs. Megan Piper and Saul Shiffman) of a supplemental issue of *Nicotine and Tobacco Research* to help bring EMA methods to the forefront in

tobacco research. A key finding my colleagues and I published in that issue explicates dynamic processes that unfold during a quit attempt and shows how smoking cessation interventions can have a time-varying effect not only on craving over time, but also on the time-varying salience of other factors, such as negative affect, on craving. My collaborators and I are poised to make substantive contributions by applying TVEM to intensive longitudinal data on smoking cessation, alcohol and drug addiction recovery, medication adherence (including HAART), and increased physical activity. This work will contribute to critical future directions for interventions administered via mobile devices in ways that adapt to an individual's changing needs and evolving history of response to the intervention. Along with my colleagues, I published a paper in the *Journal of Consulting and Clinical Psychology* that introduces clinicians and intervention scientists to dynamical systems modeling of intensive longitudinal data to inform this type of intervention.

- a. **Lanza**, S. T., Vasilenko, S., Liu, X., Li, R., & Piper, M. (2014). Advancing the understanding of craving during smoking cessation attempts: A demonstration of the time-varying effect model. *Nicotine and Tobacco Research*, 16 Suppl 2, S127-S134. doi: 10.1093/ntr/ntt128 PMCID: PMC3977629
- b. Liu, X., Li, R., **Lanza**, S. T., Vasilenko, S., & Piper, M. (2013). Understanding the role of cessation fatigue in the smoking cessation process. *Drug and Alcohol Dependence*, 133, 548-555. doi: 10.1016/j.drugalcdep.2013.07.025. PMCID: PMC4057045
- c. Vasilenko, S. A., Piper, M. E., **Lanza**, S. T. Liu, X., Yang, J. & Li, R. (2014). Time-varying processes involved in smoking lapse in a randomized trial of smoking cessation therapies. *Nicotine and Tobacco Research*, 16, S135-S143. doi: 10.1093/ntr/ntt18. PMCID: PMC3977637
- d. Lagoa, C., Bekiroglu, K., **Lanza**, S. T., & Murphy, S. (2014). Designing adaptive intensive interventions using methods from engineering. *Journal of Consulting and Clinical Psychology*, 82, 868-78. PMCID: PMC4176810

**5. Dissemination of Innovative Methods.** I am devoted to disseminating advanced statistical methods to behavioral, health, and social science researchers. Dissemination is successful only when talented researchers can (a) understand the conceptual underpinnings of a method and which precise research questions it can be used to address and (b) access user-friendly tools and training in order to use the new method in their own work. When dissemination is successful, research proceeds more rapidly and features greater innovation. As PI since 2006 of a NIDA-funded R13 that has funded the annual Summer Institute on Innovative Methods, I have organized hands-on workshops on cutting-edge methods. These workshops have been taught by the nation's leading expert methodologists. My commitment to dissemination also is evidenced by my role (2007-2014) as director of the Methodology Center's software development and technology transfer core; the mission of this core is to place innovative statistical methods in the hands of health and behavioral researchers everywhere. Many free software products, including SAS PROC LCA & PROC LTA and SAS macros for time-varying effect modeling, are now available for download at <http://methodology.psu.edu/downloads>. I have been invited to present many methodological workshops for behavioral researchers both nationally and internationally, have presented many didactic talks at academic meetings, and have written tutorial papers in top journals introducing multilevel modeling, latent class analysis, latent transition analysis, propensity score analysis, and time-varying effect modeling.

- a. **Lanza**, S. T., Moore, J. E., & Butera, N. M. (2013). Drawing causal inference using propensity scores: A practical guide for community psychologists. *American Journal of Community Psychology*, 52, 380-392. doi: 10.1007/s10464-013-9604-4. PMCID: PMC4098642
- b. **Lanza**, S. T. & Rhoades, B. L. (2013). Latent class analysis: An alternative perspective on subgroup analysis in prevention and treatment. *Prevention Science*, 14, 157-168. PMCID: PMC3173585
- c. **Lanza**, S. T., & Cooper, B. R. (2016). Latent class analysis: Contributions to developmental research and new directions. *Child Development Perspectives*, 10, 59-64.
- d. **Lanza**, S. T., Dziak, J. J., Huang, L., Wagner, A., & Collins, L. M. (2015). *PROC LCA & PROC LTA users' guide* (Version 1.3.2). University Park: The Methodology Center, Penn State. Retrieved from <http://methodology.psu.edu>

#### **Complete List of Published Work in MyBibliography:**

<http://www.ncbi.nlm.nih.gov/myncbi/stephanie.lanza.1/cv/20501/>

## **D. Research Support**

### **Ongoing Research Support**

R01 DA039854 Lanza (PI) 7/1/15-5/31/19

Age-Varying Effects in the Epidemiology of Drug Abuse

The goal of this project is to improve understanding of the age-related changes in behavior prevalences, comorbidities, and health disparities, and the evolving role of various risk factors from ages 12-50.

Role: PI

R13 DA020334 Bray (PI) 6/15/16-6/14/21

Drug Abuse and HIV Prevention Research Methodology Conferences

This ongoing series of dissemination conferences, called Summer Institutes on Longitudinal Methods, will focus on methods for ecological momentary assessment (EMA) to help ensure that the field of prevention research maintains highest, state-of-the-art methodological standards in studies relying on EMA data capture.

Role: Co-Investigator

P50 DA039838 Collins (PI) 9/1/15-8/31/20

Center for Complex Data to Knowledge in Drug Abuse and HIV Behavioral Science (CD2K Center)

The focus of the Center is the development and dissemination of the innovative statistical methods that are essential to unlock the knowledge contained in complex behavioral data and apply it in the fight against drug abuse and HIV.

Role: Scientific Project Director, Core Director, Co-Investigator

R01 DA037902 Patrick (PI) 4/1/15-12/31/18

Title: Dynamic Links Between Risk Factors, Substance Use, and Consequences: Ages 18-35

This project will advance understanding of the etiology of complex substance use patterns and the correlates, determinants, and consequences of use using longitudinal data from the Monitoring the Future study.

