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The Enduring Effects of Mother–Child Interactions on Episodic Memory in Adulthood

Objective: *The objective of this study was to examine the enduring effects of retrospective reports of early-life mother–child interactions on psychosocial and cognitive functioning later in life.*

Background: *Mother–child interactions have been linked to cognitive outcomes in childhood, however, little work has examined whether early-life mother–child interactions have far-reaching effects on episodic memory in adulthood. Early-life mother–child interactions may also influence cognitive functioning in adulthood indirectly through the development of academic competence (education attainment), social competence (marital satisfaction, social support, contact frequency) or depressive symptoms.*

Methods: *Using longitudinal data from the Wisconsin Longitudinal Study sibling respondents (T1: 1993–1994, T2: 2004–2007, T3: 2011; baseline 29–79 years), we examined how retrospective positive mother–child interactions (PMCI) and negative mother–child interactions (NMCI) were independently associated with episodic memory. Structural equation modeling was used to model direct and indirect pathways from PMCI and NMCI to episodic memory and latent change in episodic memory.*

Results: *More PMCI retrospectively reported at T1 were associated with higher T2 memory and less memory decline from T2 to T3 via higher education. In addition, more PMCI were associated with higher T2 memory through greater marital satisfaction. Independent of these indirect effects, more PMCI and NMCI were each associated with higher T2 memory, but not memory change.*

Conclusion: *Mother–child interactions appeared to have an enduring effect on episodic memory in adulthood. These findings highlight the importance of taking an integrative and lifespan approach to assessing how early-life experiences affect socioemotional and cognitive development.*

Individual differences in cognitive aging are shaped not only by late-life experiences but also by a confluence of interrelated events experienced during the life course. For example, early-life adversity has been shown to predict cognitive aging, independent of later life circumstances (e.g., Barnes et al., 2012; Marden, Tchetgen, Kawchi, & Glymour, 2017). Although social relationships measured in late life have consistently been shown to predict cognitive aging outcomes, these social relationships build off previous experiences and reflect a lifetime of social interactions (Antonucci, Ajrouch, & Birditt, 2014). Thus, a life course perspective is needed to inform a more complete understanding of the potential influence of social interactions on cognitive aging.

Early-life social interactions between mothers and children, in particular, have been linked to socioemotional (Fraley, Roisman, & Haltigan, 2013) and cognitive development in childhood (Jeon, Peterson, & DeCoster, 2013). Early-life

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social interactions with mothers form the basis for attachment and subsequently influence how children approach and explore their environment (Bowlby, 1980). Indeed, children with more secure attachments are better at problem-solving and approach cognitive tasks in more productive ways (Bretherton, 1985). In addition, children with more positive relationships with their mothers at age 3 have been found to exhibit higher mental ability at age 4, greater school-relevant skills at ages 5 and 6, and greater school achievement at age 12 (Estrada, Arsenio, Hess, & Holloway, 1987) as well as faster rates of cognitive growth over time in early childhood (Jeon et al., 2013).

Despite substantial prior research linking mother–child interactions to cognitive development in childhood, little work has assessed whether these early-life social interactions have far-reaching effects that extend across the lifespan. These early-life mother–child interactions may not only influence cognitive development in childhood but also may affect cognitive functioning later in adulthood. Therefore, the current study aimed to examine whether retrospective reports of positive mother–child interactions (PMCI) and negative mother–child interactions (NMCI) influence cognitive functioning directly and indirectly through the development of academic competence, social competence, and depressive symptoms later in adulthood.

Indirect Pathway Through Academic Competence

One pathway in which mother–child interactions may influence later cognition is through the development of academic competence. Children with poorer relationships with parents are less likely to thrive in school. This may, in part, be due to the disrupted development of regulatory behaviors (Jeon et al., 2013) such that these children have more difficulty sitting still and paying attention in classroom environments. Indeed, prior research has shown that positive parenting behaviors (support, scaffolding) are associated with better regulatory behaviors (i.e., attention, inhibitory control; Hughes & Devine, 2017) and in turn, school success (Devine, Bignardi, & Hughes, 2016). Furthermore, mother–child interactions may also scaffold the acquisition of basic school-relevant skills, such as letter and number recognition, which prepare children for the classroom environment (Hess, Holloway, Dickson, & Price, 1984) and promote academic achievement (Claessens & Engel, 2013).

Poorer educational outcomes in childhood often perpetuate poorer educational outcomes in adolescence and adulthood. Once a child begins to fall behind, it can be difficult for the child to catch up. For example, reading proficiency in elementary school has been linked to subsequent reading proficiency in later grades (Lesnick, Goerge, Smithgall, Hall, & Gwynne, 2010) as well as the motivation and potential to attend college later on (Armbruster, Lehr, & Osborn, 2001). Thus, early mother–child interactions may have enduring effects on individuals' highest level of educational attainment. Consistent with this hypothesis, children with higher reports of maternal sensitivity and quality of caretaking are less likely to drop out of high school (Jimerson, Egeland, Sroufe, & Carlson, 2000) and achieve better educational outcomes in adulthood (Raby, Roisman, Fraley, & Simpson, 2015). Despite initial findings linking early mother–child interactions to educational outcomes (i.e., Fraley et al., 2013; Jimerson et al., 2000) and evidence for the enduring effects of educational attainment on later life cognition (Evans et al., 1993; Wilson et al., 2009), little work has examined whether educational attainment mediates the relationship between early-life mother–child interactions and cognitive functioning later in adulthood.

