



Older Adults' Beliefs About their Ability to Understand Others' Mental States

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Abstract

Research has demonstrated that theory of mind (ToM), that is the ability to understand other's thoughts and feelings, declines with age. However, less is known about older people's perceptions about their own ability to "read" the mind of others. In the current study, we provide initial evidence on this issue by: (a) examining age-related differences in ToM personal beliefs; (b) analyzing the relation between personal beliefs and actual performance; and (c) investigating whether ToM, either beliefs or ability, explains individual differences in social relationships. Twenty-five independently living older adults and 26 young adults were administered both personal beliefs and performance-based ToM measures. Social relationships were analyzed by considering family members and friends separately. Results indicated lower ToM ability in older adults compared to younger participants, but no age-related differences in ToM personal beliefs. Furthermore, personal beliefs and performance were not associated in either young or older adults. Finally, regression analyses indicated that both ToM personal beliefs and ToM ability were significant predictors of relationships with friends, but not with family members. Overall, our findings indicated that, notwithstanding their impairment in ToM, older adults were as confident as young adults in their ability to understand others' minds. Crucially, we found preliminary evidence that ToM, both beliefs and ability, are relevant for people's social behavior, positively predicting better friendships.

Keywords Personal beliefs · Theory of mind · Social cognition · Mind-reading belief scale · Social relationships

Introduction

Growing evidence has shown that theory of mind -ToM (Premack and Woodruff 1978), that is the ability to "put oneself in others' shoes", declines with age (for a meta-analysis see Henry et al. 2013). Broadly speaking, ToM refers to the ability to understand what others are thinking/feeling and to reason in terms of mental states, but this ability has been given various labels, such as mindreading, mentalizing, and

cognitive empathy, depending on the research field (Epley 2008; Preckel et al. 2018; Schaafsma et al. 2015). Notwithstanding the difference in terminology, researchers are unanimous in defining ToM as a crucial skill which enables individuals to successfully move in the social world.

While the research on older adults' ToM performance is now considerable (Henry et al. 2013), little is known about older people's perception about their own ability to "read" the mind of others. Therefore, the main aim of the present study was to investigate ToM personal beliefs in aging, by examining potential age-related differences. Subsequently, we focused on the association between ToM beliefs and ToM performance and explored ToM beliefs' social outcomes, that is, relationships with family and friends. To date, this is the first study that has taken into account these variables all together and has examined their associations.

Personal beliefs represent one of the three categories of metacognition, together with knowledge and monitoring (Hertzog and Hultsch 2000). Here, we focused on a specific category of personal beliefs: perceived self-efficacy, which refers to beliefs about one's ability to perform specific

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tasks. Crucially, beliefs about one's ability—either accurate or inaccurate—do have an impact not only on performance (e.g., memory; Chasteen et al. 2005), but also on behavior (Bandura and Locke 2003; Beyer 1990; Gillet et al. 1998; Hur 2018). For instance, in a compelling study, it was found that women were more likely than men to refuse to take part in a local science competition due to their lower self-efficacy beliefs in this domain, although their objective performance on a science test was not different to that of men (Ehrlinger and Dunning, 2003).

The literature on personal beliefs has, for the most part, explored self-efficacy in the learning/educational domain and, with respect to aging, in the memory domain. Only limited research in older adults' samples has focused on age-related differences in ToM beliefs, and results from the analysis carried out in these studies are somewhat contrasting. Recent research comparing young and older adults' beliefs with the Perspective Taking scale of the Interpersonal Reactivity Index—IRI-PT (Davis 1983), found that older adults reported lower scores on personal beliefs compared to younger participants, indicating that older adults evaluate themselves as less able mind readers (Beadle et al. 2015; Sun et al. 2018). Similar results came from a study using the Empathy Quotient questionnaire (Baron-Cohen and Wheelwright 2004) in which older adults reported lower beliefs about cognitive empathy compared to those reported by younger participants (Bailey et al. 2008). Furthermore, in a large cross-sectional study involving adults with age ranging from 18 to 90 years (O'Brien et al. 2013), the authors found an inverse U-shape distribution of IRI Perspective Taking scores, suggesting that ToM beliefs reached maximum level in middle adults and started to decline from about 50–60 years of age. Yet contrasting findings emerged from Ze and colleagues' study (Ze et al. 2014), (see also Gould and MacNeil Gautreau, 2014) and from Duval and colleagues' study (Duval et al. 2011), both revealing no age-related differences in ToM personal beliefs.

A tentative explanation for this inconsistency in results may be the difference between studies in the age range of the samples examined. Studies reporting no age-related difference selected older people starting from earlier age (55/61 years old) than those reporting lower ToM beliefs (65/67 years old). In addition, the upper limit of the age range was different: 83 years for the no-difference studies, which is against an age of 93 years for the studies indicating lower ToM beliefs in aging. Hence, and in light of results from the large cross-sectional study (O'Brien et al. 2013), we hypothesized that age-related differences in ToM beliefs may have been concealed in those “younger” samples of older people.

Regarding the relationship between ToM beliefs and performance, to the best of our knowledge, only the study by Duval and colleagues (Duval et al. 2011) offers some

indications. The authors measured ToM performance with several tasks and ToM beliefs with a self-report questionnaire created ad hoc, based on existing questionnaires (a sample item was: “I can easily deduce someone's intentions”). Results indicated that, although young and older adults did not significantly differ in self-reported ToM, older adults showed impaired ToM performance. Crucially, partialling out age, the authors found no significant correlation between self-reported ToM and actual ToM performance.

Concerning the link between ToM beliefs and social relationships, we found only one study which investigated the social outcomes of older adults' self-evaluated mindreading ability (Bailey et al. 2008). The authors found that ToM personal beliefs partially mediated the relationship between age and social participation, suggesting that what people believe about their own ability to understand others has an impact on how they interact with others.

Furthermore, the association of ToM ability with interpersonal functioning deserves close attention. Notwithstanding the theoretical assumption of a strong link between the ability to understand others' intentions and emotions and positive social outcomes, empirical evidence in non-clinical populations is still scarce. Research on this issue is limited and partially controversial, especially in aging. On the one hand, Pezzuti and colleagues (Pezzuti et al. 2015) found that older people's ToM performance was not associated with social support. Similarly, Blanke and colleagues (Blanke et al. 2016), in a dyadic study, found that ToM ability was unrelated to the partner's communication satisfaction. On the other hand, Blanke and colleagues also found a weak but significant relationship between individual's ToM ability and satisfaction with one's own social relationships (2016). Other studies also indicated that friendships—both in terms of frequency of contact and quality of the relationship—were related to ToM ability, when evaluated with a measure of the spontaneous use of mindreading ability (Lecce et al. 2019), in socially motivated older adults (Lecce et al. 2017). Overall, evidence suggesting that social-cognitive abilities are associated with older people's social functioning is growing (Radecki et al. 2019; Washburn et al. 2003).