Role: Co-Investigator

UH2 AG052167 Almeida (PI) 9/1/15-8/31/20

Everyday Stress Response Targets in Science of Behavior Change

The overarching goal of this project is to utilize an experimental medicine approach to develop an efficient, ecologically valid, within-person approach to measuring and intervening on the deleterious effects of everyday stress on meeting recommended levels of two health behaviors: physical activity and sleep patterns.

Role: Co-Investigator

### **Completed Research Support**

R13 DA020334 Lanza (PI) 3/1/11-2/28/16

Drug Abuse and HIV Prevention Research Methodology Conferences

This ongoing series of dissemination conferences called Summer Institutes on Longitudinal Methods helped ensure that the field of prevention research maintains highest, state-of-the-art methodological standards.

Role: PI

R01 CA168676 Lanza (PI) 9/1/12-8/31/15

Advancing Tobacco Research by Integrating Systems Science and Mixture Models

This study examined smoking cessation by integrating time-varying effect modeling and mixture modeling and applied these approaches to analysis of ecological momentary assessment (EMA) data on tobacco use.

Role: PI

R01 DA035240 Meyers (PI) 9/15/13-7/31/16

Prescription Opioid Dependence Physiology Emotion and Treatment Outcome

This study examined central nervous system responses, diurnal cortisol, sleep, and daily/within day variability of mood, stress and craving of recently detoxified patients dependent upon prescription opioids.

Role: Co-Investigator

Center for Prevention and Treatment Methodology

The objective of this project was to develop and disseminate statistical methods that will advance drug abuse and HIV prevention research.

Role: Scientific Project Director, Core Director, Co-Investigator

OMB No. 0925-0001 and 0925-0002 (Rev. 09/17 Approved Through 03/31/2020)

## BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.  
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Doyle Fosco, Sebrina

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Research Associate

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Southern Oregon University, Ashland, OR	B.S.	06/2002	Psychology
University of Oregon, Eugene, OR	M.S.	09/2006	Psychology

### A. Personal Statement

I am interested in the application of mindfulness-based interventions to support people working or living in stressful environments. I am also interested in understanding what conditions are necessary for evidence-based interventions to be sustained at a high level; this includes how interventions are initially developed to fit within the systems they serve, and the continued use of programs with fidelity once initial funding is removed.

### B. Positions and Honors

#### Positions and Employment

2002–2004	Counselor, Drug Court/Focus program, ACES Counseling, Eugene, OR
2005	Manuscript Coordinator, Cultural Diversity and Ethnic Minority Psychology, University of Oregon, Eugene, OR
2006–2011	Clinic Coordinator, Child and Family Center, University of Oregon, Eugene OR
2007–2011	Human Subjects Coordinator, Child and Family Center, University of Oregon, Eugene, OR
2009–2011	Assessment Coordinator, “Ecological approach to family intervention and treatment (EcoFIT) integrated with PBS: An effectiveness trial in middle school” (IES-funded project), Child and Family Center, University of Oregon, Eugene, OR
2009–2011	Project Coordinator, “An internet infrastructure for the quality of implementation of Family Check Up” (NIDA/ARRA-funded project), Child and Family Center, University of Oregon, Eugene, OR
2011–2017	Project/Research Manager, “Improved classroom learning environments by Cultivating Awareness and Resilience in Education (CARE): A cluster randomized controlled efficacy

trial (IES-funded project), Edna Bennett Pierce Prevention Research Center, Pennsylvania State University

2014–present Research Associate/Principal Investigator, Family Involvement Project and Mindful Awareness Program for Wellness in Juvenile Justice Project (COP-funded projects), Edna Bennett Pierce Prevention Research Center, Pennsylvania State University

### **Certifications**

2001 Mediation and Conflict Resolution, Southern Oregon University

2004 Alcohol and Drug Counselor Education, Addiction Counseling Education Services, Eugene, OR

2012 Strengthening Families 10–14 Program Facilitator, Pennsylvania State University

2012 Motivational Interviewing, Juvenile Detention Centers Association of Pennsylvania

2015 Project Management, Pennsylvania State University

2017 Cultivating Awareness and Resilience in Education (CARE) Facilitator, Garrison Institute

## **C. Contributions to Science**

### **C1. Mindfulness Training for Teachers**

I have been involved in the implementation and evaluation of a mindfulness-based professional development program for teachers and been part of the team evaluating its impact on teacher health and wellbeing. This work has demonstrated the efficacy of mindfulness training for improved mindful awareness and emotion regulation, and decreased personal distress. Further research has also shown that fidelity to the program model affects uptake and continued use of CARE practices.

- a. **Doyle, S. L.**, Jennings, P. A., Brown, J. L., Rasheed, D., DeWeese, A., Frank, J. L., Turksma, C., & Greenberg, M. T. (revise and resubmit, under review) Exploring relationships between implementation fidelity, quality, participant responsiveness, and uptake of mindful practices in the CARE for Teachers Program. *Mindfulness*.
- b. **Doyle, S. L.**, Brown, J. L., Rasheed, D., Jones, D. E., & Jennings, P. A. (in press) Cost analysis of ingredients for successful implementation of a mindfulness-based professional development program for teachers. *Mindfulness*.
- c. Jennings, P. A., Brown, J. L., Frank, J. L., **Doyle, S. L.**, Oh, Y., Tanler, R., Rasheed, D., DeWeese, A., DeMauro, A. A., Cham, H., & Greenberg, M. T. (2017). Impacts of the CARE for Teachers program on teachers' social and emotional competence and classroom interactions. *Journal of Educational Psychology*. Advance online publication. <http://dx.doi.org/10.1037/edu0000187>
- d. DeWeese, A., Jennings, P. A., Brown, J. L., **Doyle, S. L.**, Davis, R. T., Rasheed, D. S., Frank, J. L., & Greenberg, M. T. (2017). Coding semi-structured interviews: Examining coaching calls within the CARE for Teachers program. *SAGE Research Methods Cases*, Part 2. DOI: <http://dx.doi.org/10.4135/9781473958319>

### **C2. Mindfulness Training for Counselors and Other Staff Working with High-Risk Youth**

After working extensively with staff in residential treatment centers throughout Pennsylvania, I observed the stress manifested by staff and the deleterious effects it had on their health and well-being. These observations led me to develop a new initiative, Mindfulness-Based Self-Care, in partnership with the Pennsylvania Bureau of Juvenile Justice Services (BJJS), to teach youth services workers stress management techniques needed to combat the physical and emotional effects of on-the-job stress.

