Resilience through social connectedness and cognition: Is theory of mind a form of enrichment for older adults?

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Abstract

Objective. Social connectedness is a modifiable lifestyle factor that delays age-related cognitive decline. Using cross-sectional, longitudinal, and experimental approaches, we examined whether theory of mind – inferring what others think or feel – is a potential mechanism underlying this relationship.

Methods. In Study 1, 305 community-dwelling older adults participating in two different, but related, studies completed comprehensive measures of general cognition, theory of mind, and personal social networks. We examined whether theory of mind mediated the relationship between older adults' social connectedness and cognition. 110 of those participants completed follow-up social network interviews and cognitive assessments about 1.5 years later to determine whether baseline social connectedness and theory of mind predicted cognitive change. In Study 2, 55 other older adults completed a procedural discourse task targeting a close and distant network member. We predicted that higher theory of mind would be reflected through providing more details to distant, versus close, others, especially among older adults with larger, less interconnected, personal social networks.

Results. Results revealed that theory of mind accounted for 32% of the relationship between social connectedness and overall cognition, even when covarying age, gender, education, and a control task. The effects were particularly robust for episodic memory and language. Longitudinal analyses replicated this pattern. In Study 2, older adults with larger, less dense social networks provided more details to distant versus very close network members.

Discussion. Together, these results suggest that theory of mind may provide the mechanism through which social connectedness confers cognitive resilience associated with slower cognitive decline.

Keywords: Theory of mind, Social networks, Social bridging potential, Cognitive reserve

Social connectedness has been widely implicated as a modifiable lifestyle factor that may delay the progression of Alzheimer's disease by providing cognitive enrichment (Amieva et al., 2010; Hamilton et al., under review; Perry, McConnell, Coleman, et al., 2022). Because social interactions are the most cognitively complex tasks humans perform (Cacioppo & Hawkley, 2009), novel and stimulating social interactions are a potential source of cognitive enrichment (Hamilton et al., under review; Kelly et al., 2017; Perry, McConnell, Coleman, et al., 2022). However, the specific cognitive, behavioral, or biological mechanisms through which social relationships provide enrichment are not well-understood. The current study examines whether theory of mind – the ability to infer the mental and emotional states of others –is the mechanism underlying this relationship.

Longitudinal and large-scale cross-sectional studies have shown that the size and structure of older adults' personal social networks are associated with preserved cognitive function (Amieva et al., 2010; Hamilton et al., under review; Perry, McConnell, Coleman, et al., 2022). Recent work has begun to examine the core features of personal networks (e.g., size, structure, composition) holistically to better capture their complexity (Hamilton et al., under review; Krendl et al., 2024; Peng et al., 2021). A key finding of this work has been to dissociate networks along two key dimensions: social bridging or social bonding potential (Claridge, 2018). Networks with social bridging potential – which are larger, more loosely connected, and generally contain less close relationships – preserve cognition, whereas social bonding networks – which are small, tightly connected, and supportive – do not (Hamilton et al., under review; Perry, McConnell, Coleman, et al., 2022). Social bridging potential is thought to provide cognitive enrichment through exposure to novel social stimuli and requiring processing of complex social information (Perry, McConnell, Coleman, et al., 2022). A recent study with more than 400 community-dwelling older adults found that their personal social networks varied in their respective bridging and bonding potential, with more social bridging potential predicting greater cognitive resilience over time (Hamilton et al., under review). Here we examine the novel prediction that theory of mind, a modifiable social cognitive ability (Roheger et al., 2022), mediates the relationship between social bridging potential and cognition.

Theory of mind plays a key role in facilitating social interactions (Bishop-Fitzpatrick et al., 2017). Though theory of mind declines over the lifespan (Henry et al., 2013), several recent interventions have shown that older adults' theory of mind performance can be improved through training, motivation, and/or mindset shifts (Krendl & Hughes, 2024; Roheger et al., 2022; Zhang et al., 2018). There are two key possibilities that explain why theory of mind might be a form of cognitive enrichment in networks with social bridging potential. The first is that it may stimulate general cognition. Theory of mind engages diverse cognitive resources, such as maintaining multiple pieces of information in working memory and inhibiting the incorrect prediction (Fernandes et al., 2021; Laillier et al., 2019). However, recent work has shown that, even when controlling for general cognition (executive function, episodic memory), older adults' theory of mind performance was uniquely associated with social bridging potential (Krendl et al., 2024).

