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Cognitive benefits of online social networking in healthy older adults

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Abstract

Objectives

Research suggests older adults who remain socially active and cognitively engaged have better cognitive function than those who are isolated and disengaged. This study examined the efficacy of learning and using an online social networking website, Facebook.com, as an intervention to maintain or enhance cognitive function in older adults.

Method

Forty-one older adults were assigned to learn and use Facebook (n = 14) or an online diary website (active control, n = 13) for 8 weeks, or placed on a waitlist (n = 14). Outcome measures included neuropsychological tests of executive functions, memory, and processing speed and self-report questionnaires about social engagement.

Results

The Facebook group showed a significant increase in a composite measure of updating, an executive function factor associated with complex working memory tasks, compared to no significant change in the control groups. Other measures of cognitive function and social support showed no differential improvement in the Facebook group.

Discussion

Learning and using an online social networking site may provide specific benefits for complex working memory in a group of healthy older adults. This may reflect the particular cognitive demands associated with online social networking and/or the benefits of social engagement more generally.

Key Terms: Social Media, Technology, Working Memory, Executive Function, Social Interaction, Training

Introduction

As the numbers of older adults in our population continue to grow, there is increasing interest in finding ways to promote successful aging and reduce cognitive decline. Building off research demonstrating plasticity in the brain throughout the lifespan, several intervention studies have attempted to train specific cognitive functions that decline with age, such as episodic memory, executive functions, and processing speed (see Lustig, Shah, Seidler, & Reuter-Lorenz, 2009 for review). For the most part, these interventions have led to improved performance on the trained tasks and other very similar tasks, but little transfer to other cognitive domains (Ball et al., 2002) or to everyday life (for an exception, see Rebok et al., 2014 in the domain of reasoning). Some studies, such as those focused on lifestyle factors like aerobic exercise training, have reported somewhat broader cognitive benefits (see Hertzog, Kramer, Wilson, & Lindberger, 2008 for review).

One lifestyle factor that may play a significant role in maintaining or improving cognitive function in older adults is social interaction. A growing body of literature has described positive effects of social engagement and deleterious effects of social disengagement on cognitive functioning in older adults (Seeman, Lusignolo, Albert, & Berkman, 2001; Seeman et al., 2010; Conroy, Golden, Jeffares, O'Neill, & McGee, 2010; Bassuk, Glass, & Berkman, 1999; Krueger et al., 2009). Many of these studies, however, are correlational, and so are suggestive but difficult to interpret in terms of causality. In addition, kinds and amount of social engagement are variable across studies and are often based on self-report; cognitive measures have also varied, although effects seem to be strongest in speed of processing and executive function, and somewhat weaker in episodic memory. For example, Krueger et al. (2009) reported that perceived level of social support in older adults was related to working memory, perceptual speed, and visuospatial ability, but not episodic or semantic memory. Seeman et al. (2010), based on longitudinal data, reported that numbers of social contacts were positively correlated with executive function and episodic memory at all ages, and that declines in social contacts over time were related to poorer functions in both cognitive domains. Research that analyzed data from the Victoria Longitudinal Study of aging demonstrated positive relations between engagement in lifestyle activities, especially social activities, and executive functions, speed of information processing, episodic memory and semantic memory in the Victoria Longitudinal Aging study (Small, Dixon, McArdle, & Grimm, 2012; de Frias and Dixon, 2014).

As yet, there are relatively few intervention studies that have directly manipulated social interaction and looked at effects on cognitive functions, and these too have used a variety of methodologies and measured a variety of cognitive functions. Pitkala, Routasalo, Kautianinen, Sintonen, and Tilvis (2011) examined the cognitive effects of increasing social interaction and friendships by facilitating social groups among older adults. After three months, participants in the social groups improved performance on the Alzheimer's Disease Assessment Scale-cognitive subscale (ADAS-cog) compared to no treatment controls. Mortimer et al. (2012) assigned cognitively healthy, community-dwelling older adults in China to a Tai Chi, Walking, Social, or no contact group. The Social Group met regularly to discuss selected topics of interest. After 40 weeks, participants in both the Tai Chi and Social groups showed improvements on tests of auditory verbal learning and speed of processing. No changes were observed in the Walking group. Interestingly, the researchers noted that the Social group continued to meet for two years following the conclusion of the study, suggesting the participants developed intrinsic motivation to continue with this activity.

