Three versus six sessions of problem-solving training with or without boosters for care partners of adults with dementia (CaDeS): a randomised controlled optimization trial

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Summary

Background Problem-Solving Training/Descubriendo Soluciones Juntos (PST/DSJ) can improve emotional consequences of caregiving. We assessed the number of sessions and boosters needed for reducing caregiver burden and depressive symptoms among Alzheimer's disease and related dementias (ADRD) care partners.

Methods We conducted a randomised factorial-design trial of bilingual PST/DSJ among ADRD care partners (NCT04748666). Participants were randomly assigned (blocks of 8 stratified by language) to 3 PST/DSJ sessions with (n = 19) or without (n = 21) boosters or 6 PST/DSJ sessions with (n = 28) or without (n = 29) boosters. The Zarit Burden Interview measured caregiver burden and Patient Health Questionnaire (PHQ-8) measured depressive symptoms at baseline, after sessions, and after boosters.

Findings Ninety-seven care partners participated in the study (93% of those randomised) between June 2021 and July 2023 (n = 80 women, 83%). Ninety-five were included in intention-to-treat analysis (98% retention). For caregiver burden, all groups improved significantly over time (Estimate = −0.40, p = 0.004, Cohen's D = 0.31), with no difference between intervention groups. For depressive symptoms, there was a main effect of time (Estimate = −0.16, p = 0.005, Cohen's D = 0.33) indicating overall improvement regardless of group. Within group effect sizes (Cohen's D = 0.17–0.51) suggest larger improvement with 6 sessions (Cohen's D = 0.28–0.51) than 3 sessions (Cohen's D = 0.17–0.41). No adverse events occurred.

Interpretation Neither the number of sessions nor boosters resulted in differential efficacy for caregiver burden and depressive symptoms, though six sessions and boosters yielded the largest effect sizes. These results can inform the implementation of an evidence-based, bilingual problem-solving intervention to reduce burden and improve mood among diverse dementia care partners.

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Keywords: Caregiver; Dementia; Alzheimer's disease and related dementia; Problem-solving; Dementia care; Psychosocial intervention; Metacognitive strategies

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Research in context

Evidence before this study

We used iterative PubMed searches of all published articles through September 2024, with the terms ((caregiver*) AND intervention) AND dementia to evaluate the existing evidence. Multiple systematic reviews and meta-reviews report that care partners of adults with AD/and related dementias (AD/ADRD) often experience high caregiver burden, emotional distress, depression, problematic alcohol use, health problems, isolation, and poor quality of life. Based on this abundant evidence, the Global Impact of Dementia 2013–2050 policy brief specifically called for better education and skills training for care partners of adults with Alzheimer's disease and related dementias (AD/ADRD). Many meta-analyses support the efficacy of psychosocial interventions for improving dementia care partner outcomes but note the heterogeneity in intervention components that makes implementation challenging. One such meta-analysis found that teaching care partners problem-solving skills was a key feature for effectively improving care partner mental health. Another meta-analysis of 31 studies involving more than 2800 participants with various health conditions suggested that problem-solving training interventions can be incorporated quickly into daily life and that the effects are maintained over time. Our own work on Problem-Solving Training/Descubriendo Soluciones Juntos (PST/DSJ) provides foundational evidence for its efficacy, even in as few as 2–3 sessions, but there remained a lack of data about how many sessions, which vary widely in studies, are best or the need for "booster sessions" for maintenance of benefits, impeding broader implementation.

Added value of this study

PST/DSJ was effective for improving caregiver burden and depression in as few as three sessions without boosters, though six sessions may have greater benefit (larger effect), and boosters may amplify the magnitude of this improvement.

Implications of all the available evidence

Our work builds upon the extant evidence by providing guidance regarding the number of sessions needed and need for booster sessions for an evidence-based problem-solving training intervention for AD/ADRD care partners. This is in line with The Global Impact of Dementia 2013–2050 policy brief calls for better AD/ADRD care partner interventions, and meta-analysis analyses evidence support that teaching care partners problem-solving skills is an essential effective intervention component. These results can support flexible and effective implementation of an evidence-based, culturally adapted problem-solving intervention (PST/DSJ) that reduces care partner burden and depressive symptoms among diverse English-speaking and Spanish-speaking dementia care partners.

Introduction

Care partners (informal caregivers) of persons with Alzheimer's disease and related dementias (ADRD) are a diverse and often underserved population. Many of the nearly six million ADRD care partners in the United States experience strain (e.g., caregiver burden), emotional distress (e.g., depressive symptoms), maladaptive coping, health problems, and isolation.[1,2] Half experience caregiver burden and almost one third depression according to pooled prevalence.[2] The nature and experience of these caregiving-related consequences may differ based on cultural context, social structures and support, and other individual differences.[3–5] Therefore, interventions to support dementia care partners need to be adaptable to individual needs, circumstances, and values. Most evidence-based interventions provide education about ADRD and/or teach care partners the practical caregiving skills needed to manage their care recipient's medical needs and condition-associated behaviors.[6,7] Few provide care partners with problem-solving skills that would help them balance their caregiving role with their own needs.[8,9] There is a growing consensus that providing this level of psychosocial support—in addition to caregiver education and skills training—is critical.[7–9]

There are many reasons why ADRD care partners may not seek support, including limited financial resources, lack of time, language barriers, and cultural beliefs.[10–12] Interventions that address psychosocial and educational needs, case management, and emotional support most effectively promote self-management for care partners,[6,8,13] but such interventions are often resource intensive, requiring in-person attendance and long hours that can be challenging for care partners.[8,13] Many care partners are unable to leave their care recipient alone or may not have routine or reliable respite care, which limits their ability to participate in support interventions.[14] Further, even if a care partner attempts to participate in an intervention, rigid scheduling of program offerings may be a barrier to attending because caregiving demands can change without notice. Interventions offered virtually, in accessible formats and private settings, may better engage care partners.