Present Study

The current study's goal was to offer a preliminary investigation of ToM personal beliefs in aging, given the limited evidence available on this issue. Specifically, our aims were to examine (a) age-related differences in ToM beliefs; (b) the relationship between ToM beliefs and ToM ability; and (c) the associations of ToM beliefs (and ability) with social behavior, focusing on relationships with family and friends.

In order to investigate these issues, we compared young and older adults on ToM beliefs, ToM ability, and social relationships. Notably, in designing the study we attempted

to fill some gaps left by previous studies. Firstly, we included only people aged at least 70 years in the older group. In fact, as explained above, the age range of older participants may be an important variable, as it is the potential source of the conflicting findings in previous studies. Secondly, to evaluate ToM beliefs, we decided to use a self-report questionnaire expressly created to measure ToM: the Mind-reading belief scale (Realo et al. 2003). We believe that this represents an important issue, as some of the previous studies assessed ToM personal beliefs using instruments which evaluate constructs which partly overlap with mindreading, such as empathy or social/interpersonal skills. Based on the literature reviewed above, and in line with the results from O'Brien et al. (2013), we expected older people to report lower scores on ToM beliefs compared to young participants. Moreover, ToM performance was expected to be lower in older participants compared to young adults (Henry et al. 2013). The size of these age-related effects was expected to be medium to large.

With respect to our second aim, namely, the association between ToM beliefs and ToM ability, we selected two experimental tasks which have been successfully employed in aging: the Faux Pas task (Gregory et al. 2002), which measures the ability to detect and understand social slips (Bottiroli et al. 2016; Li et al. 2013; Ruffman et al. 2016); and the Animated social triangles task (Castelli 2019; Castelli et al. 2000), which involves dynamic videos of moving triangles and measures the extent to which participants interpret actions in terms of mental states (Rosi et al. 2016; Synn et al. 2017; Van den Stock et al. 2019). We expected personal beliefs and objective performance to be unrelated to each other, as found in older adults' studies (Duval et al. 2011; Ickes 1993; Realo et al. 2003), in line with recent meta-analytic findings (Murphy and Lilienfeld 2019).

Moreover, we wanted to examine the association between ToM beliefs and older adults' behavior, that is, social outcomes. In order to do so, we investigated social functioning, adopting a fine-grained analysis of people's social relationships by considering both quantity and quality of social contacts, as well as separating the typology of relationship (i.e., relatives vs. friends). Indeed, research in the aging field indicates that both quantitative aspects, such as number of people and the frequency of contacts, and qualitative aspects, such as satisfaction and trust, are relevant for people's well-being (Siedlecki et al. 2014). Furthermore, relationships with both friends and family members are crucial for successful aging, even if they act in different ways. While family members are the main providers for instrumental support, friends are a crucial source of companionship, social integration, and self-esteem (Huxhold et al. 2014). With regard to the association between ToM beliefs and social relationships, the limited research available on this issue led us to hypothesize a weak-to-moderate link in both young and

older participants. For the association between ToM ability and social relationships, based on past studies across the life span, we hypothesized that we would find little-to-moderate associations (Lecce et al. 2017, 2019; Lewis et al. 2011; Nilsen and Bacso, 2017).

Methods

Participants

Twenty-seven young adults and 34 older adults participated in the study. However, due to some missing data, we removed ten participants from the analyses. Hence, our final sample was composed of 26 young adults (age range 19–25, $M = 21.50$, $SD = 1.65$) and 25 older adults (age range 70–80, $M = 75.16$, $SD = 2.82$). Young adults were undergraduate students recruited through the University newsletter, who received course credits in exchange for their participation. Older adults were community-dwelling individuals who lived independently and were recruited through local cultural/recreational centers and word-of-mouth; they participated as volunteers. Italian was the first language for all participants in the study. Young adults had higher educational attainment than older adults, $M_{\text{young}} = 15.54$, $SD = 1.39$, $M_{\text{old}} = 11.80$, $SD = 4.09$, Welch's $F(1, 29) = 18.77$, $p < 0.001$, partial $\eta^2 = 0.39$, 90% CI [0.18, 0.55], but lower crystallized ability, as measured by the vocabulary test from the PMA battery (Thurstone and Thurstone, 1963), $M_{\text{young}} = 42.23$, $SD = 4.25$, $M_{\text{old}} = 45.04$, $SD = 4.58$, Welch's $F(1, 48) = 5.15$, $p = 0.028$, partial $\eta^2 = 0.09$, 90% CI [0.06, 0.24].

Measures

ToM Ability

As anticipated, we measured ToM ability using two tasks: the Faux Pas task (Gregory et al. 2002) and the Animated social triangles task (Castelli 2019).

Concerning the Faux Pas task, for this study, we selected three stories containing a social slip from the original set of the stories (in particular, story 7, 14, and 16). Following each story, four questions concerning the thoughts and feelings of the protagonists and two questions investigating general comprehension were presented. The stories and questions were presented in a booklet. Participants could read the stories as many times as they needed, and then write their answers in the booklet. For each story, participants received one point if they answered each of the six questions correctly.

With regard to the animated social triangles task, this measure consists of a series of animations in which two triangles move on a screen. The task is an adaptation of

previously used tasks (Castelli et al. 2000) with shorter video clips (about 16 s per clip) and improved control conditions. The task comprises three categories of videos, varying on the type of movements and interactions depicted: ToM, goal directed, and random. For the current study, we selected three ToM video clips in which the triangles moved in such a way as to look like social interactions rich in terms of the mental states involved (i.e., deception, pretense and false belief). Participants watched each video on a laptop computer, and then described what happened by writing their answers on a sheet. Each video could be viewed only once. Answers were subsequently coded for the grade of intentionality attributed, ranging from 0 (no intentionality attributed, movements without purpose) to 5 (one triangle manipulating the mental state of the other triangle, e.g., one triangle pretending to be still while secretly following the other). Coding for all participants was done by the first author. A second expert, blind to the study's hypotheses, coded 20% of the protocols. Inter-rater reliability was good, Cohen's $k=0.80$. Scores for both the Faux Pas and the animated social triangles tasks were transformed into percentages.