Several studies, although not focused directly on effects of increased social engagement, have employed interventions that engage multiple modalities, including social interaction For example, the Experience Corps is a program that enlists older adults as volunteers in elementary school classrooms, simultaneously targeting cognitive, social, and physical functioning. After 4 to 8 months, participants in the Experience Corps reported increased physical activity and strength, and a greater number of social contacts on which they could rely. They also showed improvements in executive function (Trails B performance) and memory (Rey-Osterrieth Figure Delayed Recall) compared to a no-treatment control group (Fried et al., 2004; Carlson et al., 2008, 2009). Similarly, Senior Odyssey, a project developed by Stine-Morrow et al. (2007), investigated the cognitive effects on older adults of working together in small groups to solve complex problems. The results suggested some improvements on problem solving ability compared to a no treatment control group (Stine-Morrow, Parisi, Morrow, Greene, & Park, 2007). However, the extent to which social aspects of the intervention may have contributed to changes in cognition remains unclear because there was no social control group.

This control was used in a recent large cognitive aging intervention study from Park et al. (2014), which contrasted "productive engagement" conditions (quilting, photography, or both) with "receptive engagement" conditions (social, placebo/non-social cognitive activity). Productive engagement involved learning new complex tasks, requiring executive function, long-term memory, working memory and reasoning. Receptive engagement, on the other hand, did not involve the acquisition of any new skills or knowledge, but instead involved the activation and use of previous knowledge and skills, either as part of a "social club" or individually (placebo). They found that participants in the productive engagement group, which took place in a social environment, demonstrated higher levels of episodic memory following the three month intervention, compared to receptive engagement (whether social or not). Park and colleagues concluded that combining social engagement with other cognitively demanding activities provides benefits for memory, whereas social interaction without a learning component does not. In addition, when the two productive groups were analyzed separately, only the digital photography group showed significant benefits for episodic memory. The authors suggested that learning digital photography required greater use of episodic memory than did the more procedurally-based quilting task, and was therefore more likely to benefit memory.

The results of these multimodal studies suggest that including a social component in a cognitive interventions may enhance its benefits, and that these improvements may be domain specific, enhancing only the particular cognitive processes that are trained. However, most of these interventions required that people have the ability to travel to and from community sites, and thus they may exclude the most vulnerable groups who are home-bound or have limited mobility. Our study was designed to test the feasibility of bringing social engagement to older adults who were socially isolated or could not easily get out of their homes. Given the negative effects of social disengagement, interventions that encourage social interaction, particularly in the context of cognitive activities, would seem to be especially relevant for those individuals who lack the means to engage socially with others in their community.

One way to do this is to take advantage of resources already present in the home, such as a computer. The Internet can act as a gateway to a host of different experiences including information-gathering and socializing, and engagement with information and communication technology has also shown promise as a means for improving cognitive function in older adults. Recent research from Chan, Haber, Drew and Park (2014) found that older adults who learned and used iPads for various Internet activities had improved episodic memory and processing speed compared to a social control group. Participants in this study were trained in a group, and learned how to use various applications, including how to follow each other on Twitter and connect with family and friends. So here also, the social aspects of the training may have enhanced the cognitive benefit.

Several recent correlational studies have demonstrated that online social networking may provide a promising way to increase social connections in older adults (Leist, 2013; Bell et al., 2013; Grieve, Indian, Wittevan, Tolan, & Marrington, 2013; Richter, Bannier, Glott, Marquard, & Schwarze, 2013), and may also be beneficial for cognitive function. Research in younger adults has shown that adolescents who used Facebook for longer than one year had higher working memory and verbal abilities compared with adolescents that had been using the site for less time (Alloway, Horton, Alloway, & Dawson, 2013). Kim and Kim (2014) examined social media use and cognition in 213 community dwelling older adults, and observed that online social networking users had significantly higher performance on the Mini Mental State Exam than non-users. However, once again, because these studies were correlational in nature, it is possible that individuals with higher levels of cognitive function were simply more likely to use online social networking.

The present study directly tests the efficacy of online social networking as an intervention to maintain or enhance cognitive function in older adults.Although correlational studies are suggestive, they cannot establish the direction of causal effects. To our knowledge, no intervention study has shown that learning and using an online social networking site such as Facebook can directly impact cognitive function in older adults. Results from the Chan et al (2014) study showed that learning how to use an iPad improved memory and processing speed, but did not directly address the cognitive benefits of social activity because the control group was social. The present work will provide a comparison between two online cognitive tasks, one requiring social interaction and the other involving no social interaction, thus providing information concerning the cognitive benefits of social engagement in older adults. The use of online social networking in particular has the potential to impact quality of life in older people, particularly those who, for a variety of reasons, may be socially isolated.