Problem-Solving Training (PST) is an evidence-based metacognitive strategy training intervention, grounded in Problem-Solving Therapy theory and employing cognitive rehabilitation techniques. As such, PST addresses many of these needs and barriers experienced by ADRD care partners. Through PST, care

partners learn a simple, systematic process to identify problems and goals, generate and select solutions, develop and implement action plans, and evaluate and revise plans to maximize goal attainment.[15–17] Prior research indicates that PST can improve depressive symptoms and caregiver burden and promote adaptive social problem-solving skills among care partners.[16–18] Similar interventions have demonstrated efficacy among Spanish-speaking care partners,[19–23] and we provide a comprehensive case for adapting PST to Spanish in our prior work.[24] We have already culturally adapted PST for Spanish-speaking adults to "Descubriendo Soluciones Juntos" (DSJ),[20,24] allowing for high fidelity delivery in both English and Spanish. PST/DSJ is delivered remotely, via telephone or video conferencing, circumventing barriers associated with leaving the home and time limitations.

However, PST/DSJ implementation is impeded by the lack of data about how many sessions, which vary widely in studies of PST, are required or the need for "booster sessions" for maintenance of benefits. Evidence among care partners of adults with traumatic injuries suggests that care partners may benefit from as few as 2–3 PST sessions,[18] but this has not been systematically tested. Therefore, we followed recommendations from the MOST framework for conducting an optimization trial, designed to test the components of an intervention (and their interaction), rather than primary efficacy of the intervention and conducted a 2 × 2 factorial design randomised controlled optimization trial.[25] The trial, Caregivers in Dementia PST/DSJ (CaDeS), was designed to assess the components of number of PST/DSJ sessions and boosters for reducing caregiver burden and depressive symptoms among English- and Spanish-speaking ADRD care partners.[26] We secondarily examined effects on social problem-solving skills.[27] We hypothesized that PST/DSJ would decrease caregiver burden and depressive symptoms, and improve social problem-solving skills, regardless of number of sessions or presence of booster sessions, but that those receiving more sessions would experience greater benefits.

Methods
Study design
The CaDeS study trial was a multi-site, 2 × 2 factorial design randomised controlled optimization trial[25] offered to both English and Spanish-speaking care partners of adults with ADRD. The components of the intervention being tested were number of sessions (3 versus 6) and boosters (present versus absent). Care partners indicated which language they preferred to receive the intervention in. Those who elected English received PST and those who elected Spanish received the culturally adapted Spanish DSJ, both delivered via telephone or videocall.[20] The complete study protocol

was previously published,[26] and the study was registered prior to start at ClinicalTrials.gov (Identifier: NCT04748666). All study procedures were reviewed and approved by each site's Institutional Review Board (IRB) and performed in accordance with the ethical standards described in the 1964 Declaration of Helsinki, with University of Texas Southwestern serving as the reliance IRB for this study (IRB# STU-2020-1276). Participants provided documented informed consent, in their preferred language, prior to any study activities. This study additionally established protocols for managing crises that arose during intervention delivery (e.g., participant endorsing suicidal ideation). Diversity, equity, and inclusion were addressed in the 1) study design, which did not have any exclusion criteria designed to systematically exclude any group of persons who might benefit from the intervention, 2) execution, as we specifically attempted to enroll Hispanic and Spanish-speaking care partners and collected demographic data about gender identify, race, education, and ethnicity to report on representativeness of our sample, and 3) interpretation, as we explored if there were differences based on personal factors in intervention groups and included discussion and limitations related to representativeness of our sample.

Participants
Participants were English- and Spanish-speaking informal caregivers of persons with ADRD. ADRD was defined as any diagnosis or likely diagnosis of dementia based on care partner self-report. A list of dementia diagnoses was presented to care partners to choose from, including "other dementia" mild cognitive impairment (MCI). Recognizing that MCI is not a dementia diagnosis, we completed additional screening questions about possible contraindications and cognitive and functional decline. Determination of likely dementia for the purposes of inclusion was made by an experienced Behavioral Neurologist with dementia expertise. Recruitment occurred primarily through clinical care sites, social media (e.g., Nextdoor app), and public outreach events (e.g., health fairs). Participants were additionally recruited through caregiver registries and prior caregiver studies at the University of Texas Southwestern Medical Center (coordinating site) or University of Texas Rio Grande Valley. The research coordinator who conducted all consent and assessment was a bilingual Latina woman. Inclusion criteria were[26]: 1) individual involved in assisting a person with dementia in activities of daily living, with medical tasks, or for any other aspect of their well-being; 2) ≥1 year relationship with care recipient; 3) ability to communicate fluently in English or Spanish; 4) ≥18 years old; and 5) some depressive OR caregiver burden symptoms, defined as scores of ≥2 on the Patient Health Questionnaire 2[28] or Zarit Burden Interview 4.[29] Exclusion criteria were: 1) inability to self-consent; and 2)

dispute for caregiver's ability to participate in the care of the individual with ADRD (e.g., legal family dispute).

