

AWARD NUMBER: W81XWH-20-1-0171

TITLE: Multicomponent Behavioral Intervention Designed to Increase Functional Independence During Aging in ASD

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14. ABSTRACT Developing and maintaining functional independence in adults with autism spectrum disorders (ASD) across their lifespan is essential to improving quality of life (QoL) and reducing the estimated lifetime costs for these individuals. Our overall objective is to improve independence and QoL in adults with ASD across the lifespan using a single, personalized, multi-faceted, behavioral intervention—Strengthening Skills—that combines the PEERS social skill training program with cognitive compensation training, mindfulness-based emotional regulation, and support group components for those with ASD and their support companions. Our central hypothesis is that independence and QoL can be elevated and Strengthening Skills participants will gain skills in social communication, have improved cognition and enhanced mood. During Year 1, we developed the Strengthening Skills Curriculum combining existing literature with focused interviews with adults with ASD and their support companions. We developed the website that will accompany the instruction, compiled the weekly plan for the Strengthening Skills program, and assembled the program team. We successfully recruited two cohorts for a pilot prospective, randomized, controlled trial for 42 adults aged 21–70 years diagnosed with ASD who are not intellectually disadvantaged (IQ >70) and their program partners. We completed treatment delivery to treatment groups for cohort 1 and will complete treatment delivery to treatment groups for cohort 2 in May. Treatment delivery to the delayed treatment control group will occur in the fall of Year 3. To address the need for long-term maintenance of the treatment gains , we are incorporating a website with guided user lessons so that participants are habituated to use the website after training is completed.		

15. SUBJECT TERMS Autism Spectrum Disorder; adulthood; aging; behavioral intervention; cognitive compensation; mindfulness; emotional regulation; PEERS social skills intervention; adaptive functioning; quality of life					
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TABLE OF CONTENTS

	<u>Page</u>
1. Introduction	5
2. Keywords	5
3. Accomplishments	5
4. Impact	9
5. Changes/Problems	9
6. Products	9
7. Participants & Other Collaborating Organizations	10
8. Special Reporting Requirements	
9. Appendices	

1. INTRODUCTION

Developing and maintaining functional independence in adults with autism spectrum disorders (ASD) across their lifespan is essential to improving quality of life (QoL) and reducing the estimated lifetime costs for these individuals. Through our previous DoD funding, we found that middle-age adults with ASD have reduced executive functioning abilities, reduced engagement of functional brain networks during executive function tasks, smaller brain memory structures, and elevated levels of depression and anxiety, compared to neurotypical adults. Also, core ASD symptoms, especially social communication, may worsen with age across the adult lifespan. Thus, the **rationale** for this study is that interventions that improve independence and QoL in adults with ASD across the lifespan will improve the long-term well-being of individuals with ASD and their families, and reduce future costs to society. Our **overall objective** is to improve independence and QoL in adults with ASD across the lifespan using a single, personalized, multi-faceted, behavioral intervention—Strengthening Skills—that combines the PEERS social skill training program with cognitive compensation training, mindfulness-based emotional regulation, and support group components for those with ASD and their support companions. Our **central hypothesis** is that independence and QoL can be elevated in this population and Strengthening Skills participants will gain skills in social communication and have improved cognition and enhanced mood. During year 1, we first developed the Strengthening Skills Curriculum through a review of existing literature and focused interviews with 5 adults with ASD and 4 of their support companions. We developed the website that accompanies instruction, compiled the weekly plan for the Strengthening Skills program, and assembled the program team. In years 1 and 2, we recruited participants for two cohorts for a pilot prospective, randomized, controlled trial for adults aged 21 and older diagnosed with ASD who are not intellectually disadvantaged ($IQ > 70$) and their program partner (if available). A total of 42 adults with ASD were recruited and randomly assigned into one of three conditions: Strengthening Skills ($n = 14$), PEERS for Adults ($n = 14$), or delayed treatment control (DTC; $n = 14$). To address the need for **long-term maintenance of the treatment gains**, we incorporated a website with guided user lessons so that participants are habituated to use the website after training is completed.