Indirect Pathway Through Social Competence

Mother–child interactions in early life may also affect cognition through the development of social competence. Social interactions with mothers are theorized to be the basis for subsequent social relations with peers in childhood and adolescence (Fraley et al., 2013; Gadaire, Henrich, & Finn-Stevenson, 2017; Rah & Parke, 2008) as well as romantic partners in adulthood (Raby et al., 2015). Mother–child interactions shape how children approach social relationships through the modeling of appropriate social behaviors (Bandura & National Institute of Mental Health, 1986). For example, interaction style between mothers and children has been associated with children's social information processing and peer acceptance (Rah & Parke, 2008), and retrospective reports of parental quality have been associated with qualitative and quantitative social resources available in adulthood (Lee et al., 2015). Longitudinal studies further demonstrate that these early-life social experiences have a stable and enduring effect over time. For example, early maternal sensitivity in childhood has an enduring effect on social competence in children from 1st grade through 6th grade (Fraley et al., 2013) and social competence (i.e., romantic relationships) in young adulthood (Raby et al., 2015). These findings are consistent with the notion that early-life social interactions help frame subsequent social interactions and relationships across the life course.

Social competence across the lifespan may facilitate healthy social relationships that are beneficial for cognitive health. For example, more satisfactory social relationships (i.e., greater peer acceptance, marital satisfaction) may provide cognitive, physical, or social stimulation that maintains optimal cognition (see Hertzog, Kramer, Wilson, & Lindenberger, 2009 for a review). By providing social support, more satisfactory social relations may also reduce stress, which tax cognitive resources (Wentzel, 1998). Despite prior research linking mother–child interactions to social competence in childhood and adolescence (Fraley et al., 2013; Raby et al., 2015) and to cognitive development in childhood (Estrada et al., 1987; Jeon et al., 2013), little work has examined whether social competence mediates the relationship between early mother–child interactions and cognitive development at any stage of the life course.

Indirect Pathway Through Depressive Symptoms

Mother–child interactions may also influence cognitive functioning through the development of depressive symptoms. Observed maternal behaviors have been linked to depressive symptoms in childhood (Liu, 2003; Yap, Schwartz, Byrne, Simmons, & Allen, 2010) and retrospective early-life parental support has been linked to depressive symptoms in adulthood (Shaw, Krause, Chatters, Connell, & Ingersoll-Dayton, 2004). Early mother–child interactions may influence the frequency of depressive symptoms in childhood, and an early-life history of depressive symptoms increases the risk of major depressive episodes later in the life course (Horwath, Johnson, Klerman, & Weissman, 1992; Pine, Cohen, Cohen, & Brook, 1999).

Having a lifetime history of depressive symptoms is theorized to be a risk factor for late-life cognitive decline, and depressive symptoms in older adulthood have been linked to faster subsequent declines in cognitive functioning (Lohman et al., 2013; Zahodne, Stern, & Manly, 2014). For example, in a longitudinal study of older adults, an initial level of depressive symptoms was associated with an accelerated rate of memory decline during a 12-year study period. At the within-person level, reporting more depressive symptoms at one visit was also found to predict lower memory at the subsequent visit (Zahodne et al., 2014). These studies provide the rationale for the hypothesis that depressive symptoms in adulthood may mediate the effects of early-life mother–child interactions on later life cognitive outcomes.

PMCI and NMCI

PMCI and NMCI are distinct facets of children's social experience and may independently influence socioemotional and cognitive outcomes later in adulthood. For example, in a cross-sectional study, positive (constructive, supportive) and negative (destructive, harsh) parenting behaviors were only slightly correlated, and both independently predicted children's depressive symptoms (Dallaire et al., 2006). Furthermore, maternal supportive behaviors and controlling behavior have been independently linked to adolescent socioemotional development (Laible & Carlo, 2004) and executive functioning (Hughes & Devine, 2017)

Although negative social exchanges are often fewer in number relative to positive social exchanges (Rook, 2001), negative social exchanges have a disproportionate impact on socioemotional outcomes. For example, in a cross-sectional study, a higher frequency of aversive maternal behavior during mother–child interactions was associated with greater adolescent reported depressive symptoms and less effective regulation of positive and negative affect, controlling for positive maternal behaviors (Yap et al., 2010). In contrast, positive maternal behavior was only associated with regulation of positive affect, and this effect was limited to females (Yap et al., 2010). In another study examining social exchanges in older adults, positive exchanges were less strongly related to psychological well-being than negative social exchanges and were unrelated to psychological distress (Newsom, Rook, Nishishiba, Sorkin, & Mahan, 2005). These studies provide rationale for the hypothesis that NMCI may have a greater impact on cognitive health relative to PMCI.

The Present Study

To examine whether PMCI and NMCI have enduring effects on cognitive functioning across the life course, the current study investigated how retrospective reports of early-life mother–child interactions were associated with cognition later in adulthood. Past research has found that retrospective reports of childhood events are relatively stable over time (Rossi & Rossi, 1990; Yancura & Aldwin, 2009) and accurately represent early-life conditions. Given that episodic memory is a highly sensitive indicator of late-life cognitive decline (i.e., Daselaar & Cabeza, 2013) and one of the strongest predictors of dementia risk (i.e., Boraxbekk et al., 2015; Grober, Lipton, Hall, & Crystal, 2000), we focused our analyses on episodic memory as a meaningful indicator of later cognitive functioning in an adult lifespan sample (29–79 years at baseline).

In the current study, we aimed to examine whether academic competence, social competence, and depressive symptoms mediate the relationship between retrospective mother–child interactions and episodic memory. We hypothesized that more PMCI would be associated with higher academic competence, higher social competence and lower depressive symptoms, whereas the inverse associations were predicted for NMCI. In turn, we hypothesized that higher academic competence, higher social competence, and lower depressive symptoms would each be independently associated with better initial episodic memory and less subsequent episodic memory decline. We also aimed to examine the direct impact of mother–child interactions on episodic memory in later life independent of academic competence, social competence, and depressive symptoms. We hypothesized that more PMCI would be associated with higher initial memory and less decline in memory, whereas more NMCI would be associated with lower initial memory and greater decline in memory.

Methods

Participants

Participants were a part of the sibling cohort of the Wisconsin Longitudinal Study (WLS). The WLS is a longitudinal study that originally collected data from recent high school graduates in Wisconsin starting in 1957. Subsequently, one younger or older sibling of each graduate respondent was initially recruited in 1977 and followed longitudinally across the following three subsequent time points: 1993–1994 (T1), 2004–2007 (T2), and 2011 (T3). Additional details regarding the WLS's longitudinal design and sampling and all assessment instruments are available on the WLS website (https://www.ssc.wisc.edu/wlsresearch/).