Randomisation and masking

Participants were randomised, via blocked randomisation in blocks of 8 and stratified by language (English versus Spanish), to receive either three or six sessions of PST/DSJ with or without booster sessions (i.e., four intervention arms). The primary study coordinator used REDCap™'s randomisation feature to assign participants to interventions after consent and before completion of their baseline assessments. Outcomes were completed directly as self-report via electronic survey by participants who were not masked to intervention condition.

Intervention

PST teaches a simple, effective evidence-based strategy that guides participants through solving problems and achieving goals with a step-by-step process. Through an iterative process taught by a trained coach, participants learn how to gather information about their problems, generate and evaluate potential solutions, create an action plan, and evaluate and revise plans as needed.[16–18] They learn how to break large problems into smaller, more manageable ones and to focus on what is within their control. The PST strategy follows a stepwise process with an easy to remember mnemonic: **A** = Assess the problem; **B** = Brainstorm solutions; **C** = Consider solutions and Choose one; **D** = Develop a plan and Do it; **E** = Evaluate; **F** = Flex. Throughout the sessions, participants choose problems and goals that are important to them and then use the PST strategy to address these goals, with the participant taking more responsibility for the application of the strategy as the sessions progress. Given this person-centered process that is driven by the participant and their values and preferences, PST was ideal for cultural adaptation.[20,24] The DSJ strategy steps were conceptually the same, maintaining the mnemonic: **A** = Analice el problema; **B** = Buscar soluciones; **C** = Considere y escoja; **D** = Desarrollar un plan y ¡Desempeñelo!; **E** = Evaluar y Evolucionar. DSJ was offered to Spanish-speaking participants by bilingual coaches.

All PST/DSJ sessions were conducted remotely by telephone or video conference using Microsoft Teams. During regular sessions (occurring ∼ weekly), participants were taught the PST/DSJ strategy and then had the opportunity to practice applying the ABCDEF steps to goals/problems they identified. More detailed description of what occurs during each session in the 3 versus 6 session versions of PST/DSJ are provided in the published protocol; in short, both versions include the same training in the use of the strategy, but the six session version allows for more iterative practice applying the strategy with the coach.[26] Booster sessions, if assigned, occurred monthly for six months after

completion of allocated regular sessions. During booster sessions, which were shorter than full PST/DSJ sessions, participants had the opportunity to follow up with their coach, receive extra facilitated practice using the strategy, and further discuss PST/DSJ questions and opportunities for application.

Coaches were master's-level professionals with backgrounds in social work or counseling. Coach training was supervised by the study principal investigator, who is a certified rehabilitation counselor with expertise in problem-solving methods. Training followed an established protocol, which includes reading the coach manual, self-study, didactic sessions, and iterative role-play scenarios supervised by other trained coaches. Coaches participated in biweekly peer review meetings and regular meetings with the study team. Coaches who delivered DSJ were fluent in both English and Spanish and received additional cultural training to deliver DSJ based on a previous cultural adaptation study.[20] They were supervised by a bilingual Latina neuropsychologist.

Trained PST/DSJ coaches assessed intervention fidelity using our established fidelity protocol to score adherence to the intervention protocol while listening to audio recorded session[15] for a random 10% of all delivered PST/DSJ sessions. A total of 425 PST/DSJ sessions were delivered across the course of the study (this does not include the 132 booster sessions), so fidelity was assessed in 43 sessions (10%) selected at random. Possible fidelity scores could range from 0 (no fidelity) to 1 (perfect fidelity). Fidelity was excellent at 95%.

Outcomes

Participants had the option of completing questionnaires electronically through REDCap™ or via telephone in an interview format with a trained research staff member. Information was collected from participants at three time points: baseline, first follow-up (within 1-month after main intervention sessions were completed), and second follow-up (6-months after intervention sessions were completed and after booster sessions were completed). As described in detail elsewhere,[26] we collected information about demographics (i.e., age, gender, race, ethnicity, education), caregiver relationship (i.e., nature, duration, living situation, relationship quality measured on a 1–10 scale), and outcome measures (i.e., caregiver burden, depressive symptoms, problem-solving skills).

The primary outcome of depressive symptoms was measured with the Patient Health Questionnaire (PHQ) 8-item version. PHQ-8 measures DSIM-IV-TR symptoms that define a major depressive episode, with scores ranging from 0 to 27. Cutoff scores for depressive symptom severity are: 0–4 (none), 5–9 (mild), 10–14 (moderate), 15–19 (moderately severe), and >20 (severe). It is validated in both English and Spanish.[30,31]

The primary outcome of caregiver burden was measured with the Zarit Burden Interview (ZBI) 22-item version. ZBI is a self-reported measure of caregiver burden, including psychological and emotional health, well-being, social and family life, finances, and perceived control. Cutoff scores are: 2–20 (mild), 21–40 (mild to moderate), 41–60 (moderate to severe), and 61–88 (severe). It is validated in both English and Spanish.[32,33]

Our secondary outcome of social problem-solving skills was measured with the Social Problem-Solving Inventory—Revised: Short Form (SPSI-RS). The SPSI-RS is a 25-item self-reported measure of ability to resolve problems in everyday living. Higher scores indicate greater intensity in one of five dimensions: Positive problem orientation (PPO), Negative problem orientation (NPO), Rational problem solving (RPS), Impulsive/Carelessness style (ICS), and Avoidance Style (AS).[34]

Statistical analysis

Per the published protocol,[18] and assuming the proportion of improvement could range from 30% to 60% in one arm, we determined that a sample size of 23 per arm would achieve 80% power at a significance level of 0.05 to detect the improvements between any two arms of 30% versus 65%, 40% versus 75%, 50% versus 83%, and 60% versus 90%. Accounting for 10% attrition, the required total sample size was 104 (26 per arm) to achieve the same statistical power.

