Emotion knowledge and autobiographical memory across the preschool years:
A cross-cultural longitudinal investigation

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Abstract

Knowledge of emotion situations facilitates the interpretation, processing, and organization of significant personal event information and thus may be an important contributor to the development of autobiographical memory. This longitudinal study tested the hypothesis in a cross-cultural context. The participants were native Chinese children, Chinese children from first-generation Chinese immigrant families in the U.S., and European American children. Children’s developing emotion knowledge and autobiographical memory were assessed three times at home, when children were 3, 3.5, and 4.5 years of age. Children’s emotion knowledge uniquely predicted their autobiographical memory ability across groups and time points. Emotion knowledge further mediated culture effects on autobiographical memory. The findings provide important insight into early autobiographical memory development, and extend current theoretical understandings of the emotion–memory interplay. They further have implications for the phenomenon of infantile amnesia and cross-cultural differences in childhood recollections.

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1. Introduction

Autobiographical memory (AM) encompasses memory for personally significant, specific event episodes from an individual’s life (Nelson & Fivush, 2004). It is critical for self-identity and psychological well-being. One important characteristic of autobiographical memory is that it is often accompanied by heightened emotional reactions (McGaugh, 2003; Pillemer, 1998; Stein & Liwag, 1997). Emotion is generally held to be important or even essential to autobiographical remembering, and researchers have identified a host of mechanisms underlying the emotional effects (Christianson & Safer, 1996; McGaugh, 2003; Reisberg & Hertel, 2004). However, little theoretical or empirical attention has been paid to the mnemonic function of emotion knowledge (EK, or emotion situation knowledge), that is, the schematic knowledge of situational antecedents of emotions (Denham, Zoller, & Couchoud, 1994; Stein & Liwag, 1997). Literature of three different research areas, on the other hand, has suggested a plausible link of such knowledge to autobiographical remembering, which calls for further investigation.

1.1. Cognitive perspectives

From an information-processing point of view, EK provides a knowledge structure or mental schema based on which cognitive processes of appraisal, interpretation, or meaning analysis of an event situation can be carried out (Frijda, 1986; Stein & Liwag, 1997). Such cognitive processes are deeply involved in the anticipation and actual experience of emotions within the situation, no matter whether they initiate or simply mediate the emotional experience (Lazarus, 1982; Schachter & Singer, 1962). As Frijda (1986) claims, “Emotional experience, first of all, is experience of the situation” (p. 193). The resulting emotional activation, in turn, may trigger special encoding and consolidation mechanisms that facilitate memory formation (Christianson & Safer, 1996; McGaugh, 1995; McGaugh, 2003).

Furthermore, cognitive appraisal of the event situation enabled by EK may allow the individual to fully appreciate the emotional meaning and, thus, personal significance, of the event, making the event more memorable (Conway & Pleydell-Pearce, 2000; Pillemer, Picariello, & Pruett, 1994). And just like other schemas or scripts (Neisser, 1981; Schank, 1982), EK may provide an organizational structure to process and represent significant personal event information with co-assembled affect scenes, allowing the information to be well integrated into the autobiographical knowledge base and be effectively stored and retrieved (Conway & Bekerian, 1987; Tomkins, 1979). As a result, an autobiographical memory with event-specific details may be formed. The memory may further integrate emotional-evaluative information (e.g., “I was so happy!”) indicative of cognitive and emotional processing enabled by EK.
The development of EK and AM appears to coincide chronologically in ontogenetic development, such that the age trend in children’s acquisition of EK parallels the age trend in children’s development of AM. Specifically, from as young as age 2, children can often associate appropriate eliciting situations with simple emotions, and they show awareness of the causes of emotions experienced by themselves and others (Bretherton & Beeghly, 1982; Harris, 1989; Lewis & Michalson, 1983). Correspondingly, toddlers often exhibit an impressive ability to retain personal event information over extended periods of time, especially with adults’ assistance (Harley & Reese, 1999; Nelson & Fivush, 2004). However, EK at the early stage is still limited and general and children tend to distinguish emotion situations broadly as being positive or negative (Brody & Harrison, 1987; Hesse & Cicchetti, 1982). Similarly, when remembering past events, young children often focus on what adults would consider to be generic or routine information. For example, when asked about a recent camping trip, a 2.5-year-old child reported, “And then we waked up and eat dinner. First we eat dinner, then go to bed, and then wake up and eat breakfast” (Fivush & Hamond, 1990, p. 231). This focus on general event information in young children’s AM may stem from their insufficient EK to help them fully appreciate the unique and ultimately memorable aspects of novel events. As a result, they tend to understand and organize event information following familiar scripts.