ToM Beliefs

To measure personal beliefs, we selected a questionnaire that was expressly created to measure the self-view of participants on their ToM skills, namely the Mind-reading belief scale (MRBS -Realo et al. 2003). The questionnaire is comprised of eight items investigating general beliefs about one's ability to understand others' thoughts and emotions. A sample item was as follows: "Usually, I know beforehand what my conversation partner is going to say". Answers were on a 5-point Likert-type scale, ranging from 0 (strongly disagree) to 4 (strongly agree). Internal reliability for our sample was satisfactory, with Cronbach's $\alpha=0.70$ and an average inter-item correlation $r=0.23$. The global score ranged from 0 to 32.

Social Relationships

To measure social relationships, we used the Lubben social network scale—revised (LSNS-R -Lubben and Gironde, 2003). This 12-item scale was developed specifically for use in older adults and has been used to measure the risk of social isolation. It has the advantage of being able to investigate both the quantity (e.g., the frequency of contacts) and quality (e.g., satisfaction) aspects of social relationships, separating relatives and friends (six items for each category). An example is given as follows: "How many relatives/friends do you feel at ease with that you can talk about private matters?". Answers were rated on a 6-point Likert-type scale, ranging from 0 (none/never) to 5 (nine or more/always). Two scores—one for family and one

for friends—were calculated, each one ranging from 0 to 30. Internal reliability for the whole scale was good, with Cronbach's $\alpha=0.83$ and an average inter-item correlation $r=0.30$. Additionally, when considering the two subscales separately, statistics were good, $\alpha=0.75$, $r=0.33$ for family, and $\alpha=0.81$ and $r=0.42$ for friends.

Procedure

For young participants, the administration was conducted in the University's facilities. For older participants, the administration was conducted in the University's facilities, recreational centers, or at the participant's home, depending on the preference of the participant. When administering in recreational centers and homes, the experimenter requested a quiet room, without external disturbances. The personal beliefs questionnaire was administered before the performance tasks. Informed consent was obtained for all participants before testing. The study was presented as aiming at elucidating how cognitive functions were related to social-cognitive abilities. Participants were not told that their performance would have been compared to another age group until the end of the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical Analyses

Age differences in focus variables were analyzed by performing a series of ANOVAs, entering age groups (young vs. older) as the independent variable. Correlation analyses, separated for age groups, examined the pattern of associations between ToM beliefs and performance. To correct for multiple comparisons, we used the B-H procedure (Benjamini and Hochberg, 1995), which controls the false discovery rate (FDR- i.e., the proportion of significant results that are actually false positives). FDR was set to $q=0.05$, as in previous studies (e.g., LeBlanc et al. 2016; Lindquist and Mejia, 2015). Finally, multiple regression analyses examined the potential predictors of social relationships. We checked for potential multicollinearity among predictors by computing VIF (variance inflation factor) and tolerance statistics (Field 2009). Following recent recommendations (Pek and Flora 2018), we reported confidence intervals for effect sizes (r , R^2 and partial η^2), adopting Wuensch's website indications and tools (Wuensch 2018). Given the small sample size, we commented upon our results taking into consideration not only the p values, but also the effect sizes. In doing so, we adopted Cohen's guidelines in interpreting effect size (Cohen 1988). Sensitivity analysis were conducted after data collection to compute the minimum effect size that can be detected given alpha, power, and sample size (Perugini et al. 2018). We used G*Power and found that given a sample

size of 51, an alpha level of 0.05, and a minimum power of 0.80, there was an 80% chance of detecting medium-to-large effects, assuming statistical significance and such effects exist. Statistical analyses were conducted with SPSS 19 (IBM Corp. Released, 2010). The dataset is openly available at https://osf.io/spjz8/?view_only=7099f67253fb42d3b678d70e8ae12454 (Ceccato et al. 2020).

Results

Age-Related Differences in ToM Ability and Beliefs

Descriptive statistics, separated for young and older adults, are presented in Table 1. Firstly, we examined age-related differences in ToM performance. Univariate ANOVAs revealed age-related differences in mindreading ability, favoring young adults, with large effect sizes. Specifically, young adults outperformed older adults in both the Faux Pas, Welch's $F(1, 40) = 6.62$, $p = 0.014$, partial $\eta^2 = 0.14$, 90% CI [0.02, 0.30], and the Animated social triangles task, $F(1, 49) = 20.56$, $p < 0.001$, partial $\eta^2 = 0.29$, 90% CI [0.12, 0.44].

Interestingly, effect sizes indicated that the differences between young and older participants were greater in the Animated social triangle task compared to the Faux Pas task. However, it is important to note that 52% of young participants obtained a perfect score on the Faux Pas task, indicating a ceiling effect. This was not the case for older adults, as only 26% of participants got a perfect score. Hence, in this task the small effect size for the age differences may reflect the limited variability in the young adults group. On the other hand, the animated social triangles task did not show ceiling effect, as only 4% (young) and 3% (older) of participants obtained a perfect score.

With respect to age-related differences on ToM beliefs, results indicated that the differences between young and older adults were small in size and not statistically significant, $F(1, 49) = 1.64$, $p = 0.206$, partial $\eta^2 = 0.03$, 90% CI [0.00, 0.14].

Relation Between ToM Beliefs and Ability

We subsequently examined the link between beliefs about one's mindreading ability and actual performance, separately for young and older adults. Note that because scores on the Faux Pas task were not normally distributed (Shapiro–Wilk test's $ps \leq 0.003$), we used Spearman's rank correlation instead of Pearson's correlation.

For older people, no significant associations appeared between ToM beliefs and ToM ability, precisely with the Faux Pas task, $r(23) = -0.23$, B-H adjusted $p = 0.406$, 95% CI [-0.57, 0.18], and with the Animated social triangles task, $r(23) = 0.27$, B-H adjusted $p = 0.406$, 95% CI [-0.14, 0.60]. For young adults, correlation analyses again revealed that ToM beliefs and ToM performance were not significantly associated, either for the Faux Pas task, $r(24) = 0.13$, B-H adjusted $p = 0.533$, 95% CI [-0.27, 0.49], or for the Animated social triangles task, $r(24) = -0.39$, B-H adjusted $p = 0.153$, 95% CI [-0.67, 0.00]. Beyond statistical significance, the effect sizes were small in magnitude (i.e., lower than 0.30), and we acknowledge that we may lack the power to detect small effects, if they exist. On the contrary, the association between MRBS and Animated social triangles for young adults showed a medium effect size, and its confidence interval suggested that the link between the two variables was negative. However, as the p value did not survive to the B-H adjustment, this result should be interpreted with caution.