An intent-to-treat (ITT) analysis was conducted so that all enrolled participants were analyzed based on the arms to which they were randomised. Descriptive statistics were calculated for all participants and by intervention arm. Either means and standard deviations or medians with interquartile ranges (IQR) are reported for continuous variables, and frequencies with percentages are reported for discrete variables. Kruskal–Wallis tests and Pearson's Chi-square tests were used for testing continuous and categorical variables, respectively. Intervention groups by the use of boosters, number of sessions, and their interaction effects were tested in the regression analyses for caregiver burden and depressive symptoms. Changes in outcome measures were calculated as differences between baseline and first follow-up and between baseline and second follow-up.

Longitudinal outcome measurements at first and second follow-ups were modeled using demographic variables (age, gender) and intervention arm. Intervention arm was modeled for both the main effect of number of sessions, the main effect of booster sessions (present/absent), and their interaction. Interactions between follow-up time and intervention arm were also tested. The constrained longitudinal data analysis (cLDA) model proposed by Liang and Zeger[35] was used where both baseline and follow-up measures were treated as dependent variables, and the baseline means from different treatment arms were constrained to be the same across intervention groups given that the participants were randomised prior to the baseline measurement. According to the existing literature about longitudinal data analysis,[36] cLDA models can lead to more efficient and robust estimation than other models. Model coefficients and 95% CIs were estimated in the longitudinal analysis using generalized linear modeling with repeated measurements, which was implemented using SAS software, procedure GENMOD. A p-value ≤ 0.05 was considered statistically significant. All analyses were conducted using SAS software, version 9.4 (SAS Institute, Cary, NC).

Deviations from preregistered protocol (NCT04748666)

There were three changes made in the study procedures from the preregistered protocol. The protocol indicated that randomisation would be stratified by gender and language using blocked randomization with blocks of 16. We elected to use blocks of 8, given the overall sample size. There was an error in the randomisation coding such that randomisation was not stratified by gender, only language. We controlled for gender in all analyses to address the imbalance in study arms that resulted. Finally, we planned to compare intervention effects between PST and DSJ; however, given challenges in recruiting Spanish-only speakers (magnified by the COVID-19 pandemic), we did not achieve a sufficient sample size for this comparison. The results presented herein are for the first aim of the study protocol. The second aim, which will use Bayesian-frequentist hybrid inference for responder analysis, will be presented in forthcoming publication. Additional outcomes noted in the protocol will be reported in subsequent publications.

Role of the funding source

The funder of the study had no role in the study design, data collection, data analysis, data interpretation, or writing of the report.

Results

Ninety-seven care partners participated in the study between June 2021 and July 2023 (n = 104 consented and were randomised with 7 never completing baseline assessment). Fig. 1 presents a trial profile. Of those eligible, 78% consented, and of those consented, 92% started the intervention. The most common reason for refusal to participate was lack of interest in being in a research study, followed by lack of time and not seeing the benefit of the intervention (refer to Fig. 1). Once started, completion of all sessions as allocated was very high for those receiving 3 sessions (95%) and high for those receiving 6 sessions (82–86%). Only five participants (5%)
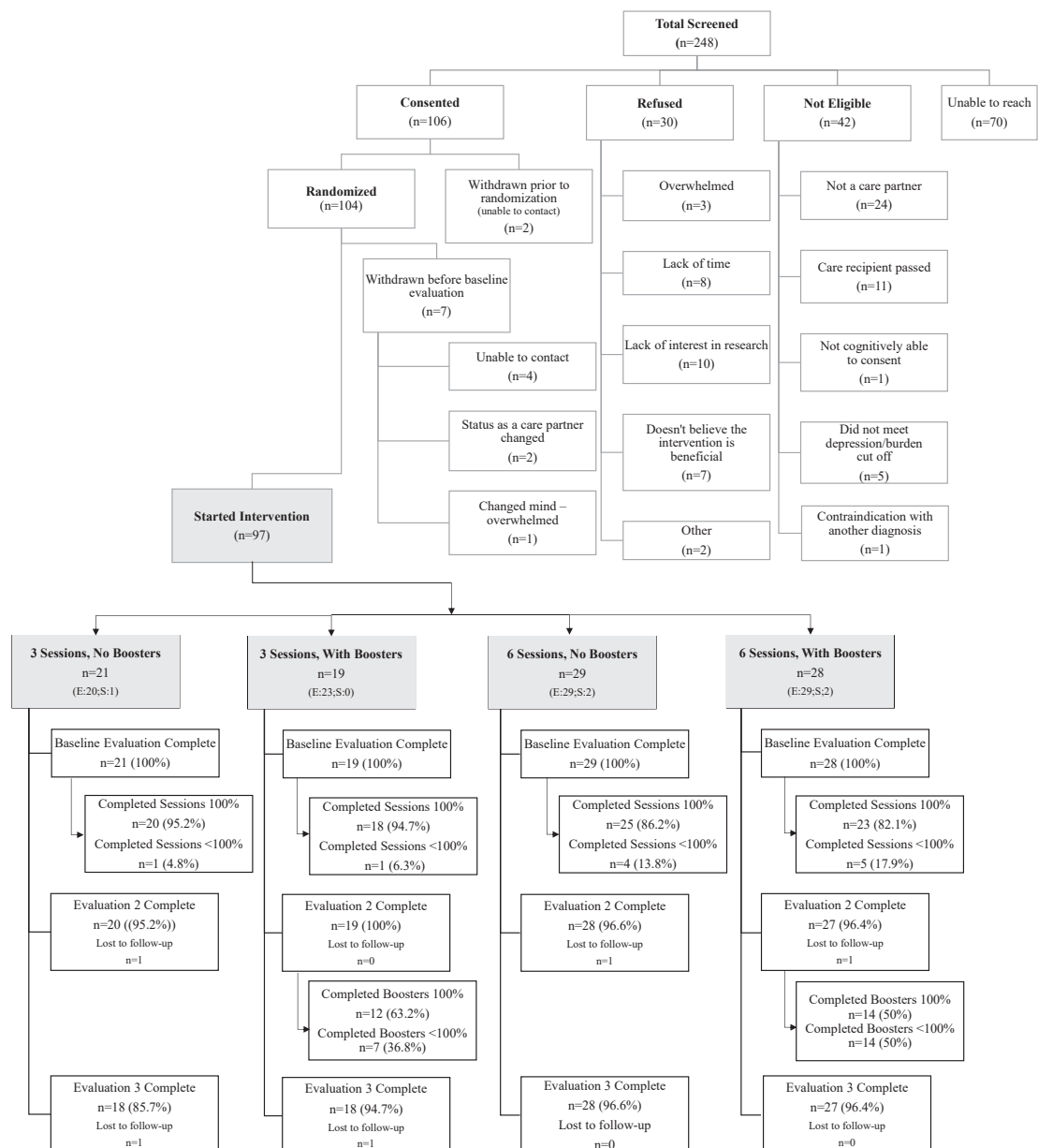
Fig. 1: Trial profile.