Methods

Pilot

We first tested the procedures with a small pilot group (n = 7, 3 males) of community-dwelling older adults (mean age of 78.5 (Range = 75-86) and 16.14 years of education (Range = 10-20)). Participants attended six 2-hour classes over two weeks to learn how to use Facebook.com, followed by six weeks of continued use at home. Before and after the intervention, they received a short battery of neuropsychological tests and questionnaires about social activities. All participants were able to learn how to use Facebook and showed a significant improvement from Time 1 to Time 2 on Trails B performance ($t(6) = 4.87$, $p = .003$), suggestive of possible benefits for executive functioning and/or processing speed following the Facebook intervention. Based on these findings and other studies in the literature (e.g., Park et al., 2014), we proceeded with a larger-scale study that added a non-social cognitive and a waitlist control group and additional cognitive tests to determine the specificity of the effects and to rule out re-test effects on our cognitive measures. We included measures of processing speed, episodic memory, and executive function.

Participants

Participants were recruited from two sites (a retirement community in Green Valley, Arizona and the greater Tucson, Arizona community) that were studied independently with the same procedures. Both cohorts were recruited using flyers and listserv announcements designed to be neutral in regards to our hypotheses about the potential benefits of Facebook.

Forty-three participants met the following eligibility criteria: They (a) either did not have an account with any online social networking sites or used it once a month or less, (b) had a computer or tablet with Internet access at home and an e-mail address, (c) did not have a significant neurological, psychiatric, or medical condition that would affect cognitive function based on self reported medical history, and (d) had a score ≥ 26 on the Mini Mental State Exam (MMSE; Folstein, Folstein, McHugh, & Fanjiang, 2001).

All individuals provided written informed consent to participate in the study. Participants from each cohort were randomly assigned to the Facebook, Online Diary, or Waitlist group. However, because of schedule conflicts, some participants were placed into a class based on their availability (two participants in the Facebook group, three participants in the Online Diary group, and zero participants in the Waitlist group). Thus assignment was not completely random.

Two participants failed to complete the entire study due to health reasons. Thus, there were a total of 41 participants (12 male) who completed the study protocol: 14 in the Facebook group, 13 in the Online Diary group, and 14 in the Waitlist group. Demographic characteristics of the groups are shown in Table 1. Collapsed across cohorts, there were no significant differences across conditions in age, education, or gender. Between cohorts, the Green Valley retirement community group was significantly older (Mean age = 81.75) than the Tucson community group (Mean age = 75.71), $t(39) = 3.11$, $p = .003$ and had significantly more males (42%) than the Tucson community group (13%), χ^2 $(1, N = 41) = 4.30$, $p = .038$. Participants in the Tucson community group did not know each other prior to the study. Participants in Green Valley, due to the nature of the retirement community, were familiar with each other prior to the study, but did not have significant pre-existing relationships (with the exception of three married couples – one in each group).

Procedure and measures

The two cohorts were tested sequentially over two 11-week periods with identical procedures and measures. All participants completed a series of baseline tests within two weeks prior to the start of training (Time 1) and again within one week of completing the 8-week intervention phase (one week of classes and seven weeks of at-home use; Time 2). The following tests were included:

Neuropsychological tests.

We measured verbal memory with the Rey Auditory Verbal Learning Test (Schmidt, 1996) and non-verbal memory with the Rey Complex Figure Test (Meyers & Meyers, 1995). To assess speed of processing, we administered the Digit Symbol Substitution Test (Lezak, Howieson, & Loring, 2004) and the Deary-Liewald reaction time task (Deary, Liewald, & Nissan, 2011). We also gave the Trail Making Test (Reitan & Wolfson, 1985), which provides measures of both visual scanning and processing speed (Trails A) and executive function (Trails B). We also administered the Controlled Oral Word Association Test and Category Fluency Test (Benton & Hamsher, 1978).

Other Executive Function Tests.

We included 6 additional tests to examine whether different aspects of executive function might be differentially affected by the intervention. This included two tests for each of three executive functions —updating, shifting, and inhibition — that were previously identified by Miyake et al. (2000) as representing independent executive functions. Updating is defined as the monitoring and refreshing of information in working memory and was measured by the Letter

Memory and Keep Track tests. Shifting is defined as switching between multiple tasks or mental sets and was measured by the Global-Local and Letter Number tasks. In particular, we examined global shift costs, or differences in reaction time on blocks of tasks requiring switching and blocks with no switching. Inhibition is defined as the inhibition of a prepotent response and was measured by the Stroop and Simon tasks. A full description of each of these tasks has been previously published (Alexander et al., 2012). For each of these three components of executive function we created a composite score by transforming raw scores from each task into z-scores based on the sample distribution at Time 1 and averaging the two relevant z-scores.