Over the preschool years, children show increasing abilities to understand and differentiate a wide range of situations eliciting a variety of emotions (Bennett, Bendersky, & Lewis, 2005; Harris, 1989; Stein & Liwag, 1997). They also show increasing abilities to retain and recall distinctive aspects of past events (Fivush, Haden, & Adam, 1995; Pillemer & White, 1989), and their memories include not only event-specific details but also emotional-evaluative information such as mental states and affect – commonly referred to as internal states language (Fivush & Baker-Ward, 2005; Haden, Haine, & Fivush, 1997). Particularly important from the current perspective, the integration of internal states language into memories may be indicative of cognitive appraisal, self-involvement, and affective organization of the event information enabled by EK. It is possible that the further development of EK helps children understand the personal significance of specific events, experience appropriate emotions during the events, and organize the event information in a structured fashion, thereby facilitating the retention of and access to the event memories over the long term. Evidence from a recent study showed that EK in 3-year-olds had a concurrent association with the children’s ability to recall specific event information (Wang, Hutt, Kulkofsky, McDermott, & Wei, 2006).

Notably, the relationship between EK and AM may well be reciprocal, particularly at the early stage of development. EK may be built upon or abstracted from a variety of unique and specific personal experiences, and its development may in turn facilitate children’s understanding, evaluation, and remembering of autobiographical events. Later on, EK, as a schematic knowledge structure, may become increasingly stabilized and context-free, and may thus be no longer susceptible to or malleable by the influence of discrete experiences. Rather, it may continue to pro-
vide the cognitive bases upon which significant personal event information can be interpreted, processed, organized, and retained.

1.3. Cross-cultural variations

Cross-cultural research further suggests a connection between EK and AM at the group level. When asked to recount recent autobiographical events (e.g., one thing the child did recently that was special and fun), Euro-American preschoolers often recall more specific episodes (e.g., “getting a new toy”) than Chinese children, who tend to report more general routine events (e.g., “playing with toys every day”) (Han, Leichtman, & Wang, 1998; Wang, 2004; Wang, 2006a). The tendency to provide general responses to a specific memory probe is thought to suggest a lack of accessibility to episodic event information (Pillemer, 1998; Singer & Salovey, 1993; Wang, 2001a). Furthermore, Euro-American children more frequently use internal states language to refer to their feelings, thoughts, and subjective evaluations in their memory accounts than do Chinese children (Han et al., 1998; Wang, 2004). The early differences in the specificity and emotional-evaluative content of AM appear to increase with age and persist into adulthood. Compared with native Chinese and Asian Americans, Euro-American adults more frequently recall specific episodes and provide more event-specific details and emotional-evaluative information in their memory reports (Wang, 2001a; Wang, 2006b; Wang & Conway, 2004; Wang & Ross, 2005).

If the cultural differences in memory specificity and internal states language are related to EK, then Euro-American children should be expected to have better grasp of EK than Chinese children. Indeed, when asked to judge the emotional nature of story situations or to describe situations likely to provoke various emotions, Euro-American preschoolers score higher than their Chinese peers regardless of age, and they make more rapid progress in EK over time (Wang, 2003; Wang et al., 2006). Conceivably, the greater EK in Euro-American children may help them better appreciate the emotional meaning of past events and better remember specific details of the events.

The cultural variation in children’s EK may result from different emotion socialization practices in Euro-American and Chinese families. In line with the cultural emphasis on autonomy and the view of emotions as an indication of individuality, middle-class Euro-American parents are often eager to raise an “emotionally intelligent” child (Chao, 1995; Gottman, 1998). They frequently discuss emotions with children, explain the antecedents of children’s feeling states, and encourage children to articulate their own feelings (Wang, 2001b; Wang & Fivush, 2005). Such practices directly contribute to children’s developing EK (Burch, Austin, & Bauer, 2004; Denham & Kochanoff, 2002). In contrast, in Chinese culture where emotions are traditionally viewed as potentially destructive to interpersonal harmony, parents are not preoccupied with helping children understand emotions but instead emphasizing psychological discipline and behavioral standards (Chao, 1995; Chen, 2000). Family conversations about emotions often focus on “teaching the child a lesson” and helping the child develop proper conduct through acceptance of social norms, with little causal discussion of the child’s feeling states (Wang, 2001b; Wang & Fivush, 2005).
These different beliefs and practices may contribute to different levels of emotional understanding in children, which may, in turn, influence children’s developing AM.