Only the sibling cohort was included in the current analyses because retrospective reports of mother–child interactions were only collected on sibling respondents at T1. These sibling respondents were an age-heterogeneous sample. At T1, the sibling cohort included 4,803 adults ranging in age from 29 to 79 years ($M_{age} = 53.22$, $SD = 7.38$, 42.2% female). At T2, 4,270 participants from the original sample (return rate 88.90%) were reexamined. The respondents ranged in age from 34 to 88 years ($M_{age} = 63.93$, $SE = 7.11$, 45.3% female). Attrition from T1 to T2 did not alter the composition of childhood socioeconomic status (SES), NMCI, or PMCI of the sample; however, when compared with T2 nonreturnees, the T2 returnees were younger, $F(1, 4{,}803) = 35.10$, $p < .001$, $\eta^2 = .01$; healthier, $F(1, 3{,}480) = 58.78$, $p < .001$, $\eta^2 = .02$; had higher education, $F(1, 4{,}801) = 69.23$, $p < .001$, $\eta^2 = .01$; and were more likely to be female, $F(1, 4{,}803) = 15.46$, $p < .001$, $\eta^2 = .003$. The final assessment, T3, included 3,397 participants from the original sample (Wave 1 return rate 70.27%; Wave 2 return rate 79.27%). The participants in T3 ranged in age from 40 to 92 years ($M_{age} = 69.24$, $SD = 6.79$; 44.2% female). Attrition from T2 to T3 did not significantly alter the composition of gender, childhood SES, martial satisfaction, depressive symptoms, social participation, social support, or NMCI of the sample. When compared with T2 nonreturnees, the T3 returnees were significantly younger, $F(1, 4{,}803) = 75.02$, $p < .001$, $\eta^2 = .02$; healthier, $F(1, 3{,}480) = 36.07$, $p < .001$, $\eta^2 = .01$; had higher education, $F(1, 4{,}801) = 59.82$, $p < .001$, $\eta^2 = .01$; higher T2 memory, $F(1,$

Table 1. *Means and Standard Deviations for Memory, Marital Satisfaction, Depressive Symptoms, Education, and Episodic Memory*

Variables	*M*	*SD*	Range
T1 age	53.23	7.38	29–79
T1 female, %	49.50	—	—
T1 non-Hispanic White, %	99%	—	—
T1 married, %	80%	—	—
T1 health	4.11	0.69	1–5
T1 childhood socioeconomic status	3.15	0.57	1–5
T1 education	13.62	2.53	0–21
T2 marital satisfaction	4.81	0.96	1–6
T2 contact frequency	6.27	5.51	0–50
T2 social support	3.73	0.96	1–5
T2 depressive symptoms	7.92	7.73	0–56
T1 PMCI	2.01	0.66	0–3
T1 NMCI	0.66	0.55	0–3
T2 episodic memory	−0.03	0.95	−3.56 to 2.68
T3 episodic memory	−0.01	0.91	−2.94 to 3.18

Note. T1 = 1993–1994; T2 = 2004–2007; T3 = 2011; PMCI = positive mother–child interactions; NMCI = negative mother–child interactions.

2,538) = 18.30, $p < .001$, $\eta^2 = .01$; more PMCI, $F(1, 3{,}371) = 4.702$, $p = .030$, $\eta^2 = .001$; and greater social support, $F(1, 3{,}171) = 5.54$, $p = .019$, $\eta^2 = .002$. The final sample consisted of 3,392 participants, and characteristics of the sample are provided in Table 1. Overall, the participants were, on average, 53.23 years old at T1 ($SD_{age} = 7.38$), 49.50% female, 80% married, and 99% non-Hispanic White.

Measures

Mother–Child Interactions. Mother–child interactions during the first 16 years of life were measured retrospectively at T1 with nine items, including five items querying PMCI ("How much did your mother enjoy talking to you?" "How much did your mother help when you needed?" "How much did your mother want you to go to college?" "How much did your mother want to know your friends?" "How much did your mother want to hug you?"*)* and four items querying NMCI *(*"How much did your mother let you make your own decisions?"[reverse-coded], "How much did your mother slap/shove/throw things at you?" "How much did your mother insult or swear at you?" "How much did your mother try to control everything you did?"*)*. The responses ranged from *not at all* (0) to *a lot* (3). To assess the underlying structure of these items, an exploratory factor analysis was conducted. A two-factor structure corresponding to PMCI and NMCI was supported. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (.79) was sufficient. Similarly, Barlett's test of sphericity was significant, $\chi^2(36) = 8{,}214.53$, $p < .001$. A comparison of model fit between a two-factor model, $\chi^2(26) = 770.15$, CFI = .91, RMSEA = 0.05 [0.05, 0.06] $p = .082$, and a one-factor model, $\chi^2(27) = 2{,}265.85$, $p < .001$, CFI = .74, RMSEA = 0.09 [0.09, 0.10], $p < .001$, revealed that the two-factor model had significantly better model fit, $\Delta\chi^2$ (1) = 1,495.70, $p < .001$. The items were averaged to create PMCI and NMCI ($.80 > \alpha > .70$), and the two domains were negatively correlated ($r = -.31$, $p < .001$).

Episodic Memory. Episodic memory was measured at T2 and T3 with a test of immediate and delayed recall. The participants were read a list of 10 words and asked to recall as many as they could immediately afterward. The participants were then asked to recall the words again approximately 8 minutes later. The total number of correct words recalled during immediate and delayed recall trials were converted into separate z-scores using means and standard deviations from T2, and z-scores were averaged at each time point to create composite scores for episodic memory.

Academic Competence. Consistent with previous literature (Raby et al., 2015; 2018), academic competence was operationalized as highest level of education achieved. Current level of education at T1 was measured through a single self-report item indicating the number of school years completed (0–21). Number of years of education were centered ($M = 13.62$) in the current analyses.