The second possibility is that networks with social bridging potential stimulate theory of mind. Recent theories on social cognitive aging suggest that relatively unfamiliar social interactions may engage more social cognitive effort than familiar interactions (Henry et al., 2023). Thus, navigating networks with social bridging potential may engage more social cognitive effort because these networks are comprised of relatively less familiar connections. Moreover, consistent with developmental theories about theory of mind acquisition (Hughes & Leekam, 2004), rich social environments, such as those associated with social bridging potential, may influence the quality of theory of mind. Indeed, recent experimental work has shown that older adults' theory of mind improves with practice (Krendl & Hughes, 2024; Roheger et al., 2022). Importantly, recent work suggests that theory of mind performance is positively related to having social bridging potential, but not social bonding, networks (Krendl et al., 2022; Krendl et al., 2024). Because theory of mind engages similar neural mechanisms as autobiographical memory (Spreng & Grady, 2010), stimulating theory of mind may be protective for general cognition. Together, these findings suggest that theory of mind may be the mechanism by which social bridging potential confers resilience. However, an alternate possibility is that having better theory of mind promotes having greater social bridging potential. Such an interpretation would be consistent with recent theories suggesting that maintaining social bridging potential might demand greater use of theory of mind (Hall & Davis, 2017; Huxhold et al., 2022). We directly explore these possibilities across two studies.

Study 1 leveraged a large (N=305) cross-sectional sample comprised of cognitively normal older adults and a sample of independently-living older adults at high-risk for Alzheimer's disease to determine whether theory of mind performance mediated the relationship between social bridging potential and cognition. A subset of these participants (N=110) completed a longitudinal follow-up to dissociate the directionality of this relationship. Specifically, we used a longitudinal lead-lagged approach to determine whether baseline social bridging potential predicted future theory of mind performance and cognitive performance (about 1.5 years later), or whether baseline theory of mind performance predicted future social bridging potential and cognition. Prior work longitudinal work has shown that older adults experience cognitive decline within this time frame (Salthouse, 2009), regardless of their education levels (Zahodne et al., 2011), making the 1.5 year follow-up appropriate to detect change. Study 2 used an experimental manipulation to determine whether older adults with networks with social bridging potential engage more theory of mind when interacting with distant versus close social connections. Together, these studies are poised to provide the first evidence that social cognitive abilities may be a form of cognitive enrichment that buffer against cognitive decline.

Study 1

Method

Participants

For the cross-sectional mediation, a sample size of 150–200 was needed to provide adequate power for detecting a significant indirect effect with a moderate effect size (i.e., $\beta \approx .25–.30$) using the above Monte Carlo resampling parameters (Hayes & Scharkow, 2013). Cross-sectional were thus collected from a total of 305 older adults (M_{age} = 73.5, *SD* = 6.64; 63% female). Longitudinal mediation modelling requires smaller sample sizes estimates as time-invariant, between-person heterogeneity is controlled (Pan et al., 2018). Using the aforementioned effect size estimates and accounting for two observations for all participants, a sample size of 94-130 would be required (Pan et al., 2018). To ensure sufficient power, we leveraged longitudinal data from 110 of the community-dwelling participants (M_{age} = 74.80, *SD* = 6.30).

For the cross-sectional comparisons, we recruited two different samples of cognitively normal older adults who were participating in related, but distinct, studies examining the effects of personal social networks on cognition. One of these samples, community-dwelling older adults (*n* = 205), were recruited from southern Indiana communities. For this sample, exclusion criteria included being under the age of 60, diagnosed with cognitive impairment, or unable to pass a six-item cognitive screener administered over the phone (Callahan et al., 2002). A subset of these older adults (*n* = 110) participated in a longitudinal follow-up for which they had been specifically recruited (see details below). The second sample was comprised of 118 participants who were recruited through the Indiana Alzheimer's Disease Research Center (ADRC).[1] These individuals were independently-living, over the age of 55, and referred to the ADRC by clinicians, self, or family. For this sample, participants with advanced cognitive impairment (i.e., Montreal Cognitive Assessment scores < 10), a history of psychiatric disorders or traumatic brain injuries, concurrent cancer treatment, and developmental disabilities were excluded.

Cognitive data were not available on 18 of these participants, so they were excluded. The two cohorts did not differ in gender or educational background, but the inclusion of both groups yielded a more racially diverse sample (see Table 1 for demographics). Cross-sectional analyses controlled for cohort.

To better interrogate causality, we examined the data from a subset of participants (n = 110) from the larger community sample who had been initially recruited for a longitudinal study. These participants completed all measures described below over two sessions about 1.5 years apart ($M_{difference}$ = 1.62 years, SD = .16; minimum =1.37, maximum = 2.65 years). Other than being recruited for a longitudinal study, the recruitment strategy for these participants did not differ from those used for the community sample. The remaining participants in the larger cross-sectional sample were comprised of the ADRC sample, who has been recruited for a different, but related, study, and thus did not complete the follow-up measures. The longitudinal sample was highly educated with 94 people having a college degree or higher. Moreover, 96% of the sample was White (n = 103). This research received Institutional Review Board approval prior to data collection.