1.4. The present research

The relation of EK to AM, once established, will have rich theoretical and empirical implications. This longitudinal study is the first to examine the developmental connection between EK and AM. Situating the study in a cross-cultural context further makes it possible to test whether the contribution of EK to AM can be generalized across cultures. Native Chinese children, Chinese immigrant children in the U.S., and Euro-American children were interviewed at ages 3, 3.5, and 4.5. The shorter interval between the first two interviews was intended to capture the rapid changes in both AM and EK during this age period (Nelson & Fivush, 2004; Stein & Liwag, 1997), and in light of the findings that adults’ earliest childhood recollections become available from around 3 to 3.5 years of age (Mullen, 1994; Pillemer & White, 1989). At the cultural level, Euro-American children were expected to exhibit greater EK than their Chinese peers, consistent with the divergent family socialization practices evident early in the children’s lives (Chao, 1995; Chen, 2000; Wang, 2001b). And this, in turn, would contribute to greater abilities in Euro-American children to remember event-specific details and to incorporate emotional-evaluative information into their memories.

Unlike most cross-cultural research that focuses on comparisons between different cultural groups, this study included two Chinese samples. Chinese children in China and the U.S. were expected to show differential developmental changes as they come to be in greater contact with the world outside home and subjected to increasing influences from multiple cultural sources such as media, peers, and socialization agents other than parents. Specifically, Chinese children in the U.S., especially those from the first-generation immigrant families, are often socialized with traditional Chinese values and practices at home, such as mutual dependence, emotional restraint, and social conformity (Chao & Tseng, 2002). As they grow older and are more exposed to cultural influences outside home, they may become increasingly acculturated to mainstream American values such as autonomy, self-expression, and personal efficacy, and subjected to practices that facilitate their emotional understanding and personal remembering (Lee & Zane, 1998; Tobin, Wu, & Davidson, 1989). In comparison, the cultural transition for native Chinese children, especially those in big cities like Beijing, may entail an opposite process. In the past two decades Chinese families have undergone major changes in family structures and practices due to drastic modernization, Western influences, and the one-child policy (Chen, Cen, Li, & He, 2005; Wang, Leichtman, & White, 1998). These changes are particularly reflected in the so-called “4-2-1 syndrome,” whereby six doting adults (four grandparents and two parents) pour their attention onto one child. Oftentimes, to satisfy the desires and wishes of the “little emperor” or “little empress” takes precedence over behavioral discipline, and parents seem more open than before with respect to discussing feelings with their children (Wang & Fivush, 2005). Outside the family, however, the larger cultural context continues to reinforce
collective values and children are expected to control their emotions and impulses for maintaining social harmony (Chen, 2000; Fuligni & Zhang, 2004; Tobin et al., 1989). It is possible then that at the earlier time points the native Chinese group would exhibit a more Western pattern of child outcomes than would the Chinese immigrant group, and this might be reversed by the end of the preschool years.

At the individual level, children’s EK was expected to uniquely predict their abilities to remember event-specific details and to integrate emotional-evaluative information into their memories, regardless of culture. EK was further expected to mediate cultural influences on children’s developing AM specificity. Notably, past research has shown that language skills predict better emotional understanding in children (Cutting & Dunn, 1999; Pons, Lawson, Harris, & deRosnay, 2003). Conceivably, being an instrument of both cognitive representation and social communication, language may enable children to understand and use emotion terms and to learn EK through participation in discussions of feeling states with others (Denham & Kochanoff, 2002; Denham et al., 1994; Dunn, Bretherton, & Munn, 1987). Similarly, research has suggested a positive impact of language on children’s memory performance (Nelson & Fivush, 2004; Simcock & Hayne, 2003). A language measure was thus included at each time point.

2. Method

2.1. Participants

Data collection took place at three time points. At Time 1, 189 children participated (mean age = 34.93 months, SD = 3.17), including 58 Chinese children (25 girls) from Beijing, China, and 60 first-generation Chinese immigrant children (30 girls) and 71 Euro-American children (34 girls) from upstate New York. Children were recruited through local nursery schools and by word of mouth, and were taking part in a larger longitudinal study of early memory development. All children came from middle-class families and the majority of mothers and fathers had college education or beyond. All Chinese children and approximately 30% Euro-American and 45% Chinese immigrant children were from only-child families. At Time 2, 170 children remained in the sample (mean age = 41.63 months, SD = 3.18), including 48 Chinese (21 girls), 57 Chinese immigrant (28 girls), and 65 Euro-American children (33 girls). At Time 3, the sample consisted of 153 children (mean age = 53.92 months, SD = 3.42), including 47 Chinese (21 girls), 43 Chinese immigrant (21 girls), and 63 Euro-American children (31 girls). The majority of the children who failed to complete all three time points were unavailable due to family move. There was no significant difference in any measure between children who continued to participate and those who did not.