Social Competence. Social competence was assessed with the following three measures: marital satisfaction, contact frequency, and social support. Marital satisfaction, an age-relevant developmental task (Roisman, Masten, Coatsworth, & Tellegen, 2004), was measured at T2 with six items, including the following: "How satisfied are you with your day-to-day support and encouragement provided by your spouse?" "How satisfied are you with the way disagreements are settled?" The responses ranged from *very dissatisfied* (1) to *very satisfied* (6). Marital satisfaction scores were calculated by averaging responses across items. Internal consistency for marital satisfaction was high ($\alpha = .95$). Contact frequency at T2 was measured by asking participants to identify the number of occasions in which they got together with friends (one item) and with family (one item) such as going out together or visiting each other's homes within the past 4 weeks. A sum score was created across friends and family to represent contact frequency where higher scores represented greater contact frequency. Finally, social support from relationships other than spouse and children at T2 was measured with the following two items: "How much do your friends and relatives, other than your spouse or children, make you feel loved or cared for?" "How much are your friends and relatives, other than your spouse or children, willing to listen to you when you need to talk about your worries or problems?" Each item was rated from *none* (1) to *a lot* (5), and the scores were averaged across the two items. Higher scores represented greater social support ($\alpha = .80$).

Depressive Symptoms. Depressive symptoms were assessed at T2 using the Center for Epidemiologic Studies Depression (Radloff, 1977) questionnaire. The 20-item Center for Epidemiologic Studies Depression questionnaire asks how frequently in the past 7 days participants had experienced 20 symptoms of depression, such as "feeling blue" or "crying spells." The responses ranged from 0 (*0 days*) to 7 (*7 days*). Consistent with previous research using the WLS (e.g., Roetker et al., 2012), the scores were converted to match the traditional scale. Specifically, the responses were recoded to zero ("<1 day"), one ("1–2 days"), two ("3–4 days"), or three ("5–7 days"), and the overall sum score could range from 0 to 60. Internal consistency for depressive symptoms was adequate ($\alpha = .88$).

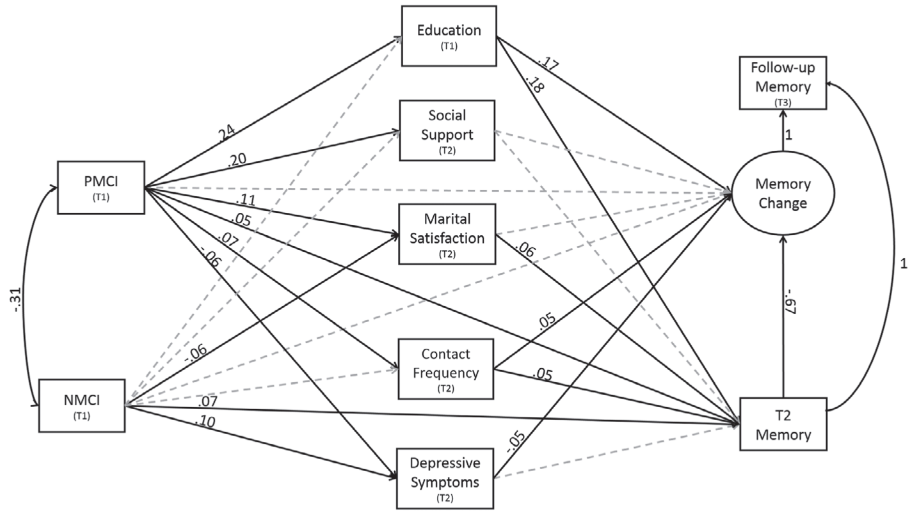
Covariates. Prior research has shown that age (Old & Naveh-Benjamin, 2008), gender, (Aartsen, Martin, & Zimprich, 2004) and early-life SES (Marden et al., 2017) influence cognitive aging. Because these variables could also influence maternal relationship quality, they were included as covariates in our analyses. In addition, prior research has shown that maternal relationship quality may influence marital status (Adamczyk & Bookwala, 2013) and self-reported health (Chopik & Edelstein, 2018), we controlled for these to isolate the specific psychosocial pathways (i.e., academic competence, social competence, and depressive symptoms) linking mother–child interactions and later life memory.

Age and gender (1 = "male," 2 = "female") were self-reported by participants at T1. Self-reported health was assessed at T1 with a single item asking participants how they would rate their current health on a five-point scale ranging from *very poor* (1) to *excellent* (5). Childhood SES was assessed with the following single item: "How does your family income or wealth compare with families in your community?" The responses ranged from *considerably below average* (1) to *considerably above average* (5). Marital status was assessed at T1 and was represented as a binary item (0 = "no partner," 1 = "partnered").

Analytic Strategy

Structural equation models were conducted in Mplus (Muthén & Muthén, 2007). Longitudinal episodic memory functioning was examined using latent difference scores (McArdle & Nesselroade, 1994). By modeling the portion of the follow-up value that is not identical to the initial T2 value, latent difference scores quantify longitudinal change in memory functioning over the two time points better than a raw difference between T2 and T3 memory. In the latent difference scores model, features

FIGURE 1. MEDIATIONAL PATHWAYS FROM POSITIVE MOTHER–CHILD INTERACTIONS (PMCI) AND NEGATIVE MOTHER–CHILD INTERACTIONS (NMCI) TO EPISODIC MEMORY THROUGH EDUCATION, MARTIAL SATISFACTION, AND DEPRESSIVE SYMPTOMS.



Note. Standardized estimates are reported. Nonsignificant paths are depicted with dotted gray lines. For simplicity, covariate effects and covariances between mediators are not included.

of change that are of interest (mean change, interindividual variability in change, relationship between initial T2 value and change) are modeled as explicit parameters (McArdle, 2009). In a single model, T2 memory and memory change from T2 to T3 were regressed on education, marital satisfaction, contact frequency, social support, depressive symptoms, PMCI and NMCI, and all covariates. All psychosocial mediators were regressed on PMCI and NMCI and were allowed to covary. Indirect effects were defined as the product of the association between mother–child interactions and a mediator (i.e., the mediators; education, marital satisfaction, contact frequency, social support, or depressive symptoms) and the association between that mediator and either T2 memory or memory change. Direct effects were defined as associations between PMCI or NMCI and T2 memory or memory change, independent of all mediators and covariates.