Materials

Social Network Interview

Egocentric social network data were collected using a semi-structured interview through an expanded PhenX Social Network Battery (Hamilton et al., 2011) administered by trained research assistants. The interview is rigorous, comprehensive, and has been validated in samples of older adults who are cognitively normal and cognitively impaired (Perry, McConnell, Peng, et al., 2022). After gathering names of individuals that participants contacted in the past six months to discuss important and/or health matters, as well as the names of family members, coworkers, volunteers, neighbors, or anyone else that they see or talk to regularly (Perry et al., 2018), data were collected for each relationship including the type (e.g., kin, friend, co-worker), strength, frequency of contact, and closeness (Perry, McConnell, Peng, et al., 2022). Additional data were collected to assess closeness among network members. See Supplemental Table 1 for all network measures collected. Network-level measures were created by aggregating across all people named in a participant's network.

Cognitive Function

The neuropsychological battery from the Uniform Data Set 3.0 (Weintraub et al., 2018) was used to examine processing speed, executive function, episodic memory, and language. The UDS uses multiple verbal and non-verbal measures to assess cognition across multiple domains. It is a comprehensive and widely-used measure of cognition in aging research that has been validated using latent factorizations from thousands of older adults across the United States (Kiselica et al., 2020). Processing speed was measured using the Digit Symbol test and reflectively transformed completion time from Part A of the Trail Making Test. Executive function was measured using Digit Span Forward and Backward tests along with standardized residuals from regressing Part A of the Trail Making Test completion time on Part B completion time to remove shared variance (MacPherson et al., 2017; Salthouse, 2011). Episodic memory was computed using the delayed recall trials from the Craft Story 21, Rey Auditory Verbal Learning test, and Benson Complex Figure Copy. Language was comprised of two verbal naming tests and the Multilingual Naming Test. These groupings have been evaluated and confirmed using latent factorizations garnered from thousands of older adult subjects across the United States (Kiselica et al., 2020) and used in previous work, e.g., (Krendl et al., 2024).

All cognitive data were standardized prior to creating composites (Crane et al., 2023). Fit statistics showed excellent fit for this latent model (Comparative fit and Tucker-Lewis fit index > 0.95 cut-point, RMSEA < 0.08). See Supplemental Table 2 for means for each variable by group.

The Montreal Cognitive Assessment (MoCA) (Nasreddine et al., 2005) was used in our analyses as a conceptual replication of general cognitive function that is empirically less precise. This brief screening tool for cognitive impairment includes tests of memory, visuospatial ability, executive functions, attention, language, and orientation to time and place. Scores range from 0-30 with higher scores indicating higher cognitive function.

Theory of Mind

To measure theory of mind, participants watched clips in sequential order from an episode of either *Nathan for You®* or *The Office®*; prior work has validated these tasks as theory of mind measures (Krendl, Hugenberg, & Kennedy, 2024). The ADRC participants and 142 of the community sample completed *The Office* task, whereas the remaining 63 community participants completed the *Nathan for You* task. In *The Office* task, 25 sequential clips ranging from 9 to 55 seconds (M_{Length} = 29 seconds, SD = 9 seconds) were extracted from Season 1, Episode 4 ("The Alliance"). Following each clip, participants responded to 1 to 5 multiple choice questions (64 total). Correctly answering the questions required respondents to use contextual or nonverbal cues to make inferences about characters' internal states (e.g., beliefs, motivations, deception, emotions, and faux pas). There were nine questions pertaining to inferring beliefs (e.g., "What will Meredith think of having an ice cream cake?"), 10 questions related to detecting deception (e.g., "Why does Pam want to talk to Jim?"), 10 questions related to understanding the character's emotions (e.g., "How does Michael feel about the comment Meredith read?"), 10 questions pertaining to inferring the motivations of others (e.g., "Why does Michael suggest having an ice cream cake?"), and 10 questions related to detecting if a faux pas had occurred (e.g., "Was it inappropriate for Michael to suggest an ice cream cake?"). There were also 15 control questions that were factually related to what a character had said or done (e.g., "When is Meredith's birthday?"). The ADRC participants (N=100) completed a shortened version of *The Office* task. This task was comprised of 15 clips and 36 questions from the original task. See Supplemental materials for additional details.

The *Nathan for You* task was developed using Season 3, Episode 3 ("The "Antique Shop"), which was divided into 18 sequential clips ranging from 15 to 45 seconds (M_{Length} = 23 seconds, SD = 4 seconds). Following each clip, participants answered 2 to 6 multiple choice (63 total). There were 11 questions that measured belief inference (e.g., "Why does Emily think having bars nearby doesn't affect her business?"), 11 that measured deception detection (e.g., "Why does the antique shop advertise free pizza?"), 10 that measured understanding emotions (e.g. "How does Emily feel about having bars and nightclubs in the areas?"), 10 for inferring motivations (e.g., "Why does Nathan want Emily to extend her hours?"), and 10 for detecting faux pas (e.g., "Did someone say or do something inappropriate in this clip?"). An additional 11 control questions were also included (e.g., "What is the policy in Emily's store?").