2.2. Procedure

Three home visits were arranged for each participating family by two native female researchers. English–Chinese bilingual researchers visited the Chinese immi-
grant families and interviewed children in the language children preferred. All materials were written in both English and Chinese and translation and back-translation procedure was carried out to ensure their equivalence in both literal and sense meaning (Chapman & Carter, 1979). The AM and EK tasks took approximately 20 min and were videotaped.

2.3. Measures

2.3.1. Autobiographical memory

During each visit, one of the researchers (interviewer) asked the mother to nominate two specific, one-moment-in time events that happened to the child within the past 2 months. After engaging the child in warm-up conversation, she told the child, “Your Mom just told me that... (e.g., you went to the amusement park last week). I’ve never been there before. Tell me what you did. I really want to know.” Standard prompts were used such as “What else happened?” and “Can you tell me more about it?” This procedure is standard in studies of children’s independent AM (Haden et al., 1997; Harley & Reese, 1999; Wang, 2004).

Coding was performed in the original languages. Noldus The Observer® 5.0 program was used, a digital coding system designed to score video materials online and enter the codes directly into a computer (Noldus, 2003). Proposition, a subject–verb construction, was used as the coding unit (e.g., “I swung,” Fivush et al., 1995). Responses to the two memory events were coded separately and the mean frequencies per event were then calculated for analysis. (1) Memory specificity: Children’s utterances concerning distinct aspects of the past event in question were classified as specific responses (e.g., “We went apple-picking”) (Harley & Reese, 1999). Utterances, although relevant to the topic, not directly about what happened in the past event but of generic information, were coded as generic responses (e.g., “Xiangshan is a park. There are a lot of trees”) (Wang et al., 2006). Specific and general responses were mutually exclusive and exhaustive. Placeholder (e.g., “I don’t know”) and off-topic talk (e.g., talking about the camera) were infrequent and not coded. Following previous research (Wang & Ross, 2005), the difference between specific and general responses was taken to form a composite measure of memory specificity. (2) Internal states language: Children’s utterances referring to their emotions, thoughts, desires, and subjective evaluations were counted (e.g., “I was a little bit angry,” and “I wanted a balloon”) (Haden et al., 1997; Han et al., 1998). Two coders independently coded 20% of each dataset for reliability. The average kappas were .87 (.67–1) for Chinese children, .85 (.65–1) for Chinese immigrant children, and .86 (.69–1) for Euro-American children. Thus, all average kappas were within the substantial to excellent range (Fleiss, 1981).

2.3.2. Emotion knowledge

Following the memory task, the interviewer assessed children’s EK in a task that has been used with children in different cultures (Harris, Olthof, Terwogt, & Hardman, 1987; Wang et al., 2006). Children were asked to describe situations likely to provoke happy, sad, fearful, or angry emotions. The interviewer presented the child
with the emotion terms one at a time and asked the child for descriptions of situations that may make people as well as the child him- or herself experience the emotion in question (e.g., “What makes people feel sad?” and “What makes you feel sad?”). For each question, she prompted the child to respond with as many situations as possible (e.g., “What else makes people (you) sad?”).

The number of emotion-eliciting situations children provided for each emotion was counted (e.g., I: “What makes people feel happy?” C: “Saying something that makes them smile” and I: “What makes you feel mad?” C: “Not giving me what I want”). Responses pertaining to the four emotions showed consistent patterns of variations across groups and time points. An aggregated score across the four emotions was thus used as each child’s final EK score at each time point. Two coders independently coded 20% of each dataset for reliability. The average kappas were .90 (.76–1) for Chinese children, .87 (.71–1) for Chinese immigrant children, and .87 (.66–1) for Euro-American children.

2.3.3. Language
During the child interview, mothers filled out the language scales of the Child Development Inventory (CDI; Ireton, 1992) that assessed children’s language production and comprehension (possible score range 0–100; Cronbach’s α = .93, .91, and .86 at ages 3, 3.5, and 4.5, respectively). Mothers answered “Yes” or “No” to statements that describe the child’s language ability (e.g., “Gives reasons for things, using the word ‘because’...” and “Understands what ‘before’ and ‘after’ mean; uses these words correctly”). The CDI is an updated version of the Minnesota Child Development Inventory (MCDI; Ireton & Thwing, 1974) and has been used in previous research on preschoolers’ EK and AM (Denham et al., 1994; Wang, 2006a).