- a. **Doyle, S. L.**, Agrusti, M. (2017, June) Self-care in juvenile justice: Mindfulness tools for stress management. Workshop provided at the PA Bureau of Juvenile Justice Services Staff Appreciation Conference, State College, PA
- b. **Doyle, S. L.**, Berrena, E., Agrusti, M., George, L., George-Huling, L. (2017). The mindful awareness program (MAP) for wellness in juvenile justice. Unpublished manual.

### **C3. Family Involvement in Juvenile Justice Services**

I led a community-based participatory research project to explore what systems-change was needed in order to increase family involvement in youth residential treatment services. State-run facilities are located in rural

areas which poses significant challenges for families to visit youth who are incarcerated. I provided assistance to BJJS to examine what research-based strategies and cross-facility best-practices could be put in place to support family involvement. I also assisted BJJS with the evaluation of effectiveness of those changes.

- a. **Doyle, S. L., & Cecil, K.** (2016, November). Enhancing family involvement in residential treatment services. Workshop presented at the James E. Anderson Pennsylvania Conference on Juvenile Justice, Harrisburg, PA.
- b. **Doyle, S. L., Gayles, J., & Nix, R.** (2017, June). A partnership formation in juvenile justice services to support youth well-being through increased family involvement. Paper presented at the 25rd Annual Society for Prevention Research Conference, Washington, D.C.
- c. **Doyle, S. L.** (2017, September) Enhancing Family Involvement In Residential Treatment Services, PA Juvenile Detention Centers and Alternative Programs Juvenile Justice Services Conference, Pocono Manor, PA.

#### **C4. Sustainability of Evidence-Based Programs**

Although we know that evidence-based programs are effective in research settings, we are still working to understand how they are implemented and sustained in the real world. My work has focused on understanding these real-world and systems settings in order to ascertain best-practices for sustainability.

- a. **Doyle, S. L., Scanlon, D. P., Dora, H., Sciegaj, M.** (2017, June) A culture of health: Creating a model to integrate social determinants of health into primary health care settings. Poster presented at the Society for Prevention Research, Washington, DC.
- b. **Doyle, S. L., Bumbarger, B., & Bradley, S.** (2015, December). *Organizational capacity correlates for sustaining evidence-based practices and policies to achieve public health impact.* Poster presented at the 8th Annual Conference on the Science of Dissemination and Implementation, Washington, D.C.
- c. **Doyle, S. L., Bumbarger, B., & Bradley, S.** (2014, May). How evidence-based programs are sustained in the "real-world": qualitative interviews from the field. Paper presented at the 22rd Annual Society for Prevention Research Conference, Washington, D.C.

#### **D. Additional Information: Research Support and/or Scholastic Performance**

##### **Ongoing Research Support**

PO #4400015622, 4300543757 (Doyle, PI)

04/01/17–06/30/18

COP: Department of Human Services

Mindfulness Based Self-Care (MBSC)

In this community-based participatory research project, Penn State staff are working with a team from the Bureau of Juvenile Justice Services Division of Quality Improvement and Training Services to develop a sustainable self-care program for staff working in residential youth facilities across the Commonwealth. Elements of this self-care curriculum will include brief mindfulness-based practices for stress management, emotion skills awareness and management, empathy and compassionate responding, and understanding of vicarious/secondary trauma.

##### **Completed Research Projects (last three years)**

COP: Bureau of Juvenile Justice Services/PA Commission on Crime & Delinquency

10/01/14–06/30/16

Technology Enhanced Family Involvement in Juvenile Justice Services/

Continuation of Enhanced Family Involvement in Juvenile Justice Services

In this research project, we worked with Juvenile Justice Centers across the state to increase the level of family involvement in rural treatment facilities. We assisted them in identifying research-based practices and cross-facility best practices for connecting with and engaging families. We also assisted them with the evaluation of those practices.

**BIOGRAPHICAL SKETCH**

Provide the following information for the Senior/key personnel and other significant contributors.  
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Roeser, Robert W.

eRA COMMONS USER NAME (credential, e.g., agency login): RROESER

POSITION TITLE: Professor

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Cornell University, Ithaca, NY	B.A.	05/1989	Psychology
Holy Names College, Oakland, CA	M.A.	05/1992	Psychology & Religion
University of Michigan, Ann Arbor, MI	M.A.	05/1993	Developmental Psych.
University of Michigan, Ann Arbor, MI	M.S.W.	05/1995	Clinical Social Work
University of Michigan, Ann Arbor, MI	Ph.D.	05/1996	Education & Psychology

**A. Personal Statement**

Dr. Roeser is an applied developmental and educational psychologist with expertise in the evaluation of interventions involving contemplative practices in applied settings. He has been a thought leader in the emerging fields of Developmental Contemplative Science and Contemplative Education – branches of study aimed at understanding the putative effects on contemplative practice interventions on educators and students in school contexts. He has directed multiple field studies of adolescent development, and, more recently, multiple field intervention trials of contemplative practices with teachers, adolescents and young children in school settings. Recent studies funded by the US Fulbright Program, Fetzer Institute, Mind and Life Institute, Spencer Foundation, Impact Foundation, Gates Foundation (via ESD112 in Vancouver, WA) and William T. Grant Foundation have focused on the use of mindfulness and compassion practices in education as a means of (a) improving health and wellbeing in teachers; (b) improving the classroom learning environment for students; and (c) improving student wellbeing, motivation and engagement in learning.