At the conclusion of each task, task familiarity was assessed via self-report (ranging from 0 = *I have never seen the show before* to 10 = *I am very familiar with the show*). For *The Office* task 67% (N=67) of the ADRC sample reported never having seen the show before, whereas 61.3% (N=87) of the community sample reported never having seen the show before. These frequencies were not significantly different, $\chi^2(1,242) = .833$, $p = .361$. Overall, familiarity with *Nathan for You* was low; 96.8% (N=61) of the sample reported never having seen it (1 participant did not respond). This low frequency is consistent with other samples Krendl, Hugenberg, & Kennedy, 2024), and was the primary reason for using this show.

The full details of the tasks, reliabilities, and validations have been published previously (Krendl, Hugenberg, & Kennedy, 2024), but example questions and additional details are available in the supplemental section. See Supplemental Table 2 for performance means by group.

Analytic Strategy

Social bridging potential was calculated using a latent variable approach (Peng et al., 2021) that combined six measures from the social network interview: network size, effective size, diversity of social relationships, density, sole bridge status, and minimum tie strength. These measures were selected because they have been previously shown to be important predictors of cognition (Hamilton et al., under review; Perry, McConnell, Peng, et al., 2022). The latent variable approach adjusts for collinearity and measurement error inherent in personal social network data.

Network size was measured by the total number of people named (range: 4 to 54). Effective size conveys information about access to non-redundant information or stimulation. It was calculated by multiplying the number of connections between network members by 2, dividing by the total number of network members, and then subtracting that value from the network size (Peng et al., 2021). Social role diversity was measured via the number of different types of relationships (range 1 (only kin in the network) to 11). Network density was measured by taking the average closeness between all network members (ranging from 0, do not know, to 3, very close), where higher numbers indicate greater density. Sole bridge status was a binary variable such that networks with no isolated alters (i.e., someone that only the participant knows) were coded as 0 and networks with at least one such alter were coded as 1. Lastly, minimum tie strength ranged from 1 (weak) to 10 (very strong), and was calculated based on the weakest tie reported. See Supplemental Table 2 for means for each variable by group. Social bridging potential was estimated using previously defined factorization structures (Hamilton et al., under review; Krendl et al., 2024) that were highly connected to cognitive outcomes in cross-sectional and longitudinal analyses. For a validation of this approach, see Supplemental Materials for additional details.

Table 2 presents the correlations between the key variables in the analyses. Mediation analyses were tested via structural equation modelling in Stata SE 18.0, followed by the -medsem- package (Mehmetoglu, 2018). Effects were evaluated for robustness by using 1,000 bootstrapped samples via Monte Carlo resampling. Covariates on all paths included age, gender (0 = *Male*; 1 = *Female*), education, and two binary variables for recruitment cohort (0 = *Community*; 1 = *ADRC*) and task (0 = *Nathan for You*; 1 = *The Office*). The recruitment cohort variable was included to address potential concerns associated with selectivity bias. By controlling for cohort, the cross-sectional results become within-sample comparisons in which study is held constant. Task-based covariates (i.e., familiarity, theory of mind control questions) were regressed only onto theory of mind.

Results

As reported in Table 1, we did not observe differences in latent cognition despite small but statistically significant differences in MoCA scores. Theory of mind and social bridging potential showed slight group differences which were typified by poorer theory of mind in the ADRC cohort and smaller, stronger, and more dense social networks (see Supplemental Table 2 for all means). Recruitment cohort was included as a covariate in the model.

For the omnibus model testing global cognition as a latent factor, the α-path was significant and in the expected direction with social bridging potential positively predicting theory of mind ($\beta = .11$, SE = .05, p =.038). The direct path between social bridging potential and latent cognition was evident in a simple bivariate correlation ($r = .25$, $p < .001$) and when controlling for covariates ($\beta = .18$, p =.003). As expected, social bridging potential was significantly correlated with all cognitive outcomes (all *r*s > .15, *p*s < .05). Most importantly, theory of mind was a significant mediator between bridging potential and cognition with an indirect effect (IE) that explained 32% of the effect of bridging potential on cognition (*IE* = .051, *SE* = .025, $z = 2.02$, $p = .043$, bootstrapped 95% CIs [.004, .100]). The effect replicated using the less nuanced MoCA scores as an outcome (*IE* = .046, *SE* = .023, $z = 1.97$, $p = .049$, bootstrapped 95% CIs [.004, .094]) and explained 36% of the effect of bridging potential on MoCA scores.