3. Results
Analyses were directed at examining the developmental connection of EK to AM at group and individual levels.

3.1. Preliminary analyses
Across the three time points, only a small percentage of children scored 0 for specific responses (10%, 2.5%, and 0.5%) or EK (10%, 2.5%, and 2.5%). The two variables and the composite memory specificity score (i.e., specific-general responses) were analyzed as continuous variables. All the continuous variables were positively skewed, with a small number of children scoring higher than most. Logarithmic transformations were thus performed on the variables before they were submitted to analysis. To facilitate comparisons with previous research, untransformed means are reported. A great percentage of children at each time point did not provide any general responses or internal states language. The two variables were thus dummy coded, respectively, with children who provided at least one response scored as 1 and those who made no relevant response scored as 0. The dummy variables were
then used in analysis, although both means and percentages of the two memory codes are reported.

In the following analyses, continuous variables were analyzed with mixed models using SAS PROC MIXED program (Singer, 1998), and categorical (dummy) variables were analyzed with generalized estimating equations using the SAS GEE macro (Norton, Bieler, Ennett, & Zarkin, 1996). Significant ($p < .05$) multivariate effects were followed up with univariate or post-hoc Tukey–Kramer honestly significant difference [HSD] tests, as appropriate, at the $p < .05$ level. Some children did not complete every task, thus the degrees of freedom varied slightly across tests. Gender and age of child at each time point showed no significant effects in preliminary analyses; and consistent with prior research (Wang, 2004; Wang et al., 2006), there were no birth order effects within the Euro-American and Chinese immigrant samples. These factors were therefore not considered further. Language scores ($M_s = 76.56, 86.36, 94.25, SD_s = 15.01, 11.82, 6.73$) were significantly correlated with EK scores at each time point (age 3: $r = .27, p = .0002$; age 3.5: $r = .29, p = .0001$; age 4.5: $r = .22, p = .007$), with memory specificity scores at the first two time points (age 3: $r = .15, p = .04$; age 3.5: $r = .20, p = .009$), and with internal states language at Time 2 ($r = .17, p = .03$). Language was thus included as a covariate in all analyses.

3.2. Emotion knowledge across groups and time points

A 3 (culture) × 3 (time point) mixed model analysis was conducted on EK, with culture being a between-subject factor, time point being a within-subject factor, and subject being a random factor. Language was included as a covariate. Significant main effects of culture, $F(2,186) = 19.69, p < .0001, \Delta R^2 = .22$, and time point emerged, $F(2,313) = 33.87, p < .0001, \Delta R^2 = .09$, qualified by a culture × time point interaction, $F(4,313) = 8.15, p < .0001, \Delta R^2 = .08$. Language was a significant covariate, $F(1,313) = 9.66, p = .002, \Delta R^2 = .10$. Post-hoc tests indicated that Euro-American children had significantly higher EK scores than both Chinese groups at ages 3, had higher scores than Chinese immigrant children at age 3.5 and than native Chinese children at age 4.5. The two Chinese groups did not differ significantly from each other at any time point. Furthermore, while Euro-American and Chinese immigrant children showed increases in EK over time, particular from ages 3.5 to 4.5, native Chinese children showed an increase from ages 3 to 3.5 and then no significant change between the later two time points. Fig. 1 illustrates the untransformed mean EK scores as a function of culture and time point.

3.3. Predicting autobiographical memory

3.3.1. AM specificity

The analysis of the composite memory specificity score aimed at testing the hypotheses that EK would not only uniquely predict children’s ability to remember specific event information, but also serve as a potent mediator for the effects of culture on memory specificity. A 3 (culture) × 3 (time point) mixed model analysis was
first conducted on memory specificity score, with language being a covariate. The model yielded significant main effects of culture, $F(2,184) = 7.90, p = .0005, \Delta R^2 = .22$, time point, $F(2,292) = 8.44, p = .0003, \Delta R^2 = .02$, and language, $F(1,292) = 4.73, p = .03, \Delta R^2 = .01$. Post-hoc tests indicated that Euro-American children scored higher on memory specificity than did Chinese immigrant children at ages 3 and 3.5, and they scored higher than did native Chinese children at age 4.5. Native Chinese children had higher specificity scores than Chinese immigrant children at age 3.5. Furthermore, Euro-American and Chinese immigrant children showed increases in memory specificity overtime, with the increase between ages 3 and 3.5 being significant for both groups. Native Chinese children showed an increase from ages 3 to 3.5 and then a decrease by age 4.5, although the difference between the later two time points was not significant. Children with greater language skills had higher memory specificity scores.