- a. Roeser, R. W. & Eccles, J. S. (2015). Mindfulness and compassion in human development: Introduction to the special section. *Developmental Psychology*, 51, 1–6.
- b. Roeser, R. W. (2014). The emergence of mindfulness-based interventions in educational settings. In T. Urdan & S. Karabenick (Eds.), *Motivational Interventions* (pp. 379–419). Emerald Group Publishing Limited.
- c. Roeser, R. W. (2013). Mindfulness and human development: Introduction to the special issue. *Journal of Human Development*, 10, 1–11.
- d. Roeser, R. W., & Zelazo, P. D. R. (2012). Contemplative science, education and child development: Introduction to the Special Section. *Child Development Perspectives*, 6, 143–145.

**B. Positions and Honors****Positions and Employment**

1996–2004	Assistant Professor of Education, Stanford University, Stanford, CA
1999	Visiting Professor, Department of Pedagogy, University of Amsterdam, Netherlands
2004	Visiting Professor, Department of Applied Psychology, New York University, NY, NY
2005	United States Fulbright Scholar in India, Maharashtra Institute of Technology, Pune, India



2005–2008	Associate Research Professor, Child Development, Tufts University, Medford, MA
2007–2010	Senior Program Coordinator, Mind and Life Institute, Boulder, CO
2008–2011	Associate Professor of Psychology, Portland State University, Portland OR
2011–2016	Professor of Psychology, Portland State University, Portland OR
2016–present	Bennett Pierce Chair in Care and Compassion, Penn State University, University Park, PA
2017	United States Fulbright Scholar in India, University of Pune, Pune, India

### **Other Relevant Professional Experiences**

2014–present	<b>Scientific advisor</b> , The Hawn Foundation – which has developed the MindUp social-emotional learning, mindfulness-based curriculum for children and adolescents.
2013–present	<b>Scientific team member</b> , Mind and Life Institute’s Ethics, Education and Human Development initiative to develop compassion curricula for teachers and children.
2007–2010	<b>Network Coordinator and team member</b> , Mind and Life Educational Research Network (MLERN). I coordinated and participated in a 3-year, trans-disciplinary group (headed by Richard Davidson and Mark Greenberg) focused on if and how to introduce contemplative practices in education in the United States.
2006	<b>Scientific advisor</b> , Birth to 20 longitudinal cohort study of all South Africans born in Soweto and Johannesburg, South Africa in 1990 – called “Mandela’s Children”

### **C. Contributions to Science**

My career has evolved from a focus on adolescent development, especially academic and social-emotional development, to a focus on teacher professional development, to a focus on the introduction of contemplative practices as a means of optimizing adolescent and teacher development:

**1. Developing a scientific basis for the study of mindfulness and compassion in education and human development.** Much of my work over the past 7 years has been focused on building the fields of Contemplative Education and Contemplative Developmental Science – interdisciplinary studies of the role of contemplative practices like mindfulness and yoga in teaching and learning, and in socialization in families, schools and communities. For instance, in regard to developmental science, my colleagues and I have recently brought attention to the underdeveloped nature of our understanding of quintessential human characteristics like mindful awareness, kindness and compassion and published a series of ground breaking empirical papers on this topic in the prestigious APA journal *Developmental Psychology*. In addition, my colleagues and I published a second set of conceptual articles on contemplative practices in education and child development in *Child Development Perspectives*. I have also published on how and why the introduction of contemplative practices with adolescents and with teachers may be particularly fruitful.

- a. **Roeser, R. W.**, & Peck, S. C. (2009). An education in awareness: Self, motivation and self-regulation in contemplative perspective. *Educational Psychologist*, 44, 119–136.
- b. Mind and Life Education Research Network. (2012). Contemplative practices and mental training: Prospects for American education. *Child Development Perspectives*, 6, 146–153.
- c. **Roeser, R. W.**, & Pinela, C. (2014). Mindfulness and compassion training in adolescence: A developmental contemplative science perspective. *New Directions in Youth Development*, 9–24.
- d. **Roeser, R. W.**, & Eccles, J. S. (2015). Mindfulness and compassion in human development: Introduction to the special section. *Developmental Psychology*, 51, 1–6.

**2. Mindfulness training reduces stress in school teachers.** Over those same 7 years, I have been involved in the development and evaluation of a teacher mindfulness program and its impact on teacher health and wellbeing. This work has demonstrated the efficacy of mindfulness training for improved attention and mindful awareness, improved emotion regulation, and decreased stress, burnout, anxiety and depression.

- a. Benn, R., Akiva, T., Arel, S., & **Roeser, R. W.** (2012). Mindfulness training effects for parents and educators of children with special needs. *Developmental Psychology*, 48, 1476–1487.

- b. **Roeser, R. W.**, Schonert-Reichl, K. A., Jha, A., Cullen, M., Wallace, L., Wilensky, R., Oberle, E., Thomson, K., Taylor, C., & Harrison, J. (2013). Mindfulness training and reductions in teacher stress and burnout: Results from two randomized, waitlist-control field trials. *Journal of Educational Psychology*, 105, 787–804.
- c. Taylor, C., Harrison, J., Haimovitz, K., Oberle, E., Thomson, K., Schonert-Reichl, K., & **Roeser, R. W. (2015)**. Examining ways that a mindfulness-based intervention reduces stress in public school teachers: A mixed-methods study. *Mindfulness*, 1–15.
- d. Crain, T., Schonert-Reichl, K., & **Roeser, R. W.** (2016). Cultivating teacher mindfulness: Effects of a randomized-controlled trial on work, home, and sleep outcomes. *Journal of Occupational Health Psychology*.

**3. Spirituality and religion are key cultural aspects of adolescent development.** My interests in adolescent development and schooling widened to include a focus on culture, religion and spiritual, and ethnicity and language. I co-authored a book on this topic to outline for the developmental science community, and was a co-author on the first chapter ever in the *Handbook of Adolescent Psychology* on spirituality and religion. I approach the topic from the perspective of identity, and have conducted research in India on the role of cultural change and identity development, including religion, in a global world.