Domains of cognition were then tested as outcomes. Results from these analyses and the global tests are visualized in Figure 1; see the online supplement for full tables. Theory of mind significantly mediated 55% of the effect of social bridging potential on episodic memory (*IE* = .051, *SE* = .025, z = 2.00, $p = .045$, bootstrapped 95% CIs [.004, .102]). It marginally mediated bridging for executive function (*IE* = .037, *SE* = .019, $z = 1.93$, $p = .053$, bootstrapped 95% CIs [.003, .077]) and language (*IE* = .027, *SE* = .014, $z = 1.89$, $p = .058$, bootstrapped 95% CIs [.002, .058]). This cross-sectional evidence presents the possibility that theory of mind may transmit the protective effects of social bridging potential in general cognition and, more specifically, episodic memory. These models all retain their significance and experience only minor changes in magnitude if the 100 cases from the ADRC are omitted[1], speaking to the robustness of these findings.

We examined longitudinal relationships by modeling the association between social bridging at baseline and theory of mind and cognitive function at follow-up for 110 participants who returned to complete a second testing session. To preserve analytic power, we reduce the number of covariates across the structural equation model for the longitudinal analyses by only including age, education, and task familiarity given their significant results in the cross-sectional models (see online supplement for full tables). There was evidence of significant time-lagged mediation for episodic memory (*IE* = .09, *SE* = .04, *z* = 2.36, *p* = .019, bootstrapped 95% CIs [.03, .17]) and MoCA scores (*IE* = .09, *SE* = .04, *z* = 2.18, *p* = .03, bootstrapped 95% CIs [.02, .17]). Reducing the direct effect of social bridging potential to non-significance in both models, theory of mind at follow-up accounted for 60% and 93% of the variance explained by social bridging potential in episodic memory and MoCA scores, respectively. Figure 2 provides visualizations. There was no evidence of lagged mediation effects for latent cognition, processing speed, executive function, or language (all *IE*s < .03, all *z*s > 1.30, all *p*s > .10).

An alternative pathway holds that better theory of mind may facilitate the cultivation and maintenance of bridging social networks (i.e., reverse causation), which in turn improve cognitive function. To address this possibility, we ran sensitivity analyses with bridging potential at follow-up as the mediator and theory of mind at baseline. All indirect effects were non-significant (all *p*s > .10). Crucially, this was the case despite a significant association between theory of mind at baseline and social bridging potential at follow-up (β = .26, SE = .11, *p* = .014), as well as a significant association between theory of mind at baseline and follow-up episodic memory (β = .20, SE = .07, *p* = .007) and MoCA scores (β = .22, SE = .06, *p* = .001). This provides support that the positive association between social bridging potential and cognition, namely episodic memory, is proliferated through preserved theory of mind over time.

Study 2

Study 2 examined whether networks with social bridging potential stimulate theory of mind because they are include a few relatively unfamiliar connections, which may engage more social cognitive effort (Henry et al., 2023). Prior work has shown that older adults' theory of mind deficits may be attenuated in emotionally close interactions (Zhang et al., 2018). The social cognitive resource framework (Henry et al., 2023) posits that theory of mind becomes relatively automatic in highly familiar, close interactions, but more effortful in relatively unfamiliar, or less close, interactions. In this case, individual differences in theory of mind abilities could influence the efficacy with which older adults engage theory of mind during less familiar interactions. To test this, we used a procedural discourse task in which older adults described a procedural task (making a sandwich, navigating a grocery store) (Hilverman et al., 2016) to a close or distant network member. Theory of mind engagement was operationalized as the number of unique details provided to the close and distant network member. We predicted that older adults with networks with social bridging potential would engage theory of mind to a greater extent (provide more unique details) toward a relatively unfamiliar versus familiar network members.

We chose the procedural discourse task for several reasons: first, discourse ability is positively associated with theory of mind (Hale & Tager-Flusberg, 2005); second, semantic and procedural knowledge, such as that evaluated in procedural discourse tasks, are associated with theory of mind (Duval et al., 2011; Lecce et al., 2015); third, the task provided an objective measure of theory of mind engagement (number of unique details provided) that could be clearly quantified. If, as expected, more unfamiliar connections engage higher level of theory of mind than more familiar connections (Henry et al., 2023), then older adults with networks with social bridging potential would be expected to provide more unique details in their descriptions to distant than close network members.

Method

Participants & Materials

Using G*power (Faul et al., 2007), 55 participants were needed to achieve a small effect size (f^2 = .15) with .80 at a = .05 in a linear regression with two predictors (number of words, bridging potential). We recruited 55 participants (M_{Age} = 75.50 years, SD = 7.45; 52 White, 25 females); two participants were excluded for not complying with task instructions. Participants completed the social network interview and *Nathan for You* theory of mind tasks described in Study 1. The social network interview was always completed first. A subset of participants also completed the UDS.[2] See Supplemental Materials for additional details.