2. KEYWORDS

Autism Spectrum Disorder; adulthood; aging; behavioral intervention; cognitive compensation; mindfulness; emotional regulation; PEERS social skills intervention; adaptive functioning; quality of life

3. ACCOMPLISHMENTS

What were the major goals of the project?

- **Specific Aim 1:** Evaluate the effectiveness of a multi-faceted, ASD–support companion dyad intervention including social communication, cognitive compensation, and emotional regulation training (Strengthening Skills; previously PEERS-plus), for improving functional independence as measured by the Adaptive Behavior Assessment System-Third Edition (ABAS-3).
- **Specific Aim 2:** Evaluate the effectiveness of the Strengthening Skills intervention for improving QoL in adults with ASD and their support companion.
- **Specific Aim 3:** Evaluate skill gains using measures that reflect specific components of the PEERS-plus intervention.

Proposed phases, milestones, and target dates:

Phase 1 (Year 1): Program Development. Aims: 1) Program development for behavioral intervention (Strengthening Skills, previously PEERS-plus) and revise based on focused interviews. 2) Prepare Strengthening Skills website. 3) Assemble and train the treatment team.

• Milestones

- *Local IRB approval for focus interview protocol – Target date: 6/30/2020; Percentage of completion: 100%; Completion Date: 3/15/2020*
- *HRPO approval for focus interview protocol – Target date: 9/30/2020; Percentage of completion: 100%; Completion Date: 7/31/2020*
- *Students trained on Strengthening Skills and PEERS protocols – Target date: 4/30/2021; Percentage of completion: 100%; Completion Date: 8/1/2021*

Phase 2 (Years 2-3): Implementation of Strengthening Skills, PEERS, and delayed-treatment

interventions: Aim: 1) Execute the protocol comparing Strengthening Skills, PEERS, and a waiting list control two times.

• Milestones

- *Complete two interventions – Target date: 11/30/2022; Percentage of completion: 50%*
- *Report results from data analyses; design larger trial based on findings: Target date – 3/30/2023; Percentage of completion: 25%*

What was accomplished under these goals?

Major Activities

A) IRB, HRPO approval and oversight

- The following amendments to the study protocol were approved by Arizona State University IRB on 4/20/21 and HRPO on 4/23/2021:
 - 1) The program name was changed from PEERS-plus to Strengthening Skills.
 - 2) Due to uncertainty regarding the pandemic, the interventions are being delivered virtually (i.e., through Zoom).
 - 3) The consent process was changed from in-person collection of consent to digital consent.
 - 4) If individuals have completed diagnostic interviews and assessments at SARRC within the last ten years, they will complete a 30-minute virtual Zoom intake visit (instead of in-person) to complete the intake interview, learn about the intervention and determine if they would like to participate.
 - 5) Previously, we said that treatment groups would participate in data collection on the first and last night of the program. Instead, all participants will be scheduled for baseline and time 2 appointments at SARRC before and after the intervention.
 - 6) Participants will be asked to complete speech elicitation tasks using the Speech Vitals application.
 - 7) We have changed the label of “Support Companion” to “Program Partner” in the consent form.
 - 8) We added an intake interview for review.
 - 9) We revised the phone screening script and added a suicidality screening process.
 - 10) We revised the study flyer.

- The following amendments were approved by ASU’s IRB on 8/12/2021. Amendments were not substantive, so they were not submitted to HRPO for review.
 - 1) Age limit of 70 years was removed to be consistent with NIH guidelines regarding research inclusion throughout the lifespan.
 - 2) The inclusion criteria requiring a program partner was removed.
 - 3) A separate consent form for video recording was added for participants enrolling in the trial.
 - 4) Multiple research staff were added to the protocol.
 - 5) A self-report adaptive functioning measure was added for program partners.
- The following amendments were approved by ASU’s IRB on 12/8/2021. Amendments were not substantive, so they were not submitted to HRPO for review.
 - 1) Revision of acceptability questionnaire
 - 2) Added “Other Therapies” questionnaire
- ASU IRB approved continuation of the study protocol on 3/15/2022 and HRPO on 3/16/2022.