RESULTS

Model fit was adequate, $\chi^2(4) = 46.44$, $p < .001$, CFI = .99, SRMR = .01, RMSEA = 0.06 [0.04, 0.07] $p = .226$, and mediational pathways are depicted in Figure 1. Significant covariation emerged between mediators. Specifically, higher education was associated with lower depressive symptoms (standardized covariance = −.05, $SE = .02$, $p < .001$). More depressive symptoms were associated with lower marital satisfaction (standardized covariance = −.31, $SE = .03$, $p < .001$), lower contact frequency (standardized covariance = −.10, $SE = .02$, $p < .001$), and lower social support (standardized covariance = −.20, $SE = .02$, $p < .001$). Higher martial satisfaction was associated with higher contact frequency (standardized covariance = .09, $SE = .02$, $p < .001$) and higher social support (standardized covariance = .18, $SE = .02$, $p < .001$). Finally, higher contact frequency was associated with higher social support (standardized covariance = .19, $SE = .02$, $p < .001$).

T2 Memory

As shown in Table 2, retrospectively reported PMCI at T1 were associated with T2 memory indirectly through education and martial satisfaction. Specifically, more PMCI were associated with higher education ($\beta = .24$, $SE = .02$, $p < .001$) and martial satisfaction ($\beta = .11$, $SE = .02$, $p < .001$). In turn, higher education ($\beta = .18$, $SE = .02$, $p < .001$) and higher marital satisfaction ($\beta = .06$, $SE = .03$, $p = .024$) were each independently associated

Table 2. *Direct and Indirect Effects of Positive and Negative Mother–Child Interactions on Initial T2 and Latent Change in Episodic Memory*

Variables	T2 memory		LDS memory	
	β	*SE*	*β*	*SE*
PMCI				
Direct effect	.05*	.02	−.02	.02
Indirect effects				
Education	.04***	.02	.04***	.01
Marital satisfaction	.01*	.00	−.00	.00
Contact frequency	.00	.00	.00	.00
Social support	−.00	.00	.00	.01
Depressive symptoms	.00	.00	.00	.01
NMCI				
Direct effect	.07**	.02	−.01	.02
Indirect effects				
Education	.00	.00	.00	.00
Marital satisfaction	−.00	.00	.00	.00
Contact frequency	−.00	.00	−.00	.00
Social support	.00	.00	.00	.00
Depressive symptoms	−.00	.00	−.01	.01
Covariates				
Age	−.24***	.02	−.25***	.02
Female	.30***	.02	.11***	.02
Health	.05*	.02	.00	.02
Childhood socioeconomic status	.03	.02	−.02	.02
Married	.03	.02	.03	.02
T2 memory	—	—	−.67***	.02

Note. T2 = 2004–2007; PMCI = positive mother–child interactions; NMCI = negative mother–child interactions; LDS = latent difference score.
*$p < .05$. **$p < .01$. ***$p < .001$.

with higher T2 memory. Although more PMCI were associated with higher contact frequency ($\beta = .07$, $SE = .02$, $p < .001$), and higher contact frequency was associated with greater T2 memory ($\beta = .05$, $SE = .02$, $p = .041$), no significant indirect effect emerged. More PMCI were also associated with fewer depressive symptoms ($\beta = -.06$, SE = .02, $p = .004$) and greater social support ($\beta = .20$, $SE = .02$, $p < .001$); however, depressive symptoms ($\beta = -.04$, $SE = -.03$, $p = .090$) and social support ($\beta = -.02$, $SE = .02$, $p = .324$) were not significantly associated with T2 memory. Independent of the indirect effects, there was also a significant direct effect such that more PMCI were associated with higher T2 memory independent of all psychosocial mediators and covariates.

No significant indirect effects of NMCI emerged for T2 memory. More NMCI were, however, significantly associated with more depressive symptoms ($\beta = .10$, $SE = .02$, $p < .001$) and lower marital satisfaction ($\beta = -.06$, $SE = .03$, $p = .017$). NMCI were not associated with education ($\beta = .03$, $SE = .02$, $p = .122$), social support ($\beta = .00$, SE = .02, $p = .990$), or contact frequency ($\beta = -.02$, $SE = .02$, $p = .365$). There was also a significant direct effect such that more NMCI were associated with higher T2 memory, independent of all psychosocial mediators and covariates.

With regard to covariates, age, health, and gender each significantly predicted T2 memory. That is, better health and being female were associated with higher T2 memory whereas older age was associated with lower T2 memory. Overall, this model accounted for 20% of the variance in T2 memory.

Latent Change in Memory

For latent change in episodic memory, an indirect effect of PMCI was found through education. That is, more PMCI were associated with higher education (estimate previously provided), and higher education ($\beta = .17$, $SE = .02$, $p < .001$) was associated with less memory decline from T2 to T3. In addition, greater contact frequency was associated with less memory decline ($b = .05$, $SE = .02$, $p = .024$), and more depressive symptoms was associated with more memory decline ($b = -.05$, $SE = -.02$, $p = .048$). Contact frequency and depressive symptoms, however, did not mediate the relationship between mother–child interactions (positive or negative) and memory change. After accounting for mediators and covariates, no direct effect of PMCI emerged.

Similar to T2 memory, no indirect effect of NMCI on memory change emerged. In addition, no direct effect of NMCI on memory change emerged. With regard to covariates, age, T2 memory, and gender were significantly associated with memory change. Older age and higher T2 memory were associated with greater decline in memory. Being female was associated with less decline in memory functioning. Overall, this model accounted for 38% of the variance in memory change from T2 to T3.