Participants were asked to describe a typical event to a close or distant network member. These individuals were selected from participants' social network interviews using relationship strength, closeness, and frequency of contact (see Supplemental Table 1). Close network members were individuals with whom the participant either had high relationship strength (1=not strong, 10 = strongest), and/or a "very close" relationship with frequent (e.g., "often") contact. Distant network members either had the weakest relationship strength, and/or a "not very close" relationship with low ("hardly ever") contact frequency.

The selected names were populated into a procedural discourse task in which participants described how to make their favorite sandwich and how to shop in their favorite grocery store (see Supplemental Materials for wording). They had five minutes to respond to each prompt. This task was modified from other work (Hilverman et al., 2016). Prompt type and network member closeness (close, distant) were fully counterbalanced within-subject. Two independent raters who were blind to all hypotheses identified the unique details in each of the subsequent passages (see Supplemental Materials for details). Reliability between the two rates was excellent (Cronbach's a = .98), and ratings were averaged together for analyses.

Results

Overall, the number of the number of words written in the close (M = 90.60, SD = 38.05) and the distant (M = 84.21, SD = 38.96) prompts did not differ, $t(52) = 1.768$, $p = .083$, Cohen's $d = .243$, and the number of unique details provided in the close (M = 14.604, SD = 6.369) and distant (M = 14.415, SD = 6.807) prompts did not differ, $t < 1$, $p = .810$, Cohen's $d = .033$. See Supplemental Results for additional information.

We conducted a linear regression to determine whether older adults with greater networks with social bridging potential provided more details to the distant versus close network members. Due to the within-subject design, we created difference scores for the outcome (number of details provided) and control (number of words written) by subtracting close from distant for both variables. The overall model was significant, $F(2,52) = 4.83$, $p = .009$, $R^2 = .162$. As seen in Table 3, this was driven by the fact that social bridging potential predicted providing more details in the distant than the close prompt (ß = .362, $p = .007$). We repeated the regression with the difference in relationship strength replacing bridging potential; this model was not significant, $F(2,52) = 1.01$, $p = .372$, $R^2 = .039$.

General Discussion

The results of this study demonstrated that the benefits of social connectedness to older adults' cognitive function may be transmitted through theory of mind. This finding is particularly important because theory of mind is modifiable, therefore making it an important potential intervention target to slowing the progression of cognitive decline. Moreover, identifying a cognitive mechanism through which social bridging potential affects general cognition is critical for informing development of effective social network interventions (i.e., what kinds of interactions would be most beneficial to older adults' cognition).

Prior work has shown that older adults' theory of mind can be improved with training (Krendl & Hughes, 2024; Roheger et al., 2022; Zhang et al., 2018). For example, in a randomized control trial, older adults who had completed a conversation-based theory of mind training (Lecce et al., 2015) showed improved theory of mind relative to older adults who completed an active control task (Cavallini et al., 2021). Another study found that manipulating social closeness (e.g., with an experimenter) also improved older adults' theory of mind performance (Zhang et al., 2018). These findings present promising avenues for future research, particularly given the relevance of theory of mind to older adults' overall cognitive function.

Our finding that theory of mind mediated the relationship between social bridging potential and episodic memory (cross-sectionally and longitudinally) and language (cross-sectionally only), but not other domains of cognition (e.g., executive function), may seem surprising given that all three domains are disrupted in healthy and pathological aging (Bäckman et al., 2005). One possibility for this finding is that there may have been underlying variability in the data that resulted in some, but not all, domains being significant. Consistent with this assertion, the confidence intervals in the cross-sectional analyses were overlapping for all domains of cognition (Figure 1), and episodic memory was correlated with all other domains of cognition (Table 2), see also (West, 1996). However, the fact that the longitudinal analyses also isolated the mediation effects to episodic memory points to the possibility that social bridging potential may play a unique role in preserving episodic memory. A recent longitudinal study found that contact with friends, which is a key element of social bridging potential, predicted relatively preserved memory over time (Sharifian et al., 2020). Given the central role that episodic memory decline plays in preclinical Alzheimer's disease (Bäckman et al., 2005), future longitudinal and neuroimaging work should further examine the role of social bridging potential on cognition.