Note that it was established in the previous section that culture, time point, and language also had significant effects on EK. Next, a $3 \times 3$ mixed model analysis was conducted on memory specificity score, with language being a covariate. This model yielded only a main effect of EK, $F(1,285) = 49.94, p < .0001, \Delta R^2 = .40$, whereby children with greater EK had higher specificity scores regardless of culture, time point, and language skills. No effects pertaining to culture, time point, or language neared significance ($F$s < .73, $p$s > .48), suggesting that the effects of the independent variables (culture, time point, language) on memory specificity were attenuated by the mediation path (EK). Thus, all conditions for mediation were met (Baron & Kenny, 1986). Consistent with the
hypotheses, EK not only uniquely predicted memory specificity but also mediated the effects of other factors, including culture, to occur.

To further understand the nature of children’s AM over time and across groups, a 3 (culture) × 3 (time point) × EK analysis was performed on specific and general responses, respectively. Language was included as a covariate. The mixed model analysis of specific responses yielded a main effect of EK, $F(1, 298) = 55.25$, $p < .0001$, $\Delta R^2 = .47$. There was no significant interaction between EK and culture or time point. Thus, EK uniquely predicted specific responses across cultures and time points. Language was not a significant covariate. A marginally significant effect of time point also emerged, $F(2, 298) = 2.42$, $p = .09$, $\Delta R^2 = .04$, qualified by a culture × time point interaction, $F(4, 298) = 2.76$, $p = .03$, $\Delta R^2 = .09$. Post-hoc tests indicated that Euro-American children provided more specific responses than Chinese immigrant children at ages 3 and 3.5, and than native Chinese children at age 4.5. Native Chinese children provided more specific responses than Chinese immigrant children at age 3.5, and the direction of the difference was reversed at age 4.5. Furthermore, Euro-American children showed a fast increase in their number of specific responses from ages 3 to 3.5 and then remained at a high response level to age 4.5. Chinese immigrant children showed a significant increase at each time point. Native Chinese children showed an increase from ages 3 to 3.5 and then a decrease by age 4.5, although the difference between the later two points was not significant.

The generalized estimating equation analysis of general responses based on the dummy code showed a significant culture × time point interaction, $\chi^2(4) = 23.59$, $p < .0001$. While Euro-American children did not show changes over time in the likelihood of providing general responses (38%, 38%, 47%), $\chi^2(2) = .66$, n.s., both Chinese (21%, 26%, 64%) and Chinese immigrant children (5%, 4%, 64%) showed a significant increase from ages 3.5 to 4.5, $\chi^2(1, N = 91) = 16.46$, $p < .0001$, $r = .43$, and $\chi^2(1, N = 99) = 20.95$, $p < .0001$, $r = .46$, respectively. EK had no significant effects on general responses. Language was not a significant covariate. Fig. 2 illustrates the untransformed means of AM specificity, specific responses, and general responses as a function of culture and time point.

### 3.3.2. Internal states language

A 3 (culture) × 3 (time point) × EK generalized estimating equation analysis of internal states language revealed a significant main effect of EK, $\chi^2(1) = 15.19$, $p < .0001$. As expected, children with greater EK were more likely to use internal states language in their memories regardless of culture and time point. Furthermore, a marginally significant culture × time point interaction emerged, $\chi^2(4) = 8.93$, $p = .06$. Euro-American children (45%, 46%, 53%) were more likely than native Chinese children (28%, 30%, 23%) to refer to internal states in their memories at all time points, age 3 $\chi^2(1, N = 128) = 3.95$, $p = .05$, $r = .18$, age 3.5 $\chi^2(1, N = 112) = 3.11$, $p = .08$, $r = .17$, and age 4.5 $\chi^2(1, N = 102) = 10.17$, $p = .001$, $r = .32$, respectively. Euro-American children were also more likely than Chinese immigrant children (23%, 14%, 49%) to integrate internal states language into their memories at age 3, $\chi^2(1, N = 131) = 6.89$, $p = .009$, $r = .23$, and age 3.5, $\chi^2(1, N = 122) = 15.39$, $p = .0001$. 

Native Chinese children were more likely than immigrant children to refer to internal states at age 3.5, $\chi^2(1, N = 104) = 3.84$, $p = .05$, $r = .19$, and this pattern was reversed at age 4.5, $\chi^2(1, N = 87) = 6.57$, $p = .01$, $r = .27$. Language was not a significant covariate. Fig. 3 illustrates the untransformed mean internal states language as a function of culture and time point.