Discussion

The primary goal of the current study was to investigate the life course effects of PMCI and NMCI on episodic memory in adulthood through academic competence, social competence, and depressive symptoms. We found indirect effects of PMCI on T2 memory and memory change through educational attainment. Specifically, more PMCI during the first 16 years of life predicted higher education in adulthood, which predicted less decline in memory over time. In addition, we found that more PMCI were associated with better T2 memory through higher marital satisfaction. Contrasting with our hypotheses, we found no indirect effects of NMCI on episodic memory through psychosocial pathways. After accounting for indirect pathways, more PMCI and more NMCI were still each directly associated with better T2 memory, but not memory change. These results provide evidence for the broad and enduring effects of early-life maternal relationships on later life developmental processes.

Indirect Effects of PMCI Through Academic Competence

Educational attainment was found to mediate the relationship between PMCI and episodic memory, but not NMCI. Thus, positive maternal behaviors may be more important for educational outcomes than negative maternal behaviors. Positive maternal behaviors may have a beneficial impact on children's regulatory abilities, which contribute to their success in school. Regulatory behaviors (i.e., attention, inhibitory control) are important skills that help to promote appropriate classroom behavior (i.e., sitting still, follow directions, sharing). When mother–child interactions are warm and supportive, parents are better able to focus their children's attention and guide their behavior (Hoffman, 2000; Hughes & Devine, 2017). Longitudinal research has demonstrated that positive parenting behaviors in childhood are associated with better effortful control (i.e., inhibitory control, attentional capacity) and, subsequently, better behavioral outcomes (Eisenberg et al., 2005). Children who demonstrate growth in regulatory skills over time also exhibit growth in reading and math achievement between kindergarten and second grade (McClelland, Acock, & Morrison, 2006), consistent with the notion that regulatory skills are a vital skill for success in the classroom. Thus, it is possible that the beneficial effects of positive maternal behaviors on academic outcomes, such as the likelihood of graduating high school (Gregory & Rimm-Kaufman, 2008; Jimerson et al., 2000), may reflect better development of regulatory behaviors.

PMCI may also influence education and subsequent episodic memory through the acquisition of foundational skills. Specifically, PMCI may help to scaffold the development of foundational skills such as letter and number recognition necessary for success in school early on (Hughes & Devine, 2017; Swartz, Kim, Uno, Mortimer, & O'Brien, 2011). Basic numeracy and literacy before entry into school have been linked to both maternal behaviors and academic success (Estrada et al., 1987; Hess et al., 1984). These emergent literacy and numeracy skills show high developmental stability from kindergarten to first grade (Lonigan, Burgess, & Anthony, 2000). Indeed, children with higher levels of foundational skills at kindergarten entry are more likely to have higher school achievement over time (Claessens & Engel, 2013), suggestive that children who start off with a strong academic skill set will continue to have an advantage as they progress through school. More advanced skills build on these foundation skills and therefore put children with higher knowledge upon school entry at an advantage. In addition, children often receive feedback from their educational environment (i.e., teacher, peers) that encourages or discourages them to engage with academic material that may bolster or hinder educational attainment.

Overall, PMCI may help build important school-relevant skills such as regulatory ability and basic literacy and numeracy, which help to prepare children for the classroom environment and in turn help to promote higher educational attainment. Educational attainment has been shown to be a strong protective factor for later life memory decline and dementia risk (Evans et al., 1993; Wilson et al., 2009). These findings highlight the importance of taking a life course perspective and examining how early-life factors such as mother–child interactions may influence the acquisition of this important protective resource and in turn cognitive functioning over the lifespan.

PMCI and NMCI and Depressive Symptoms

Retrospectively reported PMCI and NMCI at T1 were prospectively associated with a decrease and increase in depressive symptoms 10 years later, respectively. Through these early-life interactions, mothers may model regulated or dysregulated behaviors for children to imitate (i.e., social learning; Bandura & National Institutes of Mental Health, 1986). For example, in a study examining harsh parenting in Chinese parents and their preschool-aged children, greater reports of harsh parenting from both parents were associated with poorer emotion regulation skills in their children, and this led to greater aggression in school (Chang, Schwartz, Dodge, & McBride-Chang, 2003). Parents who display dysregulated behaviors may lower their children's ability to regulate their own behaviors (Eisenberg et al., 1999) and in part lead to higher reports of negative emotions in adulthood. Conversely, parents who display warm and supportive behaviors may help to enhance their children's ability to regulate their own behaviors (Dix, 1991) and lead to lower reports of negative emotions in adulthood. Positive parenting behaviors may help to convey constructive ways for their children to regulate their emotional responses to stress (Power, 2004).

Furthermore, positive and negative early-life social experiences with mothers may influence depressive symptoms through the development of self-worth and self-esteem. Indeed, prior research has theorized that children's self-perceptions of value are, in part, learned from how important others regard them (i.e., caretakers in early life; Bowlby, 1973; Elicker, Englund, & Sroufe, 1992). Consistent with this notion, prior research has shown that higher parental relationship quality, involvement, and availability are associated with higher self-esteem (Bulanda & Majumdar, 2009) and that self-worth mediates the relationship between parenting behaviors and depressive symptoms in adolescence (Gaber, Robinson, & Valentiner, 1997). Overall, our findings coincide with prior research that found that negative interactions with parents can lead to higher reports of depressive symptoms, distress, and poorer emotion regulation skills in childhood (Liu, 2003; Yap et al., 2010), whereas positive interactions with parents are associated with lower depressive symptoms (Dallaire et al., 2006; Liu, 2003). Overall, PMCI and NMCI may limit the development of socioemotional skills and feelings of self-worth that are important for managing depressive symptoms throughout the life course.

Similarly, our finding that depressive symptoms were associated with greater memory decline is consistent with previous research (Lohman et al., 2013; Zahodne et al., 2014). Depressive symptoms, however, were not a significant mediator of the effects of mother–child interactions on episodic memory despite that both PMCI and NMCI were independently associated with depressive symptoms, and more depressive symptoms were associated with greater memory decline. Thus, our findings contrast with our hypothesis that early-life mother–child interactions influence cognition through the development of depressive symptoms. The lack of an indirect effect may be due to the inclusion of qualitative and quantitative social measures, which could account for some of the effects of depressive symptoms and memory functioning. Specifically, prior research has shown that depressive symptoms decreases engagement in leisure activities (Leibold, Holm, Raina, Reynolds, & Rogers, 2014; Szczepanik et al., 2017) and thus it may be the case that depressive symptoms operate partially through social engagement.