Social Outcomes of ToM Beliefs vs. Performance

Finally, we examined whether ToM personal belief, and/or ability, could predict social relationships, in terms of both quantity and quality. Preliminary results revealed that older adults reported lower scores for friendships than younger adults, $F(1, 49) = 29.47$, $p < 0.001$, partial $\eta^2 = 0.38$, 90% CI [0.20, 0.51], with the effect size being large. Non-significant age-related difference emerged in relationships with relatives, $F(1, 49) = 2.84$, $p = 0.098$, partial $\eta^2 = 0.05$, 90% CI [0.00, 0.18].

Table 1 Means (and standard deviations) for ToM and social relationships measures, separated for age groups

		Young <i>n</i> = 26		Older <i>n</i> = 25	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<i>ToM ability</i>	Faux Pas (<i>range 0–100</i>)	82.05	21.56	61.33	34.26
	Triangles (<i>range 0–100</i>)	76.92	12.40	61.07	12.57
<i>ToM beliefs</i>	MRBS (<i>range 0–32</i>)	18.92	3.99	17.28	5.10
<i>Social relationships</i>	Friends (<i>range 0–30</i>)	22.69	3.88	16.48	4.29
	Relatives (<i>range 0–30</i>)	20.58	4.06	18.60	4.31

MRBS mind-reading belief scale, *Triangles* animated social triangles task

Next, we performed two hierarchical regression analyses, considering either relationships with friends, or relationships with relatives as the outcome (see Table 2). In both models, we set a forced entry for two predictors in the first block: age group (young vs. older) and social relationships not entered as outcome (e.g., in the regression predicting friendships, family relationships were entered as a predictor in the first step). We did as such because we know from the literature that there are important age-related differences in social relationships (Wrzus et al. 2013) and that personality factors may account for general differences in social relationships (Hill et al. 2018), so that people reporting more frequent and positive interactions with friends are likely to also have more frequent and more satisfying interactions with relatives. In the second block the ToM measures -both beliefs and ability- were selected as potential predictors through a stepwise approach. We checked for multicollinearity and concluded that there was no collinearity within our data, $VIF \leq 1.95$, average $VIF = 1.40$, tolerance ≥ 0.51 .

With respect to friendships, the first model was significant, $F(2, 48) = 29.96$, $p < 0.001$, and explained 56% of variance, 90% CI [0.375, 0.651]. Results indicated that both age group (negatively) and relationships with family

members (positively) play an important role in people's friendships, respectively, $\beta = -0.51$ and $\beta = 0.44$. Crucially, in the following block two ToM measures, namely MRBS and the animated social triangles task, explained a significant amount of additional variance in friendships and were, thus, retained in the model. Specifically, the MRBS explained 4% of additional variance, 90% CI [0.001, 0.103], $\beta = 0.21$, and the Animated social triangles task explained a further 3% of additional variance, 90% CI [0.001, 0.089], $\beta = 0.22$. However, note that both these positive effects were relatively small. Age group and family relationships remained significant predictors with medium effects, $\beta = -0.36$ and $\beta = 0.43$, respectively. Globally, the final model explained 63% of variance in friendships.

Concerning family relationships, only the first model, in which age group and friendships were forced to be entered into the model, reached statistical significance, explaining about 33% of the variance in family relationships, 90% CI [0.136, 0.457]. Notably, relationships with friends was the only significant predictor that positively explained family relationships, $\beta = 0.66$. None of the ToM measures emerged as significant predictors.

Table 2 Regression analyses examining friendships vs. family relationships

		<i>B</i>	<i>SE</i>	<i>p</i>	
<i>Friendships</i>					
Step 1	$\Delta R^2 = .56$ $F(2,48) = 29.96$, $p < .001$				
		Age group	- 2.59	- 0.50	<0.001
		Family relationships	- 0.52	- 0.12	<0.001
Step 2	$\Delta R^2 = .04$ $F(1,47) = 4.68$, $p = .036$				
		Age group	- 2.39	0.49	<0.001
		Family relationships	0.54	0.12	<0.001
		MRBS	0.23	0.11	0.036
Step 3	$\Delta R^2 = .03$ $F(1,46) = 4.06$, $p = .050$				
		Age group	- 1.81	0.56	0.002
		Family relationships	0.52	0.11	<0.001
		MRBS	0.23	0.10	0.028
		Triangles	0.08	0.04	0.050
Excluded variables		Faux Pas	-	-	0.521
<i>Family relationships</i>					
Step 1	$\Delta R^2 = 0.33$ $F(2,48) = 11.65$, $p < .001$				
		Age group	0.72	0.63	0.262
		Friendships	0.55	0.13	<0.001
Excluded variables		MRBS	-	-	0.130
		Triangles	-	-	0.627
		Faux Pas	-	-	0.553

Age group was coded as - 1 for young adults and 1 for older adults

MRBS mind-reading belief scale, *Triangles* animated social triangles task

Discussion

The main goal of the present study was to provide an investigation on whether young and older adults differ in mindreading personal beliefs. We also analyzed the relationships between personal beliefs and actual performance. Crucially, we extended previous investigations by examining the social outcomes (i.e., social relationships) of ToM beliefs and ability.

Firstly, we found large age-related differences in ToM objective performance in both the tasks we used. Our results are in line with previous research, showing older adults' impairment in mindreading reasoning, compared to young adults (Cavallini et al. 2013a, b; Johansson Nolakker et al. 2018).

Along with these age-related differences in mindreading ability, we expected an analogous decrease in personal beliefs. Indeed, as revealed by the findings of O'Brien and colleagues (2013), ToM beliefs should show a moderate but progressive decline starting from 50/60 years. In our sample of people older than 70 years, results did not confirm this expectation, instead offering support to the view that young and older people do not differ in ToM self-efficacy beliefs. This discrepancy in results may be due to the difference in the measure used to investigate ToM beliefs. While we used the Mind-reading belief scale, O'Brien and colleagues used the Perspective Taking scale from the Interpersonal Reactivity Index, a questionnaire generally used to measure empathy. Another possibility is related to cultural differences among the samples: the current study involved Italian people, while the O'Brien survey was conducted on the American population. Interestingly, there is some evidence indicating that memory personal beliefs are influenced by cultural, or even subcultural, differences (Cavallini et al. 2013a, b). Future studies examining cross-cultural differences in mindreading beliefs in young and older adults could help to solve the inconsistencies in these findings.