### 3.4. Emotion knowledge and autobiographical memory over time

To further examine the relation of EK to memory specificity across time points independent of culture and language skills, cross-lagged correlational analyses were conducted between EK and specificity scores, with the effects of culture and language partialed out. Fig. 4 presents the partial correlations. At the earlier two time points, a reciprocal relationship between EK and AM was observed, whereby children who demonstrated greater emotional understanding at age 3 were able to provide event memories with greater specificity 6 months later, and children who recalled more specific memories at age 3 exhibited greater EK 6 months later. EK and specificity scores were also correlated within each time point. Thus, EK and memory specificity were interrelated early on, showing concurrent and longitudinal bidirectionality.

At the later two time points, however, the long-term relationship between EK and memory specificity became unidirectional. Children who demonstrated greater EK at age 3.5 were better able to provide episodic event information 1 year later, regardless
of culture and children’s language skills at both time points. Children’s memory specificity at the earlier time point was not significantly related to their EK later on ($r = .08$, n.s.). In addition, both EK and specificity scores showed consistency over time such that children who exhibited greater EK and memory specificity at the earlier time points also showed greater EK and memory specificity at the later time points.

Fig. 4. Cross-lagged correlations between emotion knowledge and memory specificity with culture and relevant language effects partialed out. Only significant correlations are shown.
4. Discussion

The present study takes a novel theoretical perspective on the early development of autobiographical memory, examining the developmental connection of emotion knowledge to autobiographical remembering. The findings provide the first longitudinal evidence for the contribution of emotion knowledge to autobiographical memory development. The examination of individual processes within a cross-cultural framework further helps to identify universal parameters on memory development, as well as mechanisms that give rise to cultural variations. The study thus adds significance to autobiographical memory theory in general, and to the understanding of both cultural variations and individual differences in cognition.

As expected, EK was linked to AM at the group level. Compared with their Chinese and Chinese immigrant peers, Euro-American children exhibited overall greater understanding of emotion situations; and they recalled autobiographical events with greater specificity and integrated more internal states language into their memories. In addition, Euro-American and Chinese immigrant children exhibited an overall increase in memory specificity, corresponding with their increasing EK over time. Native Chinese children showed increases in EK and memory specificity at the earlier two time points, and had no increase in either outcome and, indeed, a decrease in memory specificity from ages 3.5 to 4.5. Interestingly, while Euro-American children provided more specific responses with age, the number of general responses they included in their memory reports remained constant over time. In contrast, both native Chinese and Chinese immigrant children significantly increased their use of general responses by the end of the preschool years, and native Chinese children’s specific responses indeed showed a decrease, although not significant, from ages 3.5 to 4.5. Thus, the focus on distinctive aspects of past events in autobiographical remembering evidenced differential developmental patterns across cultures. Although moderate use of general descriptions relevant to the past event may help to supplement contextual information and ensure the coherence and comprehensibility of the memory narrative, a great tendency to provide general responses to a specific memory probe, particularly in the case of native Chinese children by the end of the preschool years, may be indicative of a lack of accessibility to episodic event information (Pillemer, 1998; Singer & Salovey, 1993; Wang, 2001a).

At the individual level, children’s EK facilitated their memory specificity and their use of internal states language across all time points, independent of culture and language skills. Thus, children who showed greater understanding of emotions recalled memories with more event-specific details and emotional-evaluative information than children who had less emotion knowledge, regardless of culture and language skills. Furthermore, as predicted, EK functioned as a potent mediator that gave rise to cultural differences in memory specificity. EK also mediated the contributions of language skills and time point to memory specificity, such that children’s increasing memory specificity in relation to their language skills or the mere passing of time was explained by their developing EK. In addition, the long-term relationship between EK and memory specificity appeared to be reciprocal early on and became unidirectional later. At the early stage, children may learn about emotions from their unique
personal experiences, which, in turn, enables them to interpret, understand, and remember autobiographical episodes. By the end of the preschool years, children have come to form fairly sophisticated knowledge of a variety of emotion-eliciting situations (Bennett et al., 2005; Harris, 1989; Stein & Liwag, 1997). Such emotional schemas or scripts represent abstracted information and are likely resistant to discrete experiential influences (Conway & Bekerian, 1987), while, on the other hand, they continue to facilitate children’s understanding, evaluation, and remembering of distinctive aspects of past events over the long term.

The findings may shed light on the phenomenon of infantile amnesia, that is, the common inability among adults to consciously recall autobiographical events occurring before age 2 or 3 (see Pillemer & White, 1989). From the current perspective, the offset of infantile amnesia may be influenced by developmental changes in cognitive and emotional processing of event information enabled by the developing emotion knowledge. Because children develop EK over the preschool years (Bennett et al., 2005; Denham & Kochanoff, 2002), the insufficient EK in very young children may render them with inadequate “mental tools” necessary for interpreting, representing, organizing, and retrieving unique episodic event information. This may make the retention of and access to the early memories difficult from an adult standpoint and thus result in infantile amnesia. Obviously, further longitudinal data are needed to elucidate the possible effect of emotion knowledge on infantile amnesia.