- a. Lerner, R. M., **Roeser, R. W.**, & Phelps, E. (Eds.) (2008). *Positive youth development and spirituality: From theory to research*. West Conshohocken, PA: Templeton Foundation Press.
- b. King, P. D., & **Roeser, R. W.** (2009). Religion and spirituality in adolescent development. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology*, 3<sup>rd</sup> ed. (pp. 435–478). Hoboken, NJ: Wiley.
- c. Suarez-Orozco, C., Singh, S., Abo-Zena, M., Du, D., & **Roeser, R. W.** (2011). The role of religion & worship communities in the positive development of immigrant youth. In A. E. A. Warren, R. M. Lerner, & E. Phelps (Eds.), *Thriving and spirituality among youth: Research perspectives and future possibilities*. Hoboken, NJ: John Wiley & Sons, Inc. doi: 10.1002/9781118092699.ch12
- d. Rao, M. A., Berry, R., Gonsalves, A., Hastak, Y., Shah, M., & **Roeser, R. W.** (2013). Globalization and the identity remix among urban adolescents in India. *Journal of Research on Adolescence*, 23, 9–24.

**4. School and afterschool contexts socialize outcomes beyond academics.** One early thrust of my research was on how school environments not only inform academic learning, but also adolescent identities, motivational orientations to learning, and feelings of psychological distress (internalizing/externalizing) and wellbeing. I have published a number of articles showing that adolescents' experience in school affects the longitudinal course of the academic and social-emotional development, and that an integrated approach to education and academic and social-emotional forms of learning is needed in schools.

- a. **Roeser, R. W.**, Eccles, J. S., & Sameroff, A. J. (2000). School as a context of social-emotional development: A summary of research findings. *Elementary School Journal*, 100, 443–471.
- b. **Roeser, R. W.**, & Eccles, J. S. (2014). Schooling and the mental health of children and adolescents in the United States. In M. Lewis & K. D. Rudolph (Eds.), *Handbook of developmental psychopathology*, 3<sup>rd</sup> ed. (pp. 163–184). New York: Springer.
- c. Peck, S., **Roeser, R. W.**, Zarrett, N. R., & Eccles, J. S. (2008). Exploring the role of extracurricular activity involvement in the educational resilience of vulnerable adolescents: Pattern- and variable-centered approaches. *Journal of Social Issues*, 64, 135–156.
- d. Eccles, J. S., & **Roeser, R. W.** (2015). School and community influences on human development. In M. H. Boorstein & M. E. Lamb (Eds.), *Developmental psychology: An advanced textbook*. Seventh Edition. Hillsdale, NJ: Erlbaum.

**5. Schools shape students' motivation to learn, achievement and educational life-paths.** Another early thrust of my research was on how school environments can children's and adolescents' motivation to learn and educational lifepaths through schools. A focus on person- and variable-centered analyses was a hallmark of this work.

- a. **Roeser, R. W.**, Eccles, J. S., & Freedman-Doan, C. (1999). Academic and emotional functioning in middle adolescence: Patterns, progressions, and routes from childhood. *Journal of Adolescent Research*, 14, 135–174.
- b. **Roeser, R. W.**, & Peck, S. C. (2003). Patterns and pathways of educational achievement across adolescence: A holistic-developmental perspective. In W. Damon (Series Ed.) & S. C. Peck & **R. W. Roeser** (Vol. Eds.), *New directions for child and adolescent development: Vol. 101. Person-centered approaches to studying development in context* (pp. 39–62). San Francisco: Jossey-Bass.
- c. Wigfield, A., Eccles, J. S., Schiefele, U., **Roeser, R. W.**, & Kean, P. D. (2006). Development of achievement motivation. In W. Damon & R. M. Lerner (Series Eds.) & N. Eisenberg (Volume Ed.), *Handbook of child psychology, 6<sup>th</sup> ed., Vol. 3, Social, emotional and personality development* (pp. 933–1002). New York: Wiley.
- d. Lau, S., & **Roeser, R. W.** (2008). Cognitive abilities and motivational processes in science achievement and engagement: A person-centered analysis. *Learning and Individual Differences*, 18, 497–504.

#### **D. Additional Information: Research Support and/or Scholastic Performance**

##### **Ongoing Research Support**

Grant #201700095 (Roeser, PI)

11/01/16–10/31/18

Spencer Foundation

Mindfulness and Compassion Programs and Practices in K-12 Urban Educational Reform: Designing a Sustainable Future

Purpose – creating interdisciplinary meetings around the next generation of mindfulness and compassion programs in educational systems.

##### **Recently Completed Research Support (last 3 years)**

Roeser (PI)

01/01/16–12/31/17

Mind and Life Institute

Measuring Teacher Care in Elementary and Middle School Classrooms: Positivity, Presence and Patience

Purpose – developing new observational measures of the effects of mindfulness training on teachers and classrooms.

Roeser (PI)

08/01/14–07/31/17

Spencer Foundation

Testing the Efficacy of Mindfulness Training for Teachers on Improving Classroom Settings for Early Adolescents

Purpose – testing the teacher, classroom and student effects of teacher mindfulness training during early adolescence in middle school settings using a RCT design.

Roeser (PI)

08/01/14–07/31/17

William T. Grant Foundation

Testing the Efficacy of Mindfulness Training for Teachers on Improving Classroom Settings for Early Adolescents

Purpose – testing the teacher, classroom and student effects of teacher mindfulness training during early adolescence in middle school settings using RCT design.

Roeser (PI) 09/01/13–08/31/16

ESD112 & Gates Foundation

Empowering PreK-Grade 3 (MP3) Educators and Students through Mindfulness Training

Purpose – proof-of-concept study regarding possible teacher, classroom and student impacts of teacher and child mindfulness training during early childhood in elementary school settings.

**BIOGRAPHICAL SKETCH**

Provide the following information for the Senior/key personnel and other significant contributors.  
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Almeida, David

eRA COMMONS USER NAME (credential, e.g., agency login): DALMEIDA

POSITION TITLE: Professor of Human Development and Family Studies

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
California State University, Northridge, CA	B.A.	06/1987	Psychology
University of Victoria, Canada	M.A.	05/1989	Psychology
University of Victoria, Canada	Ph.D.	11/1993	Psychology
University of Michigan, Institute for Social Research, Ann Arbor, MI	Post-doc	12/1993	Survey Methodology

**A. Personal Statement**

I have conducted research on stress and health for twenty years, with a major emphasis on stressors that occur in middle and late adulthood. This research has resulted in over 150 scientific publications on this topic. My research and ties with large NIH-funded projects such as the Midlife in the United States (MIDUS), Integrative Pathways to Health during Adulthood, and the Work Family Health Network, provide a broad focus on the most recent and promising research in this area. My assimilation of biological and psychosocial measurements exemplify integrative science, including my work integrating daily psychosocial measures with biomarkers of the stress process.