Self-report questionnaires.

Self-report questionnaires included the UCLA loneliness scale (Russell, 1996) to assess loneliness, the Medical Outcomes Study Social Support Survey (Sherbourne & Stewart, 1991) and the Lubben Social Network Scale 18-item version (Lubben & Gironda, 2004) to assess social support, and the Social Provisions Scale (Cutrona & Russell, 1987) to assess social support and social integration.

Intervention.

Facebook Training. Older adults randomized to the Facebook training group attended three 2-hour Facebook training sessions over the course of one week. We licensed the use of a Facebook training protocol developed by the OASIS Institute, an evidence-based program developed to teach adults over age 50 computer skills, called The Facebook Starter Kit (OASIS Institute, 2012). The training sessions were lead by an instructor and several tutors, and took place in a computer lab classroom (one in each study location) where each participant worked on an individual computer. Participants completed homework assignments between classes and the instructor monitored progress to ensure that everyone acquired a working knowledge of how to use the website.

During the training course each person was linked to all of the other study participants in their group. Participants were asked not to search for members of other social networks or to connect with anyone who was not a participant in the study using Facebook. Members of the research team checked the privacy settings for each participant to ensure anyone outside of the intervention was unable to search for, view the profile of, or friend any member of the study group. After the training course, participants were asked to log on to Facebook once a day at home and post at least one status update and one comment for the next 7 weeks. A "status update" is a message that a Facebook user posts for their friends to read on Facebook. A comment is a message that a Facebook user posts in response to another user's status update. These two kinds of posts thus engaged participants in a back-and-forth dialogue.

Control Groups. Those assigned to the waitlist control group received no contact until the 8-week intervention period had lapsed. We also included an active control group focused on cognitive engagement without social interaction that learned to use a private online diary website, Penzu.com. Those assigned to the Online Diary group completed the same general procedures as the Facebook group, but instead of learning how to use Facebook they learned how to use Penzu. Because the OASIS Institute did not have a protocol developed to teach the use of Penzu, the researchers developed a training protocol that was distributed to participants in this group. After a one-week training course, participants in the Online Diary group were asked to log on to the website at home for the same amount of time (once a day) and in a similar manner (writing diary entries that were two to three sentences long) as the Facebook group for the next 7 weeks. In this way, using the online diary was similar to using Facebook, except that writing was not shared with other participants; there were no responses to other's postings, and thus no online social interaction.

Results

Procedural results

Training Results.

All participants attended at least two out of the three training classes. At the end of the training classes all participants in both the Facebook and Online Diary groups endorsed the items "I feel confident using Facebook/Penzu" and "I learned more about how to use Facebook/Penzu in this course" as "agree" or "strongly agree."

Website Use.

In order to determine compliance, we examined the total number of posts created by each participant divided by the number of total posts required. The Facebook group was instructed to make two posts per day (one status update and one comment), or 98 total posts. The Online Diary group was instructed to make one post per day, or 49 total posts, but their posts were to be two to three sentences long. All participants who completed the assigned number of posts or more were scored as 100% compliant. Number of total posts was examined in separate analyses below. There were no significant differences in compliance rates between the Facebook and Online Diary groups, Facebook Mean (SD) = 76.6% (23.94), Online Diary Mean (SD) = 80.52% (33.28), $t(25) = -.35$, $p = .73$ or between the Green Valley retirement community and Tucson community groups, Green Valley Mean (SD) = 71.61% (33.17), Tucson Mean (SD) = 88.50% (15.76), $t(22.78) = -1.77$, $p = .09$.

There was one participant in the Waitlist group who endorsed knowing more information about Facebook at Time 2 on a self-report measure. Because this may have indicated that the participant started to use Facebook during the waitlist period, the participant's data were removed from further analyses. Demographic characteristics, including group differences, of the subsamples were identical to the larger sample described above.

Cognitive Outcome measures

Each outcome measure was submitted to a 2 (Time) x 3(Group) mixed ANOVA. The effect of interest was the interaction showing differential changes from Time 1 to Time 2 as a function of group. To account for possible baseline differences in performance, this analysis was followed by an ANCOVA on the change scores, (Time 2 – Time 1) with Time 1 performance as a covariate.

Executive Functions.