were lost to follow-up at the final evaluation. Overall sample characteristics are presented in Table 1. When comparing participant characteristics across intervention arms (Table 2), a significantly smaller proportion of participants in the 3-Session group were women compared to other intervention arms (p < 0.001). No other statistically significant differences were observed between groups.

Longitudinal analyses are presented in Table 3. As seen in Table 3, caregiver burden was significantly reduced over time (Estimate = −0.40, p = 0.004, Cohen's D = 0.31), with men reporting significantly more

improvement in caregiver burden relative to their female counterparts (Estimate = −8.65, p = 0.004). As seen in Table 3, depressive symptom scores significantly reduced over time (Estimate = −0.16, p = 0.005, Cohen's D = 0.33) for all participants. Neither the main effects for session or booster, nor their interaction, were significant.

Supplemental Table S2A–E shows results from the longitudinal analysis of the secondary outcomes capturing problem-solving skills. Of note, negative problem orientation decreased significantly (Estimate = −0.11,

	n (%)
Gender	
Man	16 (16.5)
Woman	80 (82.5)
Transgender	–
Prefer not to disclose/unknown	1 (1.0)
Preferred language for intervention	
English	92 (94.8)
Spanish	5 (5.2)
Race (multiple Races could be selected)	
Indigenous or Native American	2 (2.1)
Asian or Asian American	1 (1.0)
Afro-Latino/Afro-Hispanic; Black or African American	15 (15.5)
Multi-racial	1 (1.0)
Native Hawaiian or Other Pacific Islander	–
White/European/Caucasian	74 (76.3)
Other race	4 (4.1)
Don't know	2 (2.1)
Hispanic ethnicity	
Hispanic/Latino	22 (22.7)
Not Hispanic/Latino	75 (77.3)
Employment status	
Employed full-time	31 (32.0)
Employed part-time	13 (13.4)
Unemployed (looking)	4 (4.1)
Unemployed (not looking)	5 (5.2)
Homemaker	4 (4.1)
Student	–
Retired	40 (41.2)
Relationship (care partner) to care recipient	
Spouse	47 (48.5)
Parent	1 (1.0)
Child	45 (46.4)
Sibling	2 (2.1)
Friend	2 (2.1)
Care recipient dementia diagnosis	
Alzheimer's disease	60 (61.9)
Frontotemporal degeneration	3 (3.1)
Lewy body dementia	7 (7.2)
Vascular contributions to cognitive impairment and dementia	7 (7.2)
Mixed etiology dementias	2 (2.1)
Mild cognitive impairment	7 (7.2)
Other	11 (11.3)
Lives with care recipient	67 (69.1)
Care recipient's FAST score	
1 (Normal)	–
2	1 (1.0)
3	2 (2.1)
4	27 (27.8)
5	10 (10.3)
6	29 (29.9)
7 (Severe)	28 (28.9)
	Mean (SD)
Age	61.57 (12.4)
Education (years)	15.81 (2.6)
Time since care recipient's diagnosis (years)	3.67 (3.3)
(Table 1 continued on next column)	