Duval et al. (2011) have suggested that the lack of age-related differences in ToM beliefs indicates that older people are not aware that their socio-cognitive skills lessen during typical aging. Herein, we were unable to elucidate whether older adults overestimate their ability or younger adults underestimate their ToM abilities, but we can attest that, irrespective of age, people are not aware of their socio-cognitive skills. In fact, our correlational analyses on the associations between ToM beliefs and abilities showed that both young and older adults were inaccurate in self-evaluations about their mindreading skills. Past studies have indicated that correlations between personal beliefs and performance are small within the interpersonal domain (Brackett et al. 2006; Murphy and

Lilienfeld, 2019). Previous research has examined young adults, but evidence on healthy aging was, and still is, lacking. Our study is a first attempt to fill this gap, and the results we obtained indicate that personal beliefs and actual performance in two ToM tasks were also unrelated in older people.

We surmise that people's unawareness about their own mindreading ability may be due to the fact that in daily life people receive limited feedback about their accuracy in detecting others' mental states (Beaudoin and Desrichard 2011; Realo et al. 2003). Past experiences are pivotal sources of information for personal beliefs; thus, having little available information about personal performance may lead to people not having an objective-based estimate of their ability. As a consequence, ToM personal beliefs are likely to be built on very limited feedback and are potentially more influenced by other sources of information, such as implicit theories (Berry and West 1993). Implicit theories refer to people's beliefs about cognitive and social abilities and their changes during the life span (Hertzog and Hultsch 2000). An intriguing possibility is that people consider ToM as a characteristic stable across adulthood and aging. Indeed, people show implicit theories of stability concerning those abilities belonging to domains related to experience, common sense, and wisdom while holding implicit theories of decline for memory and fluid abilities (Hertzog and Hultsch 2000; Riediger et al. 2014). Beyond the lack of self-awareness in one's own ToM ability, this possibility could also explain why young and older adults reported comparable ToM belief scores. Older adults may believe that mindreading skills do not change with age in the general population and, consequently, in themselves. However, given that we did not directly measure general ToM beliefs, future studies should investigate whether people of different ages think that ToM ability changes during the life span. This would also allow for the comparison of beliefs about the self and beliefs about others' ToM abilities.

An alternative explanation for the lack of association between ToM beliefs and performance may be that our measures showed limited inter-individual variability. On one hand, we found that young adults performed at ceiling in Faux Pas task, therefore limiting the inferences that can be drawn from this task. On the other hand, individual differences were large enough to detect associations in both the animated social triangles task and the MRBS. Therefore, it is unlikely that our null results were due to a lack of variability in the measures employed.

Finally, we were interested in examining whether people's ToM beliefs and/or ability were relevant for social behavior and specifically if they were related to social relationships. Previous research on young adults has suggested that ability is more relevant than personal beliefs in predicting positive social outcomes (Ames and Kammrath

2004), while evidence for older adults has suggested that both beliefs and ability are relevant (Bailey et al. 2008; Lecce et al. 2017). Our results indicated that both personal beliefs and actual performance were associated with better friendships in young and older adults.

Firstly, it is relevant to note that ToM was related exclusively to friendships, and not with relationships with family members, in line with recent studies (Lecce et al. 2017, 2019). We believe that ToM plays a specific role in managing friends, compared to family members, as friendships require the creation and maintenance of more interpersonal effort (Roberts and Dunbar 2011), probably due to their voluntary nature, while family relationships have a strong normative component and are less at risk of breaking up (Li and Cheng 2015). On a general note, we believe that this difference between family and friends is an important detail which supports the need for a more fine-grained analysis of people's social networks (Huxhold et al. 2014; O'Gorman and Roberts 2017). Past research has shown that friendships and family relationships differ in nature, correlates, and pattern of changes across the life span (Fiori et al. 2006; Litwak 1981; Wrzus et al. 2013), and our results testify to the importance of analyzing them separately.

Secondly, it is also important to acknowledge that the effects we found were relatively small in size. This is not surprising, as it is very likely that other factors not investigated in this study, such as motivation, mediated the link between ToM ability and positive social outcomes (Lecce et al. 2017). Nevertheless, our results open intriguing possibilities. Specifically, the present findings suggest that personal beliefs have a real impact on social functioning: people who believed themselves to be good at understanding others (without being very accurate in this self-evaluation) also reported more friends and higher satisfaction with these relationships. An intriguing possibility that has been put forward is that personal beliefs are more closely related to personality than to ability (Burns et al. 2016; Realo et al. 2003). Consequently, it is possible that the link between ToM beliefs and friendships is due to a latent common personality trait, such as Extroversion or Emotional stability. Furthermore, ToM ability plays a significant positive role in friendships. We noted that only the animated social triangle task emerged as a predictor, but not the Faux Pas task. We acknowledge that this may be due to the lack of variability in this measure, as described above.

Overall, it is important to recognize that ToM, both beliefs and performance, accounted for about 7% of the variance in friendships, while age and family relationships accounted for more than half of the variance in social functioning.

Limitations and Conclusion

The findings described herein should be considered with caution and in light of the study's limitations, the principal of these being its limited sample size. With the current numbers, we were able to find moderate to large effects with reasonable confidence. However, if there are some small effects, we probably failed to detect them as we did not have enough power. Nonetheless, we think that the present results should be considered as a first attempt to fill an important gap in the research, offering preliminary evidence about age-related differences in ToM personal beliefs and their relation to social functioning.

Secondly, given the correlational nature of the analyses, we can't assert a specific direction for the link we found between the variables investigated. Based on the literature reviewed in the Introduction, we assumed ToM as the predictor of social relationships; however, there are studies which suggest an opposite pattern (Pearlman-Avni et al. 2018), as well as bidirectional effects (Banerjee et al. 2011). We believe that longitudinal studies in adulthood and aging are necessary in order to examine the relation between ToM and social competence, and such studies which would offer pivotal information from both a practical and a theoretical point of view should be strongly encouraged.

Thirdly, in the present study, we were interested in how people evaluate themselves as "mind readers" in general, and we compared these personal beliefs to experimental tasks that measure two specific facets of ToM ability: the detection of social gaffes and the attribution of mental states to non-human stimuli. Yet the two tasks we selected did not exhaustively cover the wide ability of mindreading. Future studies should use a comprehensive battery of mindreading tasks in order to obtain a global index of ToM ability.

Notwithstanding these caveats, the present study describes preliminary findings that encourage further investigation. We extended previous research investigating the link between personal beliefs and actual performance in the socio-cognitive domain to the field of aging. We found that beliefs about one's ToM are mostly unrelated to actual ToM performance, both for young and older adults. That is, people are not very accurate in judging their own mindreading skills, in line with previous findings regarding young and middle-aged adults (Ickes 2003). Notably, this may be particularly relevant for older adults, who concurrently experienced objective impairments in ToM performance. On a more speculative note, a lack of awareness may lead older adults to undervalue the impact of their lessened ToM on their daily interactions.