For the composite measure of updating there was a significant Time x Group interaction, $F(2,36) = 5.29$, $p = .01$ (see Supplementary Table 1 for results of individual updating tasks). As shown in Figure 1, participants in the Facebook group showed a significant increase in performance from Time 1 to Time 2 compared to no significant change in the other two groups: Facebook, $t(12) = 3.56$, $p = .004$, Online Diary, $t(13) = 1.11$, $p = .29$, and Waitlist, $t(12) = -1.07$, $p = .30$. There were also no significant group differences at baseline, $F(2,36) = .26$, $p = .77$. Analysis of covariance (ANCOVA) on the change score also indicated a significant main effect of Group, $F(2,32) = 5.55$, $p = .008$, affirming that baseline differences were not driving the aforementioned interaction.

In order to examine the relation between how often a participant used Facebook and improvements in updating, we computed the correlation between number of Facebook posts during the study and changes in updating. For this analysis, we included all participants, including those with low compliance rates, in order to avoid problems of restricted range.

Although not significant with the small number of participants, there was a medium-sized correlation between number of posts and changes in the updating composite in the Facebook group, $r(13) = .477$, $p = .10$. There was no relation between number of posts and updating in the Online Diary group, $r(13) = -.213$, $p = .48$.

There was also a significant Time x Group interaction for the composite measure of shifting that represented global shift costs, $F(2,33) = 4.95$, $p = .013$ (see Supplementary Table 2 for results of individual global shift tasks). As shown in Figure 2, this interaction was driven by a significant improvement in the Waitlist group only ($t(11) = 2.86$, $p = .016$), which appeared to be a function of baseline differences. Consistent with this conclusion, an ANCOVA of change scores using baseline performance as a covariate demonstrated only a trend towards significance, $F(2,32) = 3.034$, $p = .06$. Analyses of the inhibition composite did not yield any significant differences.

Speed of Processing.

Trail Making Test. We examined completion time for Trails A and B to look at speed of information processing, and a ratio between Trails A and B to look at differential effects of the shifting component in Trails B. Performance is presented in Figure 3. A 2x3 mixed ANOVA revealed a significant Time x Group interaction, $F(2,37) = 3.52$, $p = .04$, for Trails B performance. A similar, but non-significant, pattern was observed in Trails A performance, $F(2,37) = 2.59$, $p = .09$. Post-hoc paired samples t-tests revealed that on Trails B, only the Facebook group showed a significant improvement in performance following the intervention, $t(13) = 2.74$, $p = .017$. The Online Diary group showed a non-significant improvement, $t(12) = 1.39$, $p = .19$, and the Waitlist group showed a non-significant decline $t(12) = -1.23$, $p = .24$. Although the interaction was not significant on Trails A, the overall pattern of effects was similar. An ANCOVA of change scores revealed similar results, suggesting these changes were unlikely due to baseline differences (Trails B, $F(2,36) = 4.13$, $p = .024$; Trails A $F(2,36) = 3.26$, $p = .05$). Analysis of the difference and ratio scores between Trails A and B showed no main effects of time or group and no interaction, suggesting that the executive component of Trails B was unaffected by the intervention. There were no differential changes across groups from Time 1 to Time 2 on any of the other cognitive measures.

Social Outcome Measures.

We examined the UCLA Loneliness scale, the Medical Outcomes Study (MOS) Social Support Survey, Lubben Social Network Scale, and the Social Provisions Scale to assess different aspects of social connections and perceived support. There were no significant changes from Time 1 to Time 2 in any of the groups on the social support measures.

Discussion

Results of this feasibility study revealed significant improvements in the Facebook group, compared to the Online Diary and the Waitlist control groups, on a composite measure of updating, which reflects the manipulation and maintenance of information in working memory. There was also a medium-sized, although not significant, positive correlation between the number of Facebook posts and improvements in updating performance in the Facebook group, while there was no relationship between number of diary posts and changes in updating in the Online Diary group. Further, there were no differential benefits for the Facebook group in any of the other executive function or memory tests. These results suggest a specific effect of the use of Facebook on an executive function associated with complex working memory, an effect that was enhanced with greater use of Facebook. There were also increases in processing speed post-intervention as measured by the Trail Making Test, and although the difference between Time 1 and Time 2 was only significant in the Facebook group, the Online Diary group showed a non-significant parallel improvement in speed of processing at Time 2. We suggest that these improvements in the Trail Making Test may reflect improved visual scanning and selection processes, which are required by both Facebook and Online Diary tasks to find and select relevant icons among several distractors.