	Mean (SD)
(Continued from previous column)	
Number of people in household	2.75 (1.6)
Number of people dependent on care partner	1.48 (1.1)
Relationship quality	8.23 (1.9)
Caregiver burden (ZBI)	37.47 (13.6)
Depressive symptoms (PHQ8)	6.13 (4.9)
Social problem-solving skills	
Positive problem orientation	12.60 (3.4)
Negative problem orientation	4.55 (3.6)
Rational problem solving	10.16 (3.2)
Impulsive/carelessness style	3.34 (3.1)
Avoidance style	5.04 (2.8)

Note. Care recipient diagnosis is based on care partner self-report. In the event they indicated Other diagnosis or diagnosis of MCI, which is not dementia, we completed additional screening questions about possible contraindications and cognitive and functional decline. A determination of likely dementia for the purposes of inclusion was made by an experienced Behavioral Neurologist with dementia expertise. FAST = Functional Assessment Staging Tool for dementia; PHQ = Patient Health Questionnaire; ZBI = Zarit Burden Interview.

Table 1: **Participant characteristics (N = 97).**

$p = 0.01$) and rational problem-solving increased significantly (Estimate = 0.09, $p = 0.048$) over time regardless of intervention arm, indicating that PST/DSJ was changing problem-solving skills in a manner we would expect. Attending 6 sessions (versus 3 sessions) was associated with a lower impulsive/careless problem-solving style (Supplemental Table S2D) at follow-up (Estimate = −1.43, $p = 0.02$). The interaction between sessions and boosters in Supplemental Table S2D was also significant (Estimate = 2.01, $p = 0.044$), indicating that the effect of boosters for lowering the impulsiveness/carelessness style was greater among those who had only received 3 (versus 6) sessions.

Mean differences in change scores between baseline and each follow-up for primary and secondary outcomes are shown in Supplemental Table S1, overall (Supplemental Table S1A) and by intervention group (Supplemental Table S1B–E). The sample size available for each outcome ranged from 90 to 95 care partners. Among all participants collectively, significant improvements were observed from baseline to 6-month follow-up for caregiver burden, depressive symptoms, and negative problem-solving orientation. There were no statistically significant changes from baseline to 1-month post-intervention follow-up. Within each intervention group, whether changes were statistically significant varied for the primary outcomes, with significant changes in both caregiver burden and depressive symptoms noted in the six-session plus booster group (Supplemental Table S1E). The effect sizes for changes in the primary outcomes were predominantly medium (Cohen's D = 0.17–0.51), notably all but one higher than the effect size of 0.20 argued to be the a small but meaningful effect for psychosocial

Summary statistics at baseline

Variables at baseline	All N = 97	3 sessions N = 21	3 sessions + boosters N = 19	6 sessions N = 29	6 sessions + boosters N = 28	p-value
Age	61, [52, 72]	67, [52, 71]	61, [54, 70]	58, [51, 68]	62.5, [52.5, 74]	0.63
Gender, Men	16 (17%)	9 (43%)	1 (5%)	3 (11%)	3 (11%)	**<0.001**
Gender, Women	80 (83%)	12 (57%)	18 (95%)	25 (89%)	25 (89%)	
Caregiver burden	37, [30, 46]	34, [25, 40]	39, [31, 47]	36, [25, 44]	42, [31.5, 46.5]	0.27
Depressive symptoms	6, [2, 8]	4, [2, 8]	4, [2, 8]	5, [3, 7]	6, [4, 10.5]	0.24
Positive problem	13, [10, 15]	13, [12, 14]	12, [10, 14]	13, [10, 15]	12.5, [9, 15]	0.63
Negative problem	4, [2, 6]	4, [3, 6]	4, [2, 7]	3, [1, 7]	3.5, [2, 6]	0.99
Rational problem	10, [8, 12]	10, [8, 12]	10, [9, 12]	10, [9, 13]	10.5, [8, 12]	0.90
Impulsive/carelessness	2, [1, 5]	3, [2, 5]	2, [1, 4]	2, [1, 4]	3, [0.5, 5.5]	0.63
Avoidance style	5, [3, 7]	5, [2, 7]	5, [3, 7]	5, [3, 6]	4.5, [3, 6.5]	0.93

Summary statistics at first follow-up

Variables at 1 month	All N = 94	3 sessions N = 20	3 sessions + boosters N = 19	6 sessions N = 28	6 sessions + boosters N = 27	p-value
Caregiver burden	35, [27, 45]	33, [22.5, 38.5]	34, [23, 47]	39, [28, 43]	36, [30, 49]	0.57
Depressive symptoms	5, [2, 8]	4, [2.5, 7.5]	5, [1, 7]	4.5, [1.5, 7.5]	6, [2, 9]	0.58
Positive problem	13, [11, 15]	14.5, [13, 16]	12, [10, 14]	13, [11.5, 14.5]	13, [10, 16]	0.32
Negative problem	4, [2, 6]	3, [1.5, 5]	5, [2, 8]	4, [2, 6]	4, [2, 6]	0.39
Rational problem	10, [8, 12]	10, [8, 12]	11, [8, 12]	10, [9, 11.5]	10, [8, 13]	0.58
Impulsive/carelessness	2.5, [1, 5]	4, [2, 5.5]	2, [1, 5]	2, [1, 4]	4, [1, 5]	0.08
Avoidance style	5.5, [4, 7]	5, [3, 6]	6, [4, 7]	5, [3, 6]	6, [4, 8]	0.10