Furthermore, we found preliminary evidence that ToM personal beliefs are relevant for people's social behavior, positively predicting better friendships. This is a particularly

interesting result for older adults who are more at risk of loneliness and social isolation (Coyle and Dugan 2012).

Finally, some practical implications can be derived from this study, specifically regarding the creation of intervention programs aimed at bolstering older people's ToM skills (e.g., Lecce et al. 2015). The present results suggest that in order to maximize the beneficial effects of such interventions on social life, beyond directly enhancing ToM abilities, they should also work on ToM personal beliefs.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

References

- Ames, D. R., & Kamrath, L. K. (2004). Mind-reading and metacognition: Narcissism, not actual competence, predicts self-estimated ability. *Journal of Nonverbal Behavior*, 28(3), 187–209. <https://doi.org/10.1023/B:JONB.0000039649.20015.0e>.
- Bailey, P. E., Henry, J. D., & Von Hippel, W. (2008). Empathy and social functioning in late adulthood. *Aging & Mental Health*, 12(4), 499–503. <https://doi.org/10.1080/13607860802224243>.
- Bandura, A., & Locke, E. A. (2003). Negative self-efficacy and goal effects revisited. *Journal of Applied Psychology*, 88(1), 87–99. <https://doi.org/10.1037/0021-9010.88.1.87>.
- Banerjee, R., Watling, D., & Caputi, M. (2011). Peer relations and the understanding of Faux Pas: Longitudinal evidence for bidirectional associations. *Child Development*, 82(6), 1887–1905. <https://doi.org/10.1111/j.1467-8624.2011.01669.x>.
- Baron-Cohen, S., & Wheelwright, S. (2004). The empathy quotient: An investigation of adults with Asperger Syndrome or high functioning autism, and normal sex differences. *Journal of Autism and Developmental Disorders*, 34(2), 163–175. <https://doi.org/10.1023/B:JADD.0000022607.19833.00>.
- Beadle, J. N., Sheehan, A. H., Dahlben, B., & Gutchess, A. H. (2015). Aging, empathy, and prosociality. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 70(2), 213–222. <https://doi.org/10.1093/geronb/gbt091>.
- Beaudoin, M., & Desrichard, O. (2011). Are memory self-efficacy and memory performance related? A meta-analysis. *Psychological Bulletin*, 137(2), 211–241. <https://doi.org/10.1037/a0022106>.
- Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society*, 57, 289–300. <https://doi.org/10.2307/2346101>.
- Berry, J. M., & West, R. L. (1993). Cognitive self-efficacy in relation to personal mastery and goal setting across the life span. *International Journal of Behavioral Development*, 16(2), 351–379. <https://doi.org/10.1177/016502549301600213>.
- Beyer, S. (1990). Gender differences in the accuracy of self-evaluations of performance. *Journal of Personality and Social Psychology*, 59(5), 960–970. <https://doi.org/10.1037/0022-3514.59.5.960>.
- Blanke, E. S., Rauers, A., & Riediger, M. (2016). Does being empathic pay off?—Associations between performance-based measures of empathy and social adjustment in younger and older women. *Emotion*, 16(5), 671–683. <https://doi.org/10.1037/emo0000166>.
- Bottiroli, S., Cavallini, E., Ceccato, I., Vecchi, T., & Lecce, S. (2016). Theory of mind in aging: Comparing cognitive and affective components in the faux pas test. *Archives of Gerontology and Geriatrics*, 62, 152–162. <https://doi.org/10.1016/j.archger.2015.09.009>.
- Brackett, M. A., Rivers, S. E., Shiffman, S., Lerner, N., & Salovey, P. (2006). Relating emotional abilities to social functioning: A comparison of self-report and performance measures of emotional intelligence. *Journal of Personality and Social Psychology*, 91(4), 780–795. <https://doi.org/10.1037/0022-3514.91.4.780>.
- Burns, K. M., Burns, N. R., & Ward, L. (2016). Confidence—More a personality or ability trait? It depends on how it is measured: A comparison of young and older adults. *Frontiers in Psychology*, 7, 518. <https://doi.org/10.3389/fpsyg.2016.00518>.
- Castelli, F. (2019). Animated social triangles. [Video Files]. Retrieved from <https://www.fulviacastelli.com/animations> upon request.
- Castelli, F., Happé, F., Frith, U., & Frith, C. (2000). Movement and mind: A functional imaging study of perception and interpretation of complex intentional movement patterns. *NeuroImage*, 12(3), 314–325. <https://doi.org/10.1006/nimg.2000.0612>.
- Cavallini, E., Bottiroli, S., Fastame, M. C., & Hertzog, C. (2013a). Age and subcultural differences on personal and general beliefs about memory. *Journal of Aging Studies*, 27(1), 71–81. <https://doi.org/10.1016/j.jaging.2012.11.002>.
- Cavallini, E., Lecce, S., Bottiroli, S., Palladino, P., & Pagnin, A. (2013b). Beyond false belief: Theory of mind in young, young-old, and old-old adults. *The International Journal of Aging and Human Development*, 76(3), 181–198. <https://doi.org/10.2190/AG.76.3.a>.
- Ceccato, I., Lecce, S., & Cavallini, E. (2020). *Older adults' beliefs about their ability to understand others' mental states* [Dataset]. Open Science Framework. <https://doi.org/10.17605/OSF.IO/SPJZ8>.
- Chasteen, A. L., Bhattacharyya, S., Horhota, M., Tam, R., & Hasher, L. (2005). How feelings of stereotype threat influence older adults' memory performance. *Experimental Aging Research*, 31(3), 235–260. <https://doi.org/10.1080/03610730590948177>.
- Cohen, J. (1988). Statistical power analysis for the behavioral sciences. *Statistical Power Analysis for the Behavioral Sciences*. <https://doi.org/10.1234/12345678>.
- Coyle, C. E., & Dugan, E. (2012). Social isolation, loneliness and health among older adults. *Journal of Aging and Health*, 24(8), 1346–1363. <https://doi.org/10.1177/0898264312460275>.
- Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, 44(1), 113–126. <https://doi.org/10.1037/0022-3514.44.1.113>.
- Duval, C., Piolino, P., Bejanin, A., Eustache, F., & Desgranges, B. (2011). Age effects on different components of theory of mind. *Consciousness and Cognition*, 20(3), 627–642. <https://doi.org/10.1016/j.concog.2010.10.025>.
- Ehrlinger, J., & Dunning, D. (2003). How chronic self-views influence (and potentially mislead) estimates of performance. *Journal of Personality & Social Psychology*, 84(1), 5–17. <https://doi.org/10.1037/0022-3514.84.1.5>.
- Epley, N. (2008). Solving the (real) other minds problem. *Social and Personality Psychology Compass*, 23(10), 1455–1474. <https://doi.org/10.1111/j.1751-9004.2008.00115.x>.
- Field, A. (2009). *Discovering Statistics Using SPSS*. Thousand Oaks, CA: Sage Publication.
- Fiori, K. L., Antonucci, T. C., & Cortina, K. S. (2006). Social network typologies and mental health among older adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 61, 25–32. <https://doi.org/10.1093/geronb/61.1.P25>.