There were no other significant differential improvements over time in either of the training groups relative to the waitlist group on any of the other cognitive measures. These results confirm our hypotheses that learning and using Facebook may impact executive function and processing speed. In addition, unlike some other recent studies (e.g., Chan et al., 2014; Park et al., 2014), we did not find improvements in episodic memory. We suggest that, in the present study, engaging in interactive activities on Facebook may have involved primarily the executive function of updating with lesser need to engage the processes of shifting and inhibition. Generated content from others appears on the news feed as it is posted, requiring participants to filter through these changes while maintaining their current goal and then responding appropriately. Reading and responding to the Facebook newsfeed almost certainly requires updating in working memory.

These findings appear to be consistent with the view that cognitive training is generally domain-specific, namely that training in one domain does not transfer to another domain. At the same time, however, the findings show that specific processes trained in the context of one task may transfer to different tasks that require the use of the same processes, in this case from the real-world Facebook task to highly controlled laboratory tasks. Our findings are also consistent with those of Park et al. (2014), who suggested that social interaction in the context of cognitive training might provide domain-specific cognitive benefits. The training in that study required the learning and memory of large amounts of new information that ultimately benefited episodic memory. The task in our study appears to require executive functions associated with working memory, which led to improved performance on the executive function tasks of updating.

Based on previous findings, we hypothesized that cognitive benefits may be attributable to social interaction. However, contrary to expectations, we failed to observe significant changes on any of the social support, social integration, or loneliness questionnaires. This may have been because our participants, for the most part, were already socially engaged. Although the majority lived alone, the participants, particularly in the Green Valley cohort, had many social activities available to them. Only two participants in the study had scores on the Lubben Social Network Scale suggesting they may be at risk for loneliness and only three participants scored in a range suggestive of loneliness on the UCLA Loneliness Scale. Additionally, the design of the study allowed participants to use Facebook to connect only with other research participants and not with real life friends or family. Some people may have been unable to form meaningful bonds with other research participants despite their daily interaction online, or these bonds may have been insufficient to elicit changes on self-report measures of social support, social integration, and loneliness. Nevertheless, during the 8-week intervention period, new relationships were formed and maintained among participants in the Facebook group. In fact, several people used Facebook to arrange face-to-face meetings and reported that they planned to continue those friendships after the conclusion of the study. Those in the Facebook group were therefore truly engaged in new social interactions during the course of the study. Thus we suggest that the findings are consistent with the conclusion that the increased social engagement that occurred in the Facebook group but not in the Online Diary group may have contributed to the improvements in updating that we observed.

For individuals who may be experiencing cognitive decline or have other problems that limit their participation in regular social engagement, such as hearing loss or physical disabilities, online social engagement may provide a way for them not only to stay socially connected and increase their social support systems, but also to continue to challenge their cognitive function as they age. The present work establishes feasibility of this intervention with a group of healthy older adults, with high adherence rates and no dropouts due to lack of interest (only health reasons). Although this study is limited by small sample size, the results are promising and suggest that further larger-scale studies are warranted. This work will add to a growing body of literature suggesting there are various activities that older adults can participate in that may help them to maintain or improve specific areas of cognitive function.

Limitations

There are several limitations to the present study. First, there was a small sample size and these results need to be replicated with a larger sample. Second, because of this small sample size and people's varying schedules, participants were only quasi-randomized. Additionally, it would have been beneficial to control for participation in other social, cognitive, or physical activity engagement with a previously validated measure. Finally, as already noted, many people may have already been socially engaged. Nevertheless, we think the findings are provocative and suggest that interventions to increase cognitively challenging social interactions among older adults may provide important cognitive benefits.

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Tables

Table 1 Demographic characteristics of participants that completed the study

Group Subgroup	Age M (SD)	Education M (SD)	Gender (% male)	MMSE M (SD)
Facebook, n =14	80.00 (7.34)	16.29 (1.94)	36% (n = 5)	28.86 (1.17)
Community, n = 6	73.17 (3.49)	16.17 (1.60)	17% (n = 1)	29.50 (0.84)
Retirement, n = 8	85.13 (4.61)	16.38 (2.26)	50% (n = 4)	28.38 (1.19)
Online Diary, n = 13	78.38 (7.32)	16.69 (1.93)	31% (n = 4)	28.85 (1.07)
Community n = 5	76.80 (8.61)	16.80 (2.10)	0% (n = 0)	29.00 (1.00)
Retirement, n = 8	79.38 (6.82)	16.63 (1.85)	50% (n = 4)	28.75 (1.16)
Waitlist, n = 14	79.29 (6.76)	16.29 (2.09)	21% (n = 3)	28.85 (1.14)
Community, n = 6	77.33 (6.50)	17.50 (1.76)	17% (n = 1)	28.50 (1.52)
Retirement, n = 8	80.75 (5.57)	16.13 (2.01)	25% (n = 2)	29.14 (0.69)

Figures

Figure 1. Changes on Updating composite z-score. Error bars represent standard errors.