Summary statistics at second follow-up

Variables at 6 months	All N = 91[b]	3 sessions N = 18[b]	3 sessions + boosters N = 18	6 sessions N = 28	6 sessions + boosters N = 27	p-value
Caregiver burden	33, [26, 45]	32.5, [20, 42]	34, [19, 51]	33, [26.5, 42.5]	33, [27, 45]	0.91
Depressive symptoms	4, [1, 7]	4.5, [3, 5]	3.5, [2, 8]	3.5, [1, 5.5]	3, [2, 7]	0.88
Positive problem	13.5, [10, 15]	14, [13, 15]	13, [10, 15]	13, [10.5, 15]	14, [9, 17]	0.35
Negative problem	3, [2, 6]	3, [1, 5]	3, [1, 7]	4, [2, 5]	3, [2, 6]	0.90
Rational problem	11, [9, 13]	11, [10, 12]	10, [8, 12]	10, [8, 11.5]	11, [9, 14]	0.20
Impulsive/carelessness	3, [1, 5]	4, [2, 6]	3, [1, 5]	2.5, [1, 4]	2, [1, 7]	0.60
Avoidance style	5, [3, 7]	4, [3, 7]	5.5, [3, 9]	5.5, [4, 7]	5, [4, 6]	0.54

[a]Median, [interquartile range] and number (percentages). [b]For all social problem-solving, N = 90 for All and N = 17 for 3 sessions group; Bold indicates p < 0.01.

Table 2: Summary statistics[a] of covariates and outcomes.

outcomes.[37] Within group effect sizes suggest there may be greater improvement with 6 sessions (Cohen's D = 0.28–0.51) than 3 sessions (Cohen's D = 0.17–0.41). No serious adverse events were reported.

Discussion

We sought to determine the effects of two components of the PST/DSJ intervention: numbers of sessions (3 versus 6) and booster sessions (present or absent), on average, for care partners of adults with ADRD. Care partners receiving PST/DSJ reported significant improvements in caregiver burden and depressive symptoms, as well as an increase in rational problem-solving and decrease in negative problem orientation, from baseline to final follow-up assessment, with no significant differences between intervention groups. This supports our hypothesis that PST/DSJ, in any dose, can

improve care partners' caregiver burden, depressive symptoms, and social problem-solving skills. This is encouraging, as having flexibility in how many sessions are required when implementing PST/DSJ makes it more attractive and feasible across multiple settings, including those where resources may be limited.

Numerous systematic reviews and meta-analyses support the efficacy of psychosocial interventions for improving dementia care partner outcomes, though all note the heterogeneity in intervention components that makes implementation challenging.[8,13,38–40] Identifying the most effective components of these interventions could make them less complex and more scalable. One meta-analysis of 30 studies on psychosocial interventions for AD/ADRD care partners found that teaching care partners problem-solving skills was a key feature of effective interventions, particularly for improving care partner mental health (e.g., depression).[39] In a meta-

Caregiver burden							
Parameter	Level	Estimate	Standard error	95% confidence limits		Z	Pr > |Z|
+Time		−0.40	0.14	−0.68	−0.13	−2.87	**0.004**
Age		0.03	0.11	−0.19	0.25	0.27	0.79
Gender	Men versus Women	−8.65	2.97	−14.47	−2.83	−2.91	**0.004**
Number of sessions	6 versus 3	1.93	3.51	−4.96	8.82	0.55	0.58
Boosters	Yes versus No	2.24	4.32	−6.23	10.72	0.52	0.60
Session*Booster	Interaction	−1.81	5.25	−12.10	8.48	−0.34	0.73
Depressive symptoms							
Parameter	Level	Estimate	Standard error	95% confidence limits		Z	Pr > |Z|
Time		−0.16	0.06	−0.27	−0.05	−2.79	**0.005**
Age		−0.02	0.04	−0.09	0.05	−0.55	0.58
Gender	Men versus Women	−1.78	1.02	−3.78	0.22	−1.75	0.08
Number of sessions	6 versus 3	0.07	1.22	−2.33	2.46	0.05	0.96
Boosters	Yes versus No	−0.02	1.42	−2.80	2.76	−0.02	0.99
Session*Booster	Interaction	1.02	1.86	−2.62	4.65	0.55	0.58

Bold indicates p < 0.05.

Table 3: Longitudinal regression estimates for the two primary outcomes: Caregiver burden and depressive symptoms.

analysis of 31 studies comprising 2800 participants with various health conditions, which care partners also experience, problem-solving training interventions were found to be effective for improving mental health and could be incorporated quickly (in few sessions) into daily life, with effects are maintained over time.[41] In line with and building upon this existing evidence, our work tested specific components of the intervention (number of sessions, boosters) that are needed to inform implementation.

There is a very high prevalence of depression among ADRD care partners (30–40%).[2] We found that, overall, care partners benefited from PST/DSJ, demonstrating a decrease over time in depressive symptoms. Improvements were generally larger when measured from baseline to second follow-up (compared to baseline to first follow-up) regardless of number of sessions or presence of booster sessions, suggesting that the effects of using the PST/DSJ strategy to address goals and problems may take time to affect overall depressive symptoms. Though not statistically significant, the six-session group had a larger effect size than the three-session group, and effect sizes for improvement in depressive symptoms were larger in the groups who received booster sessions than those who did not. Therefore, implementing PST/DSJ with both of these components (6 sessions and boosters) may represent the optimal intervention, balancing efficacy, feasibility, and participant preference, for settings in which the necessary resources are available to do so.