- Gill, M. J., Swann, W. B. J., & Silvera, D. H. (1998). On the genesis of confidence. *Journal of Personality and Social Psychology*, 75(5), 1101–1114. <https://doi.org/10.1037/0022-3514.75.5.1101>.
- Gould, O. N., & MacNeil Gautreau, S. (2014). Empathy and conversational enjoyment in younger and older adults. *Experimental Aging Research*, 40(1), 60–80. <https://doi.org/10.1080/0361073X.2014.857559>.
- Gregory, C., Lough, S., Stone, V., Erzinclioglu, S., Martin, L., Baron-Cohen, S., et al. (2002). Theory of mind in patients with frontal variant frontotemporal dementia and Alzheimer's disease: Theoretical and practical implications. *Brain*, 125(4), 752–764. <https://doi.org/10.1093/brain/awf079>.
- Henry, J. D., Phillips, L. H., Ruffman, T., & Bailey, P. E. (2013). A meta-analytic review of age differences in theory of mind. *Psychology and Aging*, 28(3), 826–839. <https://doi.org/10.1037/a0030677>.
- Hertzog, C., & Hulstsch, D. F. (2000). Metacognition in adulthood and old age. In F. I. M. Craik & T. A. Salthouse (Eds.), *The handbook of aging and cognition* (2nd ed., pp. 417–466). Mahwah, NJ: Lawrence Erlbaum Associates Inc.
- Hill, P. L., Weston, S. J., & Jackson, J. J. (2018). The co-development of perceived support and the Big Five in middle and older adulthood. *International Journal of Behavioral Development*, 42(1), 26–33. <https://doi.org/10.1177/01650254177690262>.
- Hur, M. H. (2018). Demographic and socioeconomic determinants of self-efficacy: An empirical study of Korean older adults. *The International Journal of Aging and Human Development*, 87(3), 289–308. <https://doi.org/10.1177/0091415017738081>.
- Huxhold, O., Miche, M., & Schuz, B. (2014). Benefits of having friends in older ages: Differential effects of informal social activities on well-being in middle-aged and older adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 69(3), 366–375. <https://doi.org/10.1093/geronb/gbt029>.
- Ickes, W. J. (1993). Empathic accuracy. *Journal of Personality*, 61(4), 587–610. <https://doi.org/10.1111/j.1467-6494.1993.tb00783.x>.
- Ickes, W. J. (2003). Empaths wanted, enquire within. In W. J. Ickes (Ed.), *Everyday mind reading: Understanding what other people think and feel*. Amherst, NY: Prometheus Books.
- Johansson Nolaker, E., Murray, K., Happé, F., & Charlton, R. A. (2018). Cognitive and affective associations with an ecologically valid test of theory of mind across the lifespan. *Neuropsychology*, 32(6), 754–763. <https://doi.org/10.1037/neu0000464>.
- LeBlanc, N. J., Dixon, L., Robinaugh, D. J., Valentine, S. E., Bosley, H. G., Gerber, M. W., et al. (2016). PTSD and romantic relationship satisfaction: Cluster- and symptom-level analyses. *Journal of Traumatic Stress*, 29, 259–267. <https://doi.org/10.1002/jts.22100>.
- Lecce, S., Bottiroli, S., Bianco, F., Rosi, A., & Cavallini, E. (2015). Training older adults on theory of mind (ToM): Transfer on meta-memory. *Archives of Gerontology and Geriatrics*, 60(1), 217–226. <https://doi.org/10.1016/j.archger.2014.10.001>.
- Lecce, S., Ceccato, I., Bianco, F., Rosi, A., Bottiroli, S., & Cavallini, E. (2017). Theory of mind and social relationships in older adults: The role of social motivation. *Aging & Mental Health*, 21(3), 253–258. <https://doi.org/10.1080/13607863.2015.1114586>.
- Lecce, S., Ceccato, I., & Cavallini, E. (2019). Theory of mind, mental state talk and social relationships in aging: The case of friendship. *Aging & Mental Health*, 23(9), 1105–1112. <https://doi.org/10.1080/13607863.2018.1479832>.
- Lewis, P. A., Rezaie, R., Brown, R., Roberts, N., & Dunbar, R. I. M. (2011). Ventromedial prefrontal volume predicts understanding of others and social network size. *NeuroImage*, 57(4), 1624–1629. <https://doi.org/10.1016/j.neuroimage.2011.05.030>.
- Li, T., & Cheng, S.-T. (2015). Family, friends, and subjective well-being: A comparison between the West and Asia. *Friendship and Happiness* (pp. 235–251). Dordrecht: Springer. https://doi.org/10.1007/978-94-017-9603-3_14.
- Li, X., Wang, K., Wang, F., Tao, Q., Xie, Y., & Cheng, Q. (2013). Aging of theory of mind: the influence of educational level and cognitive processing. *International Journal of Psychology*, 48, 715–727. <https://doi.org/10.1080/00207594.2012.673724>.
- Lindquist, M. A., & Mejia, A. (2015). Zen and the art of multiple comparisons. *Psychosomatic Medicine*, 77, 114–125. <https://doi.org/10.1097/PSY.000000000000148>.
- Litwak, E. (1981). *The modified extended family, social networks, and research continuities in aging*. New York, NY: Columbia University Center for Social Sciences.
- Lubben, J., & Gironde, M. (2003). Centrality of social ties to the health and well-being of older adults. In B. D. S. W. Berkman & L. M. S. W. Harootyan (Eds.), *Social work and health care in an aging world* (pp. 319–350). New York, NY: Springer.
- Murphy, B. A., & Lilienfeld, S. O. (2019). *Are self-report cognitive empathy ratings valid proxies for cognitive empathy ability?*. Negligible meta-analytic relations with behavioral task performance: Psychological Assessment. <https://doi.org/10.1037/pas0000732>.
- Nilsen, E. S., & Bacso, S. A. (2017). Cognitive and behavioural predictors of adolescents' communicative perspective-taking and social relationships. *Journal of Adolescence*, 56, 52–63. <https://doi.org/10.1016/j.adolescence.2017.01.004>.
- O'Brien, E., Konrath, S. H., Grün, D., & Hagen, A. L. (2013). Empathic concern and perspective taking: Linear and quadratic effects of age across the adult life span. *Journals of Gerontology - Series B Psychological Sciences and Social Sciences*, 68(2), 168–175. <https://doi.org/10.1093/geronb/gbs055>.
- O'Gorman, R., & Roberts, R. (2017). Distinguishing family from friends. *Human Nature*, 28(3), 323–343. <https://doi.org/10.1007/s12110-017-9292-0>.
- Pearlman-Avniot, S., Ron, N., & Ezekiel, S. (2018). Ageing and theory of mind abilities: The benefits of social interaction. *Educational Gerontology*, 44(5–6), 368–377. <https://doi.org/10.1080/03610127.2018.1480130>.
- Pek, J., & Flora, D. B. (2018). Reporting effect sizes in original psychological research: A discussion and tutorial. *Psychological Methods*, 23(2), 208–225. <https://doi.org/10.1037/met0000126>.
- Perugini, M., Gallucci, M., & Costantini, G. (2018). A practical primer to power analysis for simple experimental designs. *International Review of Social Psychology*. <https://doi.org/10.5334/irsp.181>.
- Pezzuti, L., Longobardi, E., Rossetti, S., Bartolini, E., Natale, G., Sappino, M., et al. (2015). The relation between the Theory of Mind and socio-emotional functioning in a sample of older adults. *Journal of Neurology and Psychology*. <https://doi.org/10.1136/nn-2015-02332-3469.1000021>.
- Preckel, K., Kanske, P., & Singer, T. (2018). On the interaction of social affect and cognition: Empathy, compassion and theory of mind. *Current Opinion in Behavioral Sciences*. <https://doi.org/10.1016/j.cobeha.2017.07.010>.
- Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences*, 4, 515–526. <https://doi.org/10.1016/j.celrep.2011.1011.1001.7>.
- Radecki, M. A., Cox, S. R., & MacPherson, S. E. (2019). Theory of mind and psychosocial characteristics in older men. *Psychology and Aging*, 34(1), 145–151. <https://doi.org/10.1037/pag0000324>.
- Realo, A., Allik, J., Nõlvak, A., Valk, R., Ruus, T., Schmidt, M., et al. (2003). Mind-reading ability: Beliefs and performance. *Journal of Research in Personality*, 37(5), 420–445. [https://doi.org/10.1016/S0092-6566\(03\)00021-7](https://doi.org/10.1016/S0092-6566(03)00021-7).
- Riediger, M., Voelkle, M. C., Schaefer, S., & Lindenberger, U. (2014). Charting the life course: Age differences and validity of beliefs about lifespan development. *Psychology and Aging*, 29(3), 503–520. <https://doi.org/10.1037/a0036228>.
- Roberts, S. G. B., & Dunbar, R. I. M. (2011). The costs of family and friends: An 18-month longitudinal study of relationship