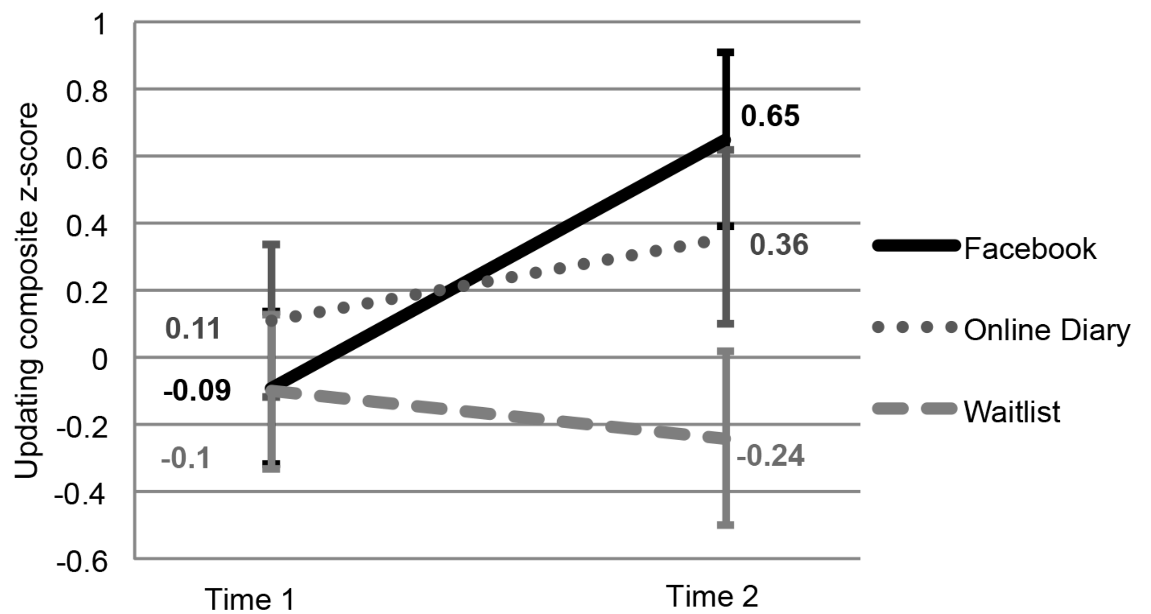


Figure 2. Changes on Global Shift composite z-score. Error bars represent standard errors.