Regardless of the specific components, PST/DSJ as a non-pharmacological intervention for ADRD care partners with depressive symptoms produces no adverse medication effects, does not require a prescribing provider, and is highly acceptable to participants. We had a particularly high level of retention among participants who began the intervention, supporting acceptability and perceived value to care partners. Given the cultural adaptation already completed for Spanish speakers and the flexibility in the variety of individuals who can deliver PST/DSJ with high fidelity, this PST/DSJ has the potential to reach diverse ADRD care partners who demonstrate the most need.

Care partners of persons with ADRD report particularly high levels of stress and caregiver burden, even higher than care partners of persons with stroke (a relatively similar age-matched group)[42] or other conditions.[43] Addressing caregiver burden is challenging, however, because it manifests in response to multiple stressors, including physical, psychological, social, and financial stressors, associated with caregiving.[44] These stressors can differ in type, timing, and intensity depending on the severity and nature of the care recipient's diagnosis as well. However, this is what makes PST/DSJ particularly promising, as it provides care partners with a strategy that can be applied to any of those stressors, at any time, and with the flexibility to apply to their specific needs in the moment. We found that, regardless of receiving three or six sessions, care partners demonstrated modest reductions in caregiver burden. Like our findings for depressive symptoms, improvements were generally larger when measured from baseline to second follow-up, suggesting that after learning the strategy in PST/DSJ, benefits of applying the strategy in daily life may take time to affect overall caregiver burden. Though not statistically different (and noting that within group changes may have been underpowered to detect in all groups), effect sizes for

improvement in caregiver burden were largest in the two groups who received booster sessions, which supports the inclusion of booster sessions as part of PST/DSJ delivery when resources allow.

We examined social problem-solving skills as a secondary outcome, as these are the direct skills PST/DSJ is teaching,[27] so these skills are a likely mechanism of action. We found that negative problem orientation and rational problem-solving improved over time, regardless of allocation arm, but no changes were observed overall for positive problem orientation, impulsive/carelessness style, or avoidance style coping. These findings are consistent with the skills taught in the PST/DSJ strategy, which provides participants with an overarching metacognitive strategy they can use to engage in proactive rational problem-solving with a goal-focused orientation. A negative problem-solving orientation is characterized by a lack of confidence and self-efficacy in one's ability to effectively solve problems,[27] and PST/DSJ is known to improve self-efficacy. A recent study of PST among Veterans also found reductions in negative problem-solving orientation that was subsequently associated with improved mental health, suggesting that negative problem-solving orientation may be a mechanism by which PST improves mental health.[45] Though we did not observe significant improvements in the other three subscales, this could be because care partners in our sample were already reporting high levels of positive problem orientation and low levels of impulsive/carelessness and avoidance style at baseline.

Though our inclusive design removed language barriers for Spanish-speakers, many of our bilingual participants preferred to receive the intervention in English. A better understanding of bilingual persons' perceptions about language and healthcare would inform language preference. Biases, stigma, and/or structural barriers associated with being a Spanish-speaker may be driving their choice. We had difficulty recruiting Spanish-speakers and were unable to conduct planned comparisons as a result. In our team's experience recruiting Spanish-speakers, it is most effective when done in person, meeting people in their communities. This was not possible during the COVID-19 pandemic when this study was conducted, and we did not have the necessary resources available to support community liaisons. Targeted strategies, such as promotora de salud or trusted members within a community who provide education, may be necessary to bridge access and trust gaps.[46] Due to these challenges, we could not stratify analyses by language of intervention delivery, as originally planned. Our Spanish-speaking participants preferred telephone to video conference, providing valuable considerations for implementation.

Due to the relatively small sample size, our sample had some homogeneity in terms of demographics (predominantly White care partners) and geography, which may introduce bias and limit generalizability. Additionally, in the rare event that participants completed the outcomes by telephone and not directly via electronic survey, the person conducting the interview was not masked to randomization status. However, the outcomes were all standardised self-reported questionnaires and did not involve any assessor interpretation or evaluation. Self-reported outcomes may confer bias related to participants' desire to please investigators, which may have been tempered by most completing measures as direct entry electronic surveys.

PST/DSJ was effective for improving caregiver burden and depressive symptoms in as few as three sessions without boosters, though six sessions may have greater benefit, and boosters may amplify the magnitude of this improvement. These results will help us establish guidelines to implement this evidence-based, culturally adapted problem-solving intervention to reduce stress and burden and improve health and well-being among diverse dementia care partners. Subsequent qualitative study of barriers and facilitators to access, engagement, and uptake will further inform implementation strategies, as will examination of difference between those who benefited from the intervention versus those who did not. While caregiver burden and depressive symptoms are prevalent and consequential outcomes, there may be other meaningful outcomes that could improve after PST/DSJ. Better understanding care partners' perspectives on how they benefited from the intervention, how they used the strategy they learned after the intervention ended, and how the intervention could be adapted to better suit their needs would likely improve intervention efficacy. Additionally, when a care partner feels burden or depressive symptoms, the health and well-being of their care recipients are directly affected,[47] so work is needed to determine whether the positive effects of PST/DSJ among care partners will also indirectly benefit persons living with ADRD as well.

required) after publication. The study protocol has been published and is registered at ClinicalTrials.gov.

Appendix A. Supplementary data
Supplementary data related to this article can be found at https://doi.org/10.1016/j.lana.2025.101222.

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