**B. Positions and Honors****Positions and Employment**

1993–1996	Postdoctoral Fellow, NIMH Multisite Family Research Consortium, Institute for Social Research, University of Michigan
1996–2000	Assistant Professor, Family Studies and Human Development, University of Arizona
2000–2003	Associate Professor, Family Studies and Human Development, University of Arizona
2003	Visiting Scholar, Institute on Aging, University of Wisconsin, Madison
2004	Visiting Scholar, Institute on Education, University of London, London, UK
2004–2007	Associate Professor, Human Development and Family Studies, Pennsylvania State University
2007–present	Professor, Human Development and Family Studies, Pennsylvania State University

**Academic Honors and Awards**

1993–1996	NIMH Postdoctoral Fellowship
-----------	------------------------------

1996	Outstanding Alumni Award, California State University, Northridge
1999	Teaching Award of Merit, National Association of Colleges and Teachers of Agriculture
1994–2002	The MacArthur Foundation Research Network Affiliate
2010	Pattishall Outstanding Research Achievement Award, Pennsylvania State University

## **C. Contributions to Science**

### **1. Measurement of Daily Stressors**

I am the Principal Investigator of the National Study of Daily Experiences (NSDE), one of the in-depth studies that are part of the Midlife in the United States Study (MIDUS). NSDE is the largest longitudinal diary study of daily experiences and health in the U.S. This research has shown that minor, yet frequent, daily stressors are often better predictors of important health outcomes than major life events, which have been the focus of research for decades. To further research in this area, I developed an instrument, the Daily Inventory of Stressful Experiences that has been used in large-scale epidemiologic and intervention studies on health and well-being. The DISE been used to assess the role of daily stress on healthy aging as well as stress processes in specific populations and contexts, such as the workplace and family interactions, parents of children with developmental disabilities, and family caregivers.

- a. Almeida, D. M., Wethington, E., & Kessler, R. C. (2002). The daily inventory of stressful experiences (DISE): An interview-based approach for measuring daily stressors. *Assessment*, 9, 41–55.
- b. Almeida, D. M. (2005). Resilience and vulnerability to daily stressors assessed via diary methods. *Current Directions in Psychological Science*, 14, 64–68.
- c. Almeida, D. M., Stawski, R. S., & Cichy, K. E. (2011). Combining checklist and interview approaches for assessing daily stressors: The daily inventory of stressful events. In R. J. Contrada & A. Baum (Eds.), *The handbook of stress science: Biology, psychology, and health*. New York, NY: Springer.
- d. Almeida, D. M., Davis, K. D., Crouter, A. C., & O'Neill, J.W. (2012). Translational research on work and family: Daily stress processes in hotel employees and their families. In E. Wethington (Ed.), *Improving the state of Americans: Translational research in the social and behavioral sciences*. Washington, DC: American Psychological Association.

### **2. Vulnerability to Daily Stress**

My initial work identified factors that exacerbate the daily stress response among a wide array of demographic and psychosocial factors such as lower socioeconomic status, ethnic minority status, age, neuroticism, lack of perceived control, discrimination, and chronic life challenges. More recent work has highlighted positive experiences that buffer the effects of daily stress including neighborhood cohesion, time in leisure activities, and social support. For example, African Americans experience stressors on 40% of the study days compared to European Americans (matched on age, gender and education) who report stressors on 34% of study days. Along with more exposure to daily stressors, this group experiences greater emotional and physical reactivity to stressors (increases in physical symptoms and negative affect on stressor days).

- a. Almeida, D. M., & Kessler, R. C. (1998). Everyday stressors and gender differences in daily distress. *Journal of Personality and Social Psychology*, 75, 670–680.
- b. Almeida, D. M., Neupert, S. D., Banks, S. R., & Serido, J. (2005). Do daily stress processes account for socioeconomic health disparities? *Journals of Gerontology: Social Sciences*, 60, 34–39.
- c. Almeida, D. M., & Wong, J. D. (2009). Life transitions and daily stress processes. In G. H., Elder, Jr., & J. Z. Giele (Eds.), *The craft of life course research* (pp. 141–162). New York: Guilford Press.
- d. Cichy, K. E., Stawski, R. S., & Almeida, D. M. (2012). Racial differences in exposure and reactivity to daily family stressors. *Journal of Marriage and Family*, 74, 572–586. doi: 10.1111/j.1741–3737.2012.00971.x

### **3. Daily Stress Pathways to Health**

More current work has focused on establishing the long-term health effects of daily stress processes. A recent series of analyses show that emotional reactivity to daily stressors (upticks in negative affect on stressor days) plays a vital role in long-term psychological and physical health. Using longitudinal data from the NSDE, we documented that individuals who reported greater stressor reactivity at baseline were 46% more likely to

experience affective disorders and 33% more likely to have increased chronic health conditions 10 years later. These results were independent baseline age, health, education and neuroticism and concurrent daily stressor reactivity. Daily stressor exposure (frequency of stressors), in and of itself, however, was not associated with an increased risk of long-term health problems. This is the first study to show a long-term impact of daily life stress on multiple domains of individual functioning in a large national longitudinal sample.