B) Development and Delivery of the Strengthening Skills Curriculum

We proposed to develop a multi-component intervention adapted from the Mayo-based HABILIT curriculum for older adults (i.e., cognitive compensation strategies for individuals with Mild Cognitive Impairment), the PEERS for Young Adults Curriculum (i.e., social skills), and Mindfulness Based Stress Reduction. The first year of the award was dedicated to developing and refining the proposed intervention based on published literature, focused interviews with autistic adults and their support companions, and consultation with experts in various relevant fields. Our first stated goal of finalizing the Strengthening Skills protocol, design and materials and preparing PEERS materials and assessments was met during Year 1.

During the second year of the award, we delivered the Strengthening Skills program or the PEERS program to the first cohort of treatment group participants. This included weekly 3-hour or 1.5-hour group meetings, respectively, for 16 weeks (PEERS group: 24 hours of intervention; Strengthening Skills group: 48 hours of intervention). The treatment team, including Dr. Matthews, Dr. Baxter, Ms. Lisa Ballard, Ms. Maria Dixon (Speech and Language Pathology students’ supervisor), Ms. Melissa Mitchell (PEERS instructor), Speech and Language graduate students, and undergraduate students (fidelity checkers), participated in weekly 2-hour preparation meetings, during which the team reviewed cases and prepared for the upcoming week. We collected feasibility and acceptability data, including participant acceptability surveys at intervention midpoint and exit. These data were used to revise the programs for the second cohort. By the end of year 2, treatment group participants in Cohort 2 had completed 8-weeks of the 16-week programs (PEERS group: 12 hours of intervention; Strengthening Skills group: 24 hours of intervention). The treatment team continued weekly 2-hour meetings to review cases and prepare for the upcoming week.

C) Website development

In year 1, an employment contract was established with a web developer for the companion website for the intervention. Dr. Braden and the website developer coordinated with ASU’s information technology office to determine logistics for maintenance of the website. The website developer created a template of the website that is currently being updated with final content for the program. Additionally, the study team met with the website developer and the biostatistician (Dr. O’Rourke) to identify the method by which backend website data will be collected and analyzed. We experienced a slight delay in completion due to some early obstacles faced when communicating with ASU’s information technology office. However, the website was completed and functional by July of 2021. For the stated goal: Prepare website with PEERS-plus modules (Basic website design and insertion of modules when completed; Target date: 3/31/21; Percentage of completion: 100%), The website was

revised after the first cohort completed the program to reflect revisions to the program and will be revised again after the second cohort completes the program.

D) Implementation of clinical trial

In year 1, the study team met with the biostatistician, Dr. O'Rourke, to finalize the recruitment strategy and plans for stratifying participants by age, gender, and adaptive functioning scores prior to randomization. Additionally, a timeline for baseline and post-intervention data collection was developed. Dr. Matthews submitted the study to clinicaltrials.gov and trained Ms. Shanna Delaney, the study coordinator, on the phone screening script and informed consent process.

In year 2, Ms. Shanna Delaney recruited and phone screened 88 potential participants for eligibility. Dr. Matthews and SARRC staff conducted intake study visits with 46 participants; 42 autistic adults completed baseline study visits with SARRC staff and were randomized to a study condition. SARRC staff conducted follow up study with 20 of 21 participants in cohort 1 (1 participant was lost to attrition). Participants in cohort 2 have not yet completed the intervention or wait period; follow-up visits will be conducted with cohort 2 during year 3. When autistic adults were able to identify a study partner, study partners completed questionnaires remotely at baseline and follow-up study visits.