PMCI and NMCI and Social Competence

Consistent with our hypotheses, more PMCI were significantly associated with higher marital satisfaction, higher contact frequency, and higher social support later in life. More NMCI were associated with lower marital satisfaction, but not social support or contact frequency, partially consistent with our hypotheses. Our findings coincide with prior research that found that maternal behaviors in childhood have an enduring effect on social competence across the lifespan (i.e., Fraley et al., 2013; Raby et al., 2015). When mothers are responsive and supportive, children may develop a sense that others are generally available (i.e., secure attachments; Bigelow et al., 2010). If mothers are unresponsive or inattentive, children may develop a working model that emphasizes the inconsistency of others (i.e., insecure attachments; Bigelow et al., 2010; for a review, see Siegler, DeLoache, & Eisenberg, 2011). Internal working models of attachment are relatively stable over time, and subsequent attachments in adulthood (e.g., with romantic partners) tend to mirror internal working models of attachment developed in childhood (Waters, Merrick, Treboux, Crowell, & Albersheim, 2000).

Mother–child interactions may also influence social competence through the modeling of socially appropriate behaviors. Early-life social interactions with mothers help to teach children social etiquette through observational learning. In particular, social learning theory (Bandura & National Institute of Mental Health, 1986) emphasizes that learning is inherently a social process and is largely based on observations of others during childhood. In a classic example, children who observed an adult acting aggressively toward a bobo doll, when placed alone in the room with the same bobo doll, often modeled the aggressive behavior they had seen (Bandura, Ross, & Ross, 1961). Thus, if a child observes aggressive and unsupportive behaviors from their parent, they may exhibit similar behaviors in subsequent social relationships. If a parent demonstrates positive and supportive behaviors, their children may be more likely to act more supportive and positive toward social partners in adulthood and in turn, have greater social resources (i.e., marital satisfaction, contact frequency, social support). For example, in a longitudinal study, secure attachments at 15 months were prospectively associated with greater social activity, greater popularity, greater prosocial behaviors, and less withdrawal and social anxiety at 8 ½ years old (Bohlin, Hagekull, & Rydell, 2000). Similarly, in a longitudinal study examining attachment in adolescents in summer camp, more securely attached children spent more time with their peers, showed more interpersonal sensitivity, and demonstrated greater positive bias when evaluating their peers' performance compared to children who were insecurely attached (Elicker et al., 1992).

Overall, children with more PMCI may demonstrate greater social competence in later life through the development of secure internal working models of attachment and the development of socially appropriate behaviors. These children, through their interactions with parents, may have instilled in them more positive expectations regarding social interactions (i.e., people are trustworthy and available) and in turn have greater satisfaction with intimate relationships, greater availability of social support, and more frequency contact with social partners. Furthermore, children with more NMCI may be less likely to have a healthy attachment style and may in turn have lower satisfaction with intimate relationships in adulthood.

Indirect Effects of PMCI on Memory Through Social Competence

Although PMCI were positively associated with the availability of social resources in later life, a significant indirect effect of PMCI on T2 memory only emerged through marital satisfaction. Scant research has examined the relationships between marital satisfaction and cognition in adulthood; however, our findings coincide with prior research examining marital status and cognition (Gow & Mortensen, 2016; Håkansson et al., 2009) and martial quality and health outcomes (Choi, Yorgason, & Johnson, 2016). For example, prior research has shown that individuals who report having a supportive spouse as well as being perceived as supportive themselves report less disability and better self-reported health (Choi et al., 2016). In a wound-healing study, local cytokine production was lower and wound healing was slower following conflicts than after supportive interactions between married couples (Kiecolt-Glaser et al., 2005). Overall, these findings suggest that a satisfying marriage may provide beneficial resources (i.e., emotional support) that help to alleviate stress that can tax cognitive resources (Wentzel, 1998).

Of note, marital satisfaction was only associated with concurrent memory functioning, not with longitudinal memory change. Therefore, these findings cannot rule out reverse causation. That is, individuals with lower memory may have worse marital satisfaction. These findings highlight the need for further investigation linking marital satisfaction and cognitive functioning in later life. It may be the case that effects occur at a finer grained time scale. Prior research has shown marital quality to exhibit substantial fluctuation over time (i.e., intraindividual variability; Xu, Thomas, & Umberson, 2016) and therefore, linking marital satisfaction and memory functioning years later may not accurately portray its relationship.

Finally, although PMCI predicted both higher contact frequency and greater social support, neither of these social competence variables mediated associations between PMCI and memory. This pattern of results suggests that these aspects of social competence may be less consequential for later life cognitive health than marital satisfaction. It may be that intimate relationships (i.e., marriage) may play a more critical role in cognitive aging than nonintimate relationships (i.e., other familial ties and friendships). However, it is also possible that this pattern of results reflects differences in the specificity of the measures used to operationalize social competence. That is, contact frequency and social support were assessed more broadly across the individual's social networks (i.e., friends and family), whereas marital satisfaction assessed a more specific relationship (i.e., spouse/partner). Therefore, future research should use more comprehensive measures of various types of social resources to clarify potential links between early-life mother–child interactions and cognition through social competence.

Distinctions Between PMCI and NMCI

We also aimed to assess the distinct effects PMCI and NMCI on later life socioemotional and cognitive outcomes. Contrasting with our original hypothesis that negative interactions would have a disproportionate effect on psychosocial and cognitive development, we found that both PMCI and NMCI impacted cognitive functioning in adulthood. Furthermore, we found that PMCI had a broader impact on psychosocial functioning later in life when compared with NMCI. Although prior research has found that both positive and negative parenting behaviors independently influenced socioemotional development in children (i.e., Dallaire et al., 2006; Laible & Carlo, 2004), other work suggests that negative interactions have a greater impact (Rook, 2001; Yap et al., 2010).