The findings may further help to explain cross-cultural differences in adults’ childhood recollections. Studies have shown that Euro-American adults can access earlier and a greater number of childhood memories and often provide more episodic details and emotional-evaluative information of past events than Chinese, Koreans, and Asian Americans (Mullen, 1994; Wang, 2001a; Wang, Conway, & Hou, 2004; Wang & Ross, 2005). These cultural differences may be related to the current finding that Euro-American children as young as age 3 acquired greater EK than their Chinese peers, and such knowledge may, in turn, facilitate their detailed encoding and efficient organization of personal event information for long-term retention.

As expected, interesting differences emerged between the two Chinese groups. At the earlier time points, Chinese children in Beijing showed greater similarities to Euro-American children in both EK and AM measures than did Chinese immigrant children. This pattern was reversed by the end of the preschool years, where Chinese immigrant children came to resemble more their Euro-American peers than native Chinese children in both EK and AM outcomes. This pattern of results may reflect the differential enculturation processes from home to the outside world for native and immigrant Chinese children, as they get older and more susceptible to the influences of socialization agents and cultural sources other than parents. One such important influence, for instance, is through early education programs. In Mainland China, many educators are concerned that “in single-child families, the child receives too much attention at home and, as a result, is spoiled.” A major task at day-care centers and preschools is therefore to train children to “observe rules and regulations, be polite to teachers, follow rules in games, and think about others” (Lee, 1992, p. 383). And to bridge the divergent practices between home and school, parents are asked “to cooperate with day-care centers by training their child at home in
accordance with the center’s goals” (Lee, 1992, p. 387). In contrast, day-care centers and preschools in the U.S. place a great emphasis on the rights and priority of the individual child, and a major purpose of early education is to “promote life, liberty, and the pursuit of happiness,” and to “teach children to exercise their rights of free speech” (Tobin et al., 1989, p. 137). It appears that under such cultural influences, native Chinese children are gradually being transformed from “little emperors” and “little empresses” in the family to effective members of a larger collective, whereas Chinese immigrant children in the U.S. are being socialized into a society embracing individuality and self-assertiveness (Chao & Tseng, 2002; Wang et al., 1998). The current results elucidate cultural influences on human development as a dynamic process that takes place in the transactions between individuals and their proximal social settings (Rogoff, 2003). They also point to the importance of examining in future research multiple sociocultural factors in predicting developmental outcomes.

Notably, although the present study provided compelling evidence for the developmental connection of emotion knowledge to autobiographical memory, the data did not directly explicate basic level cognitive and emotional processes underlying such a connection. As suggested by cognitive theories (Conway & Bekerian, 1987; Stein & Liwag, 1997), emotion knowledge may affect the remembering of personal experiences through multiple pathways. The finding that EK facilitated the integration of feeling states language into memories is suggestive pertaining to these pathways. As recent research has shown, children interpret, understand, and evaluate the personal meaning of past events through the use of internal states language that is indicative of cognitive and emotional processing (Fivush & Baker-Ward, 2005). Still, further research is required to elucidate the specific processes and mechanisms for the mnemonic effects of emotion knowledge. It should also be acknowledged that the current sample was composed of middle-class families in the U.S. and China with relatively high educational levels, which could affect memory and emotion socialization practices within the families (Wang et al., 1998; Wiley, Rose, Burger, & Miller, 1998). Additional research exploring a wider variety of socio-economic classes and parental educational levels is needed. In addition, discrete emotions are often associated with different goals and problem-solving strategies and thus may differentially impact on autobiographical remembering (Levine & Pizarro, 2004). Future research should examine how children’s knowledge of specific emotions influences the way they remember events in which they experienced the emotions.

Importantly, emotion knowledge may only be one of many factors contributing to early memory development (see Nelson & Fivush, 2004). This is consistent with the pluralistic view that autobiographical memory development is a result of interactions among various biological, linguistic, cognitive, and social-cultural variables (Harley & Reese, 1999; Nelson & Fivush, 2004; Pillemer, 1998). Still, with the acquisition and further enrichment of emotion knowledge, children become increasingly able to interpret, represent, and organize significant personal event memories for long-term retention. Emotion knowledge may thus be one of the prerequisites to the development of autobiographical memory.
References