E) Other Related Accomplishments

Drs. Matthews and Smith published a mixed-methods study examining adaptive functioning in autistic young adults. The study, which involved qualitative analysis of semi-structured interviews with young adults and their parents, was **published in *Autism: International Journal of Research and Practice***. This study identified specific needs and considerations for working with autistic adults, which informed the development of the Strengthening Skills protocol. Specifically, themes identified suggest that interventions focus on helping adults achieve interdependence in their communities rather than complete independence, that adults may face multiple interruptions to independence, which could require support from family and public services, and that many adults know how to complete most self-care and domestic tasks but have difficulty with initiating and managing them. Findings also identified the importance of balancing helpful and harmful parent involvement and the need for autistic adults to focus on safety online and in the community. We used these findings as starting points to determine the similarities and differences of the needs of adults with ASD of different ages when designing the focused interviews with older autistic adults and their support companions as a part of the current project. Additionally, Dr. Matthews presented findings from this study at the annual conference of the Autism Society of Greater Phoenix (virtual event) and through a webinar hosted by one of SARRC's community partners.

During year 1, **Dr. Braden published two papers that influenced the development of the present study**. First, we found that mindfulness-based stress reduction improved depressive symptomatology in adults with ASD and identified related-brain changes (Pagni et al., 2020, *Journal of Neuroscience Research*). This work helped us identify the most salient aspects of the mindfulness program to emphasize in Strengthening Skills for adults with ASD, and highlighted the need to include depression as a secondary study endpoint. Second, in a cross-sectional study we found that women with ASD may improve in social cognition as they age whereas men may decline (Pagni et al., 2020, *Frontiers in Integrative Neuroscience*). This helped inform our study design to balance sex across groups for Strengthening Skills and the need to explore secondary analyses on effects of sex. In year 2, **we have continued to published on sex differences in mental and physical health-related quality of life and responses to mindfulness-based stress reduction intervention (Braden et al., 2021), social communication challenges (Walsh et al., 2021), and social compensatory behavior (i.e. "camouflaging"; Walsh et al., 2022) in autistic adults across the lifespan**. These findings further emphasize the importance of considering sex differences in intervention response for autistic adults as well as guide appropriate outcome measures for our exploratory analyses. Finally, **we have published preliminary findings on the effects of mindfulness-based stress reduction on emotion regulation in autistic adults (Pagni et al., 2021)**, which further emphasizes the utility of this program for this population.

What opportunities for training and professional development has the project provided?

Training and professional development was not a major goal of this project; however, Dr. Smith is a formal mentor for Dr. Braden through an NIH K01 Career Development Award. Dr. Braden mentors two PhD, two Master's, and six undergraduate students that have all gained foundational knowledge in intervention development and delivery through lab meetings and/or collecting intervention fidelity data during the course of this project. Five graduate students in Speech and Hearing Sciences at ASU gained training in the delivery of PEERS and/or Strengthening Skills through an internship placement with our treatment team.

How were results disseminated to communities of interest

- **Nothing to Report**

What do you plan to do during the next reporting period to accomplish the goals?

- We will complete delivery of the intervention to the second cohort of participants in May of 2022. We will deliver the revised intervention to the delayed treatment control group participants beginning in Fall of 2022.
- We will collect post-treatment data (intervention exit, 3-month follow-up, and 6-month follow-up) from all participants and ensure data is entered efficiently and accurately.
- We will submit at least one manuscript for publication in a peer-reviewed journal to report feasibility, acceptability, and preliminary effectiveness data.
- We will present preliminary findings program at a minimum of one local and one national/international conference.
- We will begin writing grant applications to fund a larger, randomized controlled trial of the Strengthening Skills program.

4. IMPACT

Principal Disciplines

- **Nothing to Report**

Other Disciplines

- **Nothing to Report**

Technology Transfer

- **Nothing to Report**

Society Beyond Science and Technology

- **Nothing to Report**

5. CHANGES/PROBLEMS

Changes in approach and reasons for change

Due to the COVID-19 pandemic, we are delivering the intervention through Zoom meetings rather than in-person. Virtual delivery of group interventions for teens and adults with ASD has become commonplace since the onset of the pandemic and Dr. Matthews has experience delivering the PEERS program to four cohorts of teens and their parents using this modality. Open-ended responses from acceptability surveys suggest that some

participants would prefer to participate in the program in-person, but generally understand that virtual delivery is necessary due to current circumstances.