At first glance, a potential limitation of these results is that theory of mind could mediate the relationship between social bridging potential and cognition because of its overlap with cognition, including executive function and episodic memory (Fernandes et al., 2021; Laillier et al., 2019). However, our analyses controlled for this potential confound by using control questions. Because our control questions mirrored the design of the theory of mind questions (e.g., they required participants to answer questions about clips they had just seen, follow the overarching plotlines of the respective show), they also engaged attention, episodic memory, and executive function. The key distinction between the control and theory of mind questions is that to correctly answer the theory of mind questions, respondents needed to use contextual or nonverbal cues to make inferences about characters' internal states. However, the control questions were factually related to what a character had said or done, so they did not engage theory of mind. This approach is similar to the types of control questions used in other theory of mind tasks (Saxe, 2006), and allows researchers to better isolate psychological processes unique to theory of mind.

There are several benefits to the theory of mind tasks used in the current work. First, because the plot and characters unfold over the course of the show, participants were required to integrate and update their knowledge in real-time, much as might unfold in a real-world interaction. These tasks address concerns that traditional theory of mind measures may lack specificity and ecological validity (Quesque & Rossetti, 2020). Second, by using two complementary, but distinct, measures of theory of mind, we demonstrated that the role of theory of mind in mediating the relationship between social bridging potential and cognition is not unique to performance on one specific task but is robust across measures.

There are several limitations to the current work. First, though we predicted that social bridging potential would elicit more theory of mind, it is also possible that greater theory of mind facilitated bridging potential. Such a finding would be consistent with recent theories suggesting that maintaining social bridging potential demands greater cognitive resources (Hall & Davis, 2017; Huxhold et al., 2022). To examine this, we modeled follow-up bridging potential as the mediator between baseline theory of mind and follow-up cognition. There was no evidence of significant mediation on any of the measures of cognition. The longitudinal results and Study 2 further support our claims. Specifically, Study 2 demonstrated that older adults with greater networks with social bridging potential engaged more theory of mind during procedural discourse with a distant versus close network member. However, it is also possible that there are bidirectional effects between social bridging and theory of mind. Future work should explore this possibility. An additional limitation of the current work was that our sample was not representative (Hamilton et al., 2022). The ADRC was more racially diverse than the community sample, but because performance across both theory of mind tasks is influenced by sociodemographic factors (Krendl, Hugenberg, et al., 2024), future work should strive to improve the representativeness of the samples to improve the generalizability and subsequent impact of these results.

In summary, our findings demonstrate that social connectedness may confer resilience against cognitive decline by providing social cognitive enrichment. This work contributes to a growing literature showing that theory of mind and general cognition are distinct, albeit overlapping, processes (Grainger et al., 2023; Krendl et al., 2024). Further clarifying the role of social cognition in cognition is an important future avenue of work, particularly because it is modifiable.

Author Notes

1. Excluding these participants does not change the directionality nor the significance of any reported mediation results for the cross-sectional analyses. Similarly, 12 of these participants were diagnosed with MCI/AD, and another 38 were undiagnosed. Excluding these individuals also does not change the directionality/significance of these results.
2. In Study 2, the UDS was not administered to participants whose social network interviews lasted more than one hour. Because these differences were systematic (typically individuals with longer interviews have larger social networks), we did not consider the cognitive data in Study 2.

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Conflict of Interest

None.

Data Availability

This study was not preregistered, but data, analytic methods and study materials can be found at: https://osf.io/e9bty/?view_only=98a1794c9f17408388a9841a45f45c48

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Table 1. Demographic and performance data for each cohort.

Variable	Community Sample (n = 205)		IADRC Sample (n = 100)		t or X^2	p	d
	Mean (SEM)	N	Mean (SEM)	N			
Age	73.63 (0.47)		73.16 (0.63)		.59	.28	.07
Gender					.69	.41	-
Male		79		34			
Female		124		66			
Race					50.80	< .001	-
White		197		75			
Black		2		25			
Asian		2		0			
Mixed / Other		6		0			
Education					7.83	.10	-
High school		9		1			
Some college		22		6			
College graduate		44		18			
Advanced degree or more		67		27			
MoCA	25.89 (0.19)		24.53 (0.35)		3.71	< .001	.45
Social Bridging Potential	.47 (.05)		-.178 (.12)		5.82	< .001	.711
Theory of Mind	.831 (.01)		.764 (.02)		4.05	< .001	.494
Cognitive Composite	.09 (.06)		.000 (.09)		0.87	.39	.111

Note. IADRC = Indiana Alzheimer's Disease Research Center. MoCA = Montreal Cognitive Assessment.

Table 2. Correlation matrix for all key variables across all samples (N=305).

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Social bridging potential	—						
(2) Theory of Mind	.334***	—					
(3) MoCA	.292***	.535***	—				
(4) Latent Cognition	.255***	.530***	.612***	—			
(5) Processing Speed	.153**	.302***	.341***	.552***	—		
(6) Executive Function	.176**	.348***	.384***	.713***	.125*	—	
(7) Episodic Memory	.215**	.536***	.586***	.774***	.274***	.392***	—
(8) Language	.151**	.256***	.376***	.725***	.296***	.349***	.396***

Note. MoCA = Montreal Cognitive Assessment.