- a. Almeida, D. M., Piazza, J. R., Stawski, R. S., & Klein, L. C. (2012). The speedometer of life: Stress, health and aging. In K. W. Schaie & R. Levey (Eds.), *The handbook of the psychology of aging*. Elsevier: New York.
- b. Charles, S. T., Piazza, J. R., Sliwinski, M., Mogle, J., & Almeida, D. M. (2013). The wear-and-tear of daily stressors on mental health. *Psychological Science*, 24, 733–741. doi: 10.1177/0956797612462222. PMCID: PMC3654031
- c. Ong, A. D., Exner–Cortens, D., Riffin, C., Steptoe, A., Zautra, A., & Almedia, D. (2013). Linking stable and dynamic features of positive affect to sleep. *Annals of Behavioral Medicine*, 46, 52–61. doi: 10.1007/s12160–013–9484–8
- d. Piazza, J. R., Charles, S. T., Sliwinski, M., Mogle, J., & Almeida, D. M. (2013). Affective reactivity to daily stressors and long-term risk of reporting a chronic physical health condition. *Annals of Behavioral Medicine*, 45, 110–120. doi: 10.1007/s12160–012–9423–0. PMCID: PMC3626280

#### 4. Stress and Diurnal Cortisol

Another area of recent transformative work has been our dynamic assessment of diurnal cortisol in relation to both daily and chronic stress processes. Prior to our research, many studies have documented elevated cortisol levels in response to laboratory-controlled acute psychological stressors. The NSDE is the largest study to investigate the relationship between naturally-occurring stressors and cortisol utilizing over 25,000 samples of salivary cortisol from over 2000 individuals. Our work has linked dysregulated cortisol rhythms and levels to increasing age, daily stressors, negative affect, social strain poor cognitive performance, widowhood, non-normative parenting, early and late retirement, early life adversity, and cancer survivorship. Using brain imaging data we have also shown that that sustained activity in the striatum and dorsolateral prefrontal cortex to positive stimuli is linked to better cortisol regulation and higher well-being. Current analyses have focused on a specific diurnal rhythm characterized by both a low peak following waking and a failure to lessen cortisol output throughout the day leading to we have identified as compressed dynamic range (CDR). CDR is a new and innovative potential marker for chronic stress and is linked to lower education, minority status and chronic health conditions.

- a. Almeida, D. M., McGonagle, K., & King, H. (2009). Assessing daily stress processes in social surveys by combining stressor exposure and salivary cortisol. *Biodemography and Social Biology*, 55, 220–238. PMCID: PMC2878770
- b. Almeida, D. M., Piazza, J. R., & Stawski, R. S. (2009). Inter-individual differences and intra-individual variability in the cortisol awakening response: An examination of age and gender. *Psychology and Aging*, 24, 819–827. PMCID: PMC2810505
- c. Karlamangla, A., Friedman, E., Stawski, R. S., & Almeida, D. M. (2013). Daytime trajectories of cortisol: Demographic and socioeconomic differences. Findings from The National Study of Daily Experiences. *Psychoneuroendocrinology*, 38, 2585–2597. doi: 10.1016/j.psyneuen.2013.06.010 PMCID: PMC3812359
- d. Stawski, R., S., Cichy, K. E., Piazza, J. R., & Almeida, D. M. (2013). Associations among daily stressors and salivary cortisol: Findings from the National Study of Daily Experiences. *Psychoneuroendocrinology*, 38, 2654–2665. doi: 10.1016/j.psyneuen.2013.06.023 PMCID: PMC3914662

#### D. Additional Information: Research Support and/or Scholastic Performance Ongoing Research Support

5PO1-AG020166 (Ryff, PI)  
07/15/11–06/30/18  
NIH/NIA

### **Integrative Pathways to Health and Illness**

The MIDUS (Midlife in the U.S.), conducted with 7,108 Americans (Aged 25-74) to investigate the influence of sociodemographic, psychological, and behavioral factors on health and well-being from early adulthood to later life. The two central aims are to augment the longitudinal MIDUS sample with 2,100 new respondents (aged 25-54), and initiate the 3rd wave of data collection on the existing sample (MIDUS III). Project 2 (Penn State-Almeida) Changes in Daily Stress and Well-Being. The overarching goal is to better understand how daily stressors influence psychological and physical health in the United States. We seek to identify socioedemographic factors (e.g., gender and education) as well as personal characteristics (e.g., personality, genetic endowment) that make individuals more vulnerable or resilient to the health effects of daily stressors.  
Role: Project 2 Principal Investigator

T32AG049676 (Almeida, PI)

05/01/17–04/30/21

NIH/NIA

### **Psychosocial Determinants and Biological Pathway to Healthy Aging**

This is a new training program, "Psychosocial Determinants and Biological Pathways to Healthy Aging" (PATHWAYS), that builds on our established track record in pre-doctoral and post-doctoral training. Consistent with goals of NIH to encourage interdisciplinary training and research, the PATHWAYS program focuses on the junction of behavioral, social and biological research.

Role: Principal Investigator

5UH2AG052167 (Almeida, PI)

09/30/15–06/30/18

NIH/NIA

### **Everyday Stress Response Targets in the Science of Behavior Change**

The overarching goal of this project is to utilize an experimental medicine approach to develop an efficient, ecologically valid, within-person approach to measuring and intervening on the deleterious effects of everyday stress on meeting recommended levels of two health behaviors: physical activity and sleep patterns.

Role: Principal Investigator

5R01HD087266 (Teti, Almeida Co-PIs)

04/01/16–03/31/21

NIH/NICHD

### **Parenting, Child Sleep, and Transition to Kindergarten**

The present study draws upon work by the principal investigator and others in his investigative team and focuses on the unique role of sleep in young children in predicting children's adjustment across the kindergarten year, and the role of parenting in shaping good sleep habits in young children during this transition.

Role: Co-Principal Investigator

### **Recently Completed Projects (last three years)**

5R01 AG031758-03 (Zarit, PI)

03/1/09–02/28/15

NIH/NIA

### **Daily Stress, Health and Well-Being of Family Caregivers**

This study looked at how the relationship among daily stressors, well-being and biomarkers of health affect caregiver's health.

Role: Co-Investigator

5R01 HD062547-03 (Fuligni, PI)

08/01/12–07/31/16

NIH/NICHD

### **Daily Experience in Adolescence and Biomarkers of Early Risk for Adult Health**

The major goal of this project was to conduct a longitudinal study of adolescents and their caregivers from Mexican, Chinese and European backgrounds to assess the impact of daily experience on biological indicators of early risk for adult health.