Actual or anticipated problems or delays and actions or plans to resolve them

As discussed in the change of approach section above, the COVID-19 pandemic prevented in-person delivery of the intervention. To resolve this problem, we have used and plan to continue using videoconferencing technology. We had some COVID-19-related attrition in our cohorts but we over-recruited in anticipation of some attrition; therefore, we remain within our sample size goals.

Changes that had a significant impact on expenditures

Nothing to Report.

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

Due to the pandemic, we incorporated the use of videoconferencing to the approved protocol, which was approved by both ASU's IRB and HRPO. An initial modification for the focused interviews was approved by ASU's IRB on 8/4/2020 and a second modification for the intervention was approved by ASU's IRB on 4/20/2021.

6. PRODUCTS

Publications, conference papers, and presentations

- Nothing to Report

Website(s) or other Internet site(s)

- Nothing to Report

Technologies or techniques

- Nothing to Report

Inventions, patent applications, and/or licenses

- Nothing to Report

Other products

- Nothing to Report

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals worked on the project?

Name: Nicole Matthews

Project Role: Principal Investigator

Researcher Identifier (e.g. ORCID ID): 0000-0001-7433-1142

Nearest person month worked: 4

Contribution to Project: Dr. Matthews worked on submitting IRB and HRPO amendments and renewals, developing materials for the Strengthening Skills intervention, training Strengthening Skills and PEERS assistants, supervising SARRC staff who administered baseline and follow-up visit. She also supervised delivery of the PEERS and Strengthening Skills weekly meetings and served as the PEERS group or program partner group leader for both programs.

Name: Blair Braden

Project Role: Co-Principal Investigator

Researcher Identifier (e.g. ORCID ID): [0000-0001-6842-9784](https://orcid.org/0000-0001-6842-9784)

Nearest person month worked: 4

Contribution to Project: Dr. Braden worked on submitting IRB and HRPO amendments and renewals, developing and revising materials for the Strengthening Skills intervention, supervised recruitment efforts conducted by Ms. Delaney, and contributed to development of the companion website.

Name: Leslie Baxter

Project Role: Co-Investigator

Researcher Identifier (e.g. ORCID ID): 0000-0002-3971-863X

Nearest person month worked: 4

Contribution to Project: Dr. Baxter contributed to refining materials for the intervention and contributed to development of the companion website. Dr. Baxter led the cognitive compensation component of the Strengthening Skills program and provided supervision for staff and students implementing the PEERS and Strengthening Skills programs.

Name: Shanna Delaney

Project Role: Lab Coordinator

Researcher Identifier (e.g. ORCID ID): 0000-0002-7338-6579

Nearest person month worked: 6

Contribution to Project: Ms. Delaney assisted the principal investigators with the communication with ASU's IRB as the study team responded to HRPO inquiries and submitted the study amendment. She also recruited, screened, scheduled, and consented clinical trial participants and assisted with coordination of baseline and follow-up study visits.

Name: Holly O'Rourke

Project Role: Co-Investigator

Researcher Identifier (e.g. ORCID ID): 0000-0002-2927-0333

Nearest person month worked: 2

Contribution to Project: Dr. O'Rourke randomized study participants and helped to develop timelines for baseline and post-treatment data collection. Dr. O'Rourke continued to consult with the website designer as needed to inform the collection of backend data.

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

Jon Templeton Foundation (Total Costs: \$230,000)
Bennett (PI), Braden (Co-PI)
10/01/2021 - 01/31/2022
Sanctifying Scientific Practice: Technical Work as 'Soul-Work'

What other organizations were involved as partners?

Organization Name: Arizona State University

Location of Organization: 975 S. Myrtle Ave., Tempe, AZ 85281

Partner's contribution to the project: Co-PI subaward; Biostatistician

Collaboration: Recruitment of participants; collaboration with development of the Strengthening Skills Protocol and website; data interpretation and manuscript preparation

Organization Name: Mayo Clinic Arizona

Location of Organization: 5777 East Mayo Blvd, Phoenix, AZ 85054

Partner's contribution to the project: Co-I subaward

Collaboration: Collaboration with development of the Strengthening Skills Protocol and website; data interpretation and manuscript preparation