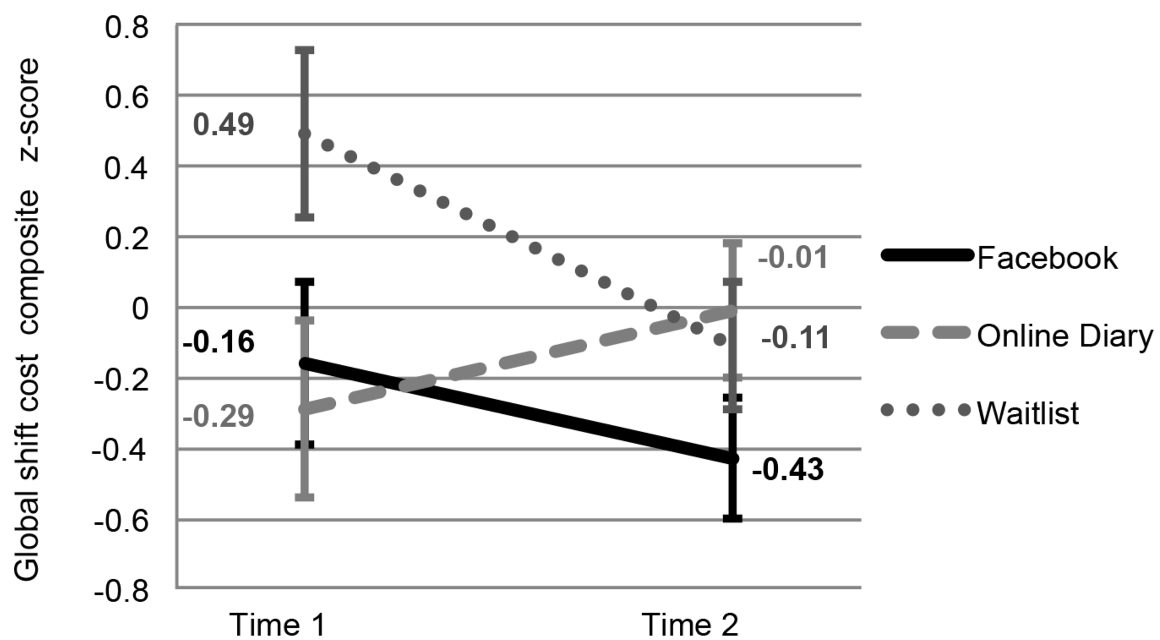
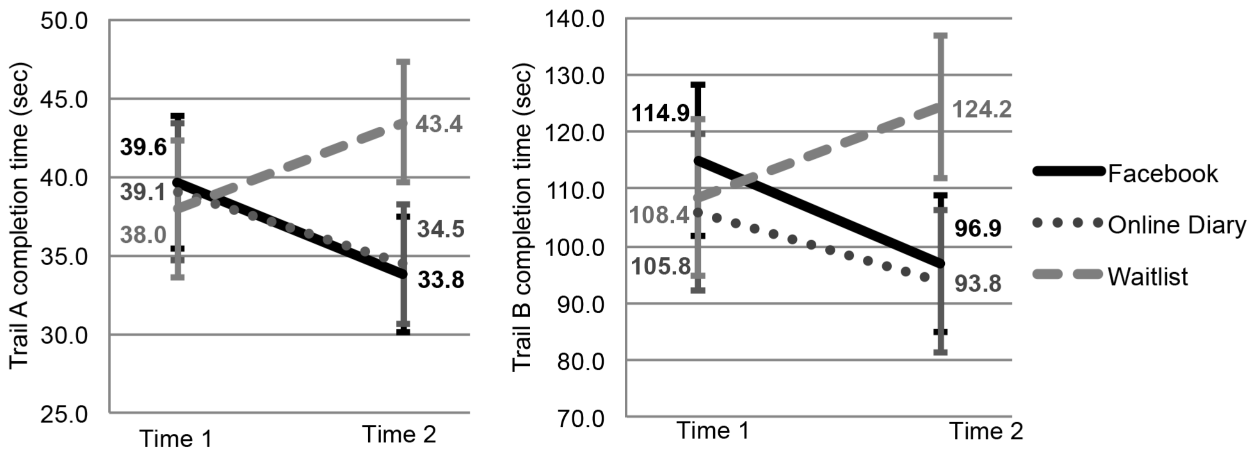


Figure 3. Changes on Trails A and Trails B performance. Error bars represent standard errors.



Supplementary Tables

Supplementary Table 1 Performance on the Letter Memory and Keep Track tasks

	Facebook M (SD)		Online Diary M (SD)		Waitlist M (SD)	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Letter Memory***	67.23 (11.28)	69.77 (10.51)	68.00 (13.64)	68.38 (13.92)	66.92 (10.14)	59.23 (10.08)
Keep Track*	17.62 (2.84)	21.15 (3.44)	18.54 (2.30)	19.85 (3.69)	17.62 (3.28)	18.77 (2.71)

Notes: Scores are number correct out of 108 for Letter Memory and number correct out of 30 for Keep Track. One participant in the Facebook group refused to complete the Keep Track task at baseline and so data were removed from analyses. Time x Group Interaction: * = p<.10 ** = p<.05, *** = p<.01.

Supplementary Table 2 Global Shift Costs on the Number-Letter and Local-Global tasks

	Facebook M (SD)		Online Diary M (SD)		Waitlist M (SD)	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Number-Letter Global Shift	769.82 (231.63)	602.93 (252.37)	707.64 (554.00)	705.66 (452.79)	1036.67 (450.79)	786.41 (418.88)
Local-Global Global Shift*	1458.93 (523.27)	1326.66 (515.36)	1390.21 (541.05)	1793.96 (740.86)	2095.49 (1149.33)	1454.34 (732.82)

Notes: Individual task scores are in milliseconds. Due to errors in the computer capturing responses on both tasks, there were a total of 13 Facebook, 11 Online Diary, and 12 Waitlist participants included in these analyses. Time x Group Interaction: * = p<.10 ** = p<.05, *** = p<.01.