Role: Subcontract Principal Investigator

R01 AG042431 (Charles, PI)

09/01/13–08/31/16

NIH/NIA

### **Age, Emotional Well-Being, and Physical Health**

The focus of the proposed was to determine how well-being differentially influences physical health across the life span, and determining the psychosocial environments associated with poorer well-being in late life, present additional challenges, but ones that must be addressed to better identify older adults most at risk for poor mental and physical health.

Role: Subcontract Principal Investigator

R01 AG039409 (Sliwinski, PI)

04/15/11–03/31/16

NIH/NIA

### **Stress, Unconstructive Repetitive Thought and Cognitive Aging**

The research studied how unconstructive repetitive thought (URT) contributes to the accumulation of stressful experiences and cognitive, physical and emotional health. This study addressed four aims: Aims 1 and 2 examined the role of URT in accounting for the effects of current stress on short-term (daily) and mid-term (biannual) intraindividual cognitive variability and change. Aims 3 and 4 examined URT as a mediator of the cumulative effects of stress on long-term (across years) cognitive change.

Role: Co-Investigator

## **10. Literature Cited**

- [1] Hilton, Lara, et al. "Mindfulness meditation for chronic pain: systematic review and meta-analysis." *Annals of Behavioral Medicine* 51.2 (2016): 199-213.
- [2] Parsons, Christine E., et al. "Home practice in Mindfulness-Based Cognitive Therapy and Mindfulness-Based Stress Reduction: A systematic review and meta-analysis of participants' mindfulness practice and its association with outcomes." *Behaviour research and therapy* 95 (2017): 29-41.
- [3] Bhattarai, Priyanka, and Jane L. Phillips. "The role of digital health technologies in management of pain in older people: An integrative review." *Archives of gerontology and geriatrics* 68 (2017): 14-24.
- [4] Toivonen, Kirsti I., Kristin Zernicke, and Linda E. Carlson. "Web-based mindfulness interventions for people with physical health conditions: systematic review." *Journal of medical Internet research* 19.8 (2017).
- [5] Carmody, James, and Ruth A. Baer. "Relationships between mindfulness practice and levels of mindfulness, medical and psychological symptoms and well-being in a mindfulness-based stress reduction program." *Journal of behavioral medicine* 31.1 (2008): 23-33.
- [6] Institute of Medicine, *Relieving pain in America: a blueprint for transforming prevention, care, education, and research*, 2011, National Academies Press, Washington, DC.
- [7] Johannes, Catherine B., et al. "The prevalence of chronic pain in United States adults: results of an Internet-based survey." *The Journal of Pain* 11.11 (2010): 1230-1239.
- [8] Dowell, Deborah, Tamara M. Haegerich, and Roger Chou. "CDC guideline for prescribing opioids for chronic pain—United States, 2016." *Jama* 315.15 (2016): 1624-1645.
- [9] Veehof, M. M., et al. "Acceptance-and mindfulness-based interventions for the treatment of chronic pain: a meta-analytic review." *Cognitive behaviour therapy* 45.1 (2016): 5-31.
- [10] Lucas, Gale M., et al. "It's only a computer: Virtual humans increase willingness to disclose." *Computers in Human Behavior* 37 (2014): 94-100.



- [11]: Purington, Amanda, et al. "Alexa is my new BFF: social roles, user satisfaction, and personification of the amazon echo." *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems*. ACM, 2017.
- [12]: Devilly, Grant J., and Thomas D. Borkovec. "Psychometric properties of the credibility/expectancy questionnaire." *Journal of behavior therapy and experimental psychiatry* 31.2 (2000): 73-86.
- [13]: Kelly, Peter J., et al. "The Client Satisfaction Questionnaire-8: Psychometric properties in a cross-sectional survey of people attending residential substance abuse treatment." *Drug and alcohol review* 37.1 (2018): 79-86.
- [14]: Brooke, John. "SUS: A quick and dirty usability scale." *Usability evaluation in industry* 189.194 (1996): 4-7.
- [15]: Stoyanov, Stoyan R., et al. "Development and validation of the user version of the Mobile Application Rating Scale (uMARS)." *JMIR mHealth and uHealth* 4.2 (2016).
- [16]: Rosenzweig, Steven et al. "Mindfulness-based stress reduction for chronic pain conditions: Variation in treatment outcomes and role of home meditation practice. *Journal of Psychosomatic Research* 68 (2010).
- [17]: Cherkin, Daniel C., et al. "Effect of mindfulness-based stress reduction vs. cognitive behavior therapy or usual care on back pain and functional limitations in adults with chronic low back pain: a randomized trial" *JAMA* 315.12 (2016).
- [18]: Morone, Natalia. E., et al. "A mind-body program for older adults with chronic low back pain: A randomized clinical trial". *JAMA Internal Medicine* 176.3 (2016).
- [19]: Jacob, Julie A "As opioid prescribing guidelines tighten, mindfulness meditation holds promise for pain relief". *JAMA* 315.22 (2016).
- [20]: Davis, Mary C., et al. "Mindfulness and cognitive-behavioral interventions for chronic pain: Differential effects on daily pain reactivity and stress reactivity." *Journal of consulting and clinical psychology* 83.1 (2015): 24.
- [21]: Kercher, Kyle. "Assessing subjective well-being in the old-old: The PANAS as a measure of orthogonal dimensions of positive and negative affect." *Research on Aging* 14.2 (1992): 131-168.
- [22]: Almeida, David M., Elaine Wethington, and Ronald C. Kessler. "The Daily Inventory of Stressful Events: An interview-based approach for measuring daily stressors." *Assessment* 9.1 (2002): 41-55.
- [23]: Jensen, Mark P., Paul Karoly, and Sanford Braver. "The measurement of clinical pain intensity: a comparison of six methods." *Pain* 27.1 (1986): 117-126.
- [24]: Smeets, Rob JEM, et al. "Reduction of pain catastrophizing mediates the outcome of both physical and cognitive-behavioral treatment in chronic low back pain." *The Journal of Pain* 7.4 (2006): 261-271.
- [25]: Lorig, Kate, et al. "Development and evaluation of a scale to measure perceived self-efficacy in people with arthritis." *Arthritis & Rheumatology* 32.1 (1989): 37-44.