Previous reports of disproportionate effects for negative interactions compared with positive interactions may be due in part to the method of measurement. Positive social exchanges may influence well-being to a lesser extent than negative social exchanges because of the individual's appraisal of the interaction. That is, positive social exchanges may not always be viewed as positive (i.e., unwanted support or advice). Prior research has demonstrated that appraisals mediate the relationship between positive and negative social exchanges and well-being (Newsom et al., 2005). Furthermore, not only does positive parenting (i.e., supportiveness, warmth) affect development but the consistency of these positive parenting behaviors in childhood is also critical (Landry, Smith, Swank, Assel, & Vellet, 2001). In the current study, only retrospective reports of maternal behaviors were available. Adults reflecting on positive and negative interactions with their mothers in childhood may better capture the individual's appraisals and thus more accurately highlight the benefits of PMCI. Furthermore, by asking about these mother–child interactions retrospectively, they may capture overall consistency (i.e., did your mother typically hug you or enjoy talking to you) rather than a single event. These may represent more stable (i.e., consistent) PMCI and may have a greater impact on later life outcomes.

Direct Effects of Mother–Child Interactions and Episodic Memory

Significant direct effects of both PMCI and NMCI on T2 memory indicate that academic competence, social competence, and depressive symptoms only partially explained the relationship between early-life mother–child interactions and episodic memory later in adulthood. Consistent with our hypothesis, we found that PMCI reported at T1 positively predicted T2 memory. This finding coincides with past research that found that supportive and positive maternal behaviors are critical for cognitive development in childhood (e.g., Estrada et al., 1987; Jeon et al., 2013) and demonstrates the implications of early-life social interactions with mothers for cognitive functioning not only in childhood but also across the lifespan.

With regard to NMCI, we similarly found that these negative interactions were positively related to T2 memory, contrasting with our hypothesis. Specifically, accounting for psychosocial pathways and covariates, those with greater NMCI had better T2 memory. Although we hypothesized that negative interactions may hinder cognitive development, the presence of some NMCI may actually be beneficial. For example, take the following scenario: A child is asked to share some of his or her favorite snack with his or her sibling. The child may think that "mommy was being mean and unfair to me!" when, in fact, this mother–child interaction may provide meaningful information to the child (importance of sharing; social bonding). Some prior research has found that monitoring—a form of controlling parental behavior—was associated with the prevention of adolescent alcohol use and deviant behavior (Barnes & Farrell, 1992). Therefore, controlling behaviors (i.e., mother tried to control everything), which are categorized as negative, may have some beneficial effects. Still, additional longitudinal investigations with cognitive measures both in childhood and later in adulthood are needed to disentangle what aspects of PMCI and NMCI may help or hinder cognitive development across the lifespan.

Limitations and Future Directions

Although the current study highlights the importance of examining cognitive aging from a lifespan perspective and the long-term impact of early social environment, there are some notable limitations. First, the current study used retrospective reports of positive and negative interactions with mothers in early life from T1. Although retrospective reports may be prone to recall bias (Hardt & Rutter, 2004), the fact that these retrospective reports prospectively predicted education, depressive symptoms, martial satisfaction, contact frequency, social support, and episodic memory 10 years later (T2) reduces concerns about reverse causation. Furthermore, prior research has found that retrospective reports of parent–child interactions are relatively stable from adolescence to adulthood (Rossi & Rossi, 1990) and in adulthood (Yancura & Aldwin, 2009). In addition, prior research has suggested that children's perceptions of their parents' behaviors are a stronger predictor of childhood outcomes than actual parental behavior (Barnes & Farrell, 1992). Still, future research should use additional sources of mother–child interactions such as maternal reports and observations obtained in childhood. To our knowledge, no study has used observational mother–child interaction data to predict cognition in middle-age and older adulthood.

Second, episodic memory was only assessed at two time points, and thus growth curve modeling could not be used to obtain precise estimates of memory slope. Furthermore, episodic memory was not collected at T1, and therefore there may be initial level differences in episodic memory related to retrospective reports of mother–child interactions. Future research should use three or more time points to better estimate episodic memory trajectories, which may not be linear and control for initial episodic memory level in subsequent analyses. Third, although the current study used a large age-heterogeneous sample, future research should still replicate these findings with more diverse samples. Specifically, a majority of participants in the WLS sibling sample were from the same birth cohort (1928–1945) and identify as being non-Hispanic White (99%).

Finally, the current study can only theorize about the underlying mechanisms of how early-life social experiences may impact socioemotional and cognitive pathways. We theorized that mother–child interactions may impact these outcomes through social modeling, development of regulatory abilities, and internal working models of attachment; however, we cannot directly examine whether these are the pathways by which mother–child interactions influence these processes in adulthood with the current data set. Furthermore, our mediators only partially mediated the relationship between early-life social interactions and episodic memory later in life, suggesting that other mechanisms may also contribute to the link between early-life social interactions and cognition later in adulthood. Therefore, future research would benefit from further investigating the underlying mechanisms linking childhood social environment to socioemotional and cognitive development in adulthood.

The methodological strengths of this article include the longitudinal design, the examination of multiple mediational pathways between early-life mother–child interactions and episodic memory, and the examination of latent change in episodic memory in addition to T2 memory. The inclusion of both PMCI and NMCI also helped to disentangle the independent effects of positive and negative interactions in childhood.

Conclusion

In conclusion, both PMCI and NMCI appear to have enduring effects on longitudinal episodic memory in older adulthood. This link between PMCI and longitudinal episodic memory is partially explained by higher academic competence and greater marital satisfaction. These findings highlight the importance of examining both positive and negative interactions in childhood on later life outcomes. Furthermore, these findings highlight the importance taking a life course perspective in assessing how early-life social outcomes may influence the psychosocial resources available in adulthood that help to preserve episodic memory across the adult lifespan.

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