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3. Hierarchical regression models for predicting the number of unique details provided to distant versus close network members.

Variables	# unique details (distant – close)			
	ß	*t*	ß	*t*
#words written (distant – close)	.175	1.272	.179	1.38
Social Bridging Potential	_	_	.362	2.80**
F	1.619		4.83	
R^2	.031		.162	
p	.209		.012	

Note. Outcomes (number of unique details) and number of words are presented as difference scores (distant minus close).

** $p < .01$.

Figure 1. A coefficient plot for the indirect effects of social bridging potential through theory of mind.

Notes. Shaded region represents 95% confidence interval for the indirect effect for latent cognition. Age, gender, education, recruitment cohort, task familiarity, task type (*Office* or *Nathan for You*), and performance on the non-theory of mind control questions were covaried.

Alt Text:

Figure 2. Longitudinal mediation results for (A)episodic memory and (B) Montreal Cognitive Assessment (MoCA) scores.

Notes. Standardized regression coefficients are reported for each path, including the auto-regressive path from baseline scores on each outcome variable. Age, education, recruitment cohort, and task familiarity were covaried.

Alt Text:

Figure 1

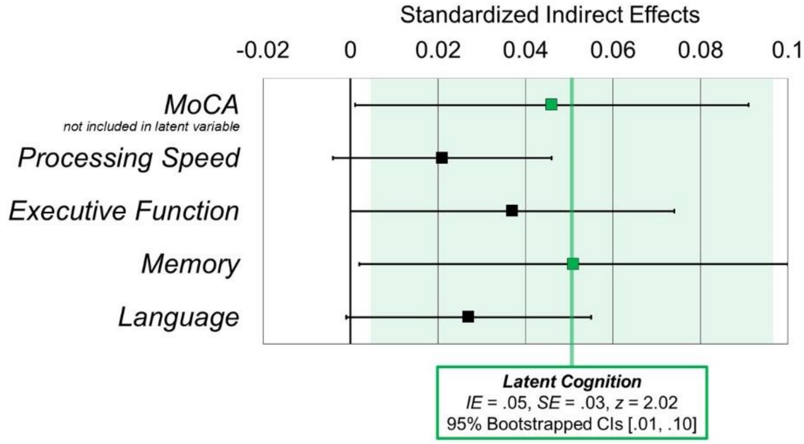
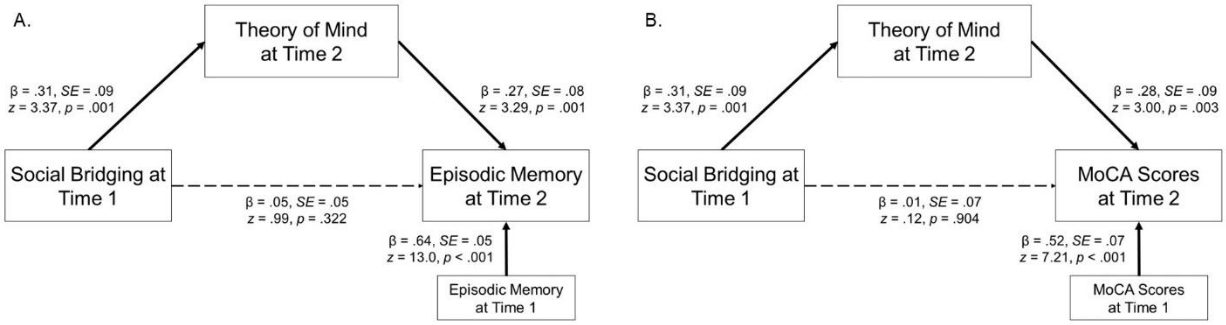

Standardized Indirect Effects
-0.02
0
0.02
0.04
0.06
0.08
0.1
MoCA
not included in latent variable
Processing Speed
Executive Function
Memory
Language
Latent Cognition
IE = .05, SE = .03, z = 2.02
95% Bootstrapped CIs [.01, .10]

Figure 2


A.
Theory of Mind at Time 2
β = .31, SE = .09
z = 3.37, p = .001
β = .27, SE = .08
z = 3.29, p = .001
Social Bridging at Time 1
Episodic Memory at Time 2
β = .05, SE = .05
z = .99, p = .322
β = .64, SE = .05
z = 13.0, p < .001
Episodic Memory at Time 1
B.
Theory of Mind at Time 2
β = .31, SE = .09
z = 3.37, p = .001
β = .28, SE = .09
z = 3.00, p = .003
Social Bridging at Time 1
MoCA Scores at Time 2
β = .01, SE = .07
z = .12, p = .904
β = .52, SE = .07
z = 7.21, p < .001
MoCA Scores at Time 1