- maintenance and decay. *Evolution and Human Behavior*, 32, 186–197. <https://doi.org/10.1016/j.evolhumbehav.2010.08.005>.
- Rosi, A., Cavallini, E., Bottiroli, S., Bianco, F., & Lecce, S. (2016). Promoting theory of mind in older adults: does age play a role? *Aging & Mental Health*, 20(1), 22–28. <https://doi.org/10.1080/13607863.2015.1049118>.
- Ruffman, T., Zhang, J., Taumoepeau, M., & Skeaff, S. (2016). Your way to a better theory of mind: A healthy diet relates to better faux pas recognition in older adults. *Experimental Aging Research*, 42(3), 279–288. <https://doi.org/10.1080/0361073X.2016.1156974>.
- Schaafsma, S. M., Pfaff, D. W., Spunt, R. P., & Adolphs, R. (2015). Deconstructing and reconstructing theory of mind. *Trends in Cognitive Sciences*, 19(2), 65–72. <https://doi.org/10.1016/j.tics.2014.11.007>.
- Siedlecki, K. L., Salthouse, T. A., Oishi, S., & Jeswani, S. (2014). The relationship between social support and subjective well-being across age. *Social Indicators Research*, 117(2), 561–576. <https://doi.org/10.1007/s11205-013-0361-4>.
- Sun, B., Luo, Z., Zhang, W., Li, W., & Li, X. (2018). Age-related differences in affective and cognitive empathy: Self-report and performance-based evidence. *Aging, Neuropsychology, and Cognition*, 25(5), 655–672. <https://doi.org/10.1080/13825585.2017.1360835>.
- Synn, A., Mothakunnel, A., Kumfor, F., Chen, Y., Piguët, O., Hodges, J. R., et al. (2017). Mental states in moving shapes: Distinct cortical and subcortical contributions to Theory of Mind impairments in dementia. *Journal of Alzheimer's Disease*, 61(2), 521–535. <https://doi.org/10.3233/JAD-170809>.
- Thurstone, T. G., & Thurstone, L. L. (1963). *Primary mental ability*. Chicago, IL: Science Research Associates.
- Van den Stock, J., De Winter, F.-L., Stam, D., Van de Vliet, L., Huang, Y.-A., Dries, E., et al. (2019). Reduced tendency to attribute mental states to abstract shapes in behavioral variant frontotemporal dementia links with cerebellar structural integrity. *NeuroImage Clinical*, 22, 101770. <https://doi.org/10.1016/J.NICL.2019.101770>.
- Washburn, A. M., Sands, L. P., & Walton, P. J. (2003). Assessment of social cognition in frail older adults and its association with social functioning in the nursing home. *Gerontologist*, 43(2), 203–212. <https://doi.org/10.1093/geront/43.2.203>.
- Wrzus, C., Hänel, M., Wagner, J., & Neyer, F. J. (2013). Social network changes and life events across the life span: A meta-analysis. *Psychological Bulletin*, 139, 53–80. <https://doi.org/10.1037/a0028601>.
- Wuensch, K. L. (n.d.). Placing a Confidence Interval on Multiple R2. Retrieved July 23, 2018, from <https://core.ecu.edu/psyc/wuensch/StatHelp/CI-R2.htm>.
- Ze, O., Thoma, P., & Suchan, B. (2014). Cognitive and affective empathy in younger and older individuals. *Aging & Mental Health*, 18(7), 929–935. <https://doi.org/10.1080/13607863.2014.899973>.

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