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Autobiographical Memory and Past Time Reference

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The purpose of this research was to investigate the relationship between the acquisition of language and the development of autobiographical memory. The investigation was based on the analysis of longitudinal caregiver-child interaction data from 10 children learning English during the period from approximately 2 to 4 years of age. Three forms of past reference were analyzed: (1) regular and irregular simple past tense, (2) past progressive, and (3) subordinate clause constructions with *when* and past time reference (i.e., past *when*-sentences). Simple past was acquired relatively early at 2;4 (cf. Brown, 1973), past *when*-sentences relatively late at 3;6 (cf. Limber, 1973), and past-progressive in the interim at 2;10. The discourse segments surrounding the sentences that contained these forms were analyzed for the following three elements: (1) reference time context established, (2) a supporting event expressed in the segment, and (3) reference made to a self-relevant, real-life event. The likelihood that a discourse segment would include these three elements increased as past reference advanced from simple past to past progressive and then to past *when*-sentences. As the morpho-syntax of past reference became more complex, a higher proportion of past time references provided evidence for autobiographical memory.

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AUTOBIOGRAPHICAL MEMORY AND PAST TIME REFERENCE

Based on research utilizing the delayed-recognition (e.g., Rovee-Collier, 1997) and the novelty preference (e.g., Bahrick & Pickens, 1995) paradigms, a strong argument has been made that declarative memory develops during infancy together with procedural memory (cf. Schacter & Moscovitch, 1984). While the nature of the infant's memory process remains controversial (e.g., Perner, 2000), research within the deferred imitation paradigms has left very little question that the toddler has the capacity to utilize declarative memory processes from near the beginning of the second year of life (e.g., Bauer, 1996; Meltzoff, 2005). Furthermore, during the second year, there is a substantial increment in the robust quality of the toddler's declarative memory (Bauer, Wenner, Dropik, & Wewerka, 2000). Hence, preverbal children remember events in their lives, and their capacity to do so develops during the early period of language acquisition. As the capacity for language emerges, the likelihood that children will be able to remember events in their life increases (Peterson & Rideout, 1998; Simcock & Hayne, 2002). However, the question of exactly how language acquisition is related to the development of memory remains unanswered (see Bauer, 2007, and Farrant & Reese, 2000, for reviews).

In order to probe the relationship between language and memory, the concept of declarative memory requires further explanation, contrast, and refinement. Tulving (1985, p. 387–388) characterized procedural memory as “a blueprint for future action without containing information about the past,” e.g., the reading skill. Tulving partitioned declarative memory into “semantic” memory (i.e., representations that “describe the world without prescribing any particular action,” e.g., the knowledge that birds can fly) and “episodic” memory (i.e., representations that “carry information about the relation of represented events to the rememberer's personal identity as it exists in subjective time and space,” e.g., a trip to the emergency room). Autobiographical memory may be viewed as a type of episodic memory. Bauer (2007, pp. 350–355 and Table 11.1) defined the prototypical autobiographical memory with the following properties: (1) “self-relevant,” (2) “distinct spatial and temporal location,” (3) “expressed verbally,” and (4) “a sense of ‘re-living’ the event” (p. 354).

Children begin to make reference to events that have occurred prior to speech time during the holophrastic phase of acquisition, e.g., at 1;5, Bowerman's Christi said, *meow*, when approaching a place where a cat was encountered three months earlier (Bowerman, 1981). Bowerman's interpretation of Christi's memory is quite consistent with current knowledge that at 1;4, children can remember an action sequence for six months (Bauer et al., 2000). The initial linguistic evidence for past time reference in English is found in the simple past tense. In the early research on temporal systems in child language, linguists were skeptical about the meaning of the past tense morphology. Influenced by the

Piagetian framework for conceptual development, these investigators argued that the children must be coding an aspectual notion of completion rather than the deictic concept of event time prior to speech time (e.g., Aksu-Koç, 1988; Antinucci & Miller, 1976; Bronckart & Sinclair, 1973). In aspect-prominent languages such as Russian or Polish, it is quite clear that children understand some basic aspectual concepts in an early phase of the acquisition of finite morphology (e.g., Stoll, 1998; Weist, 1983). However, recent research has shown that children have the capacity to code tense independent of aspect (Valian, 2006; Weist, Pawlak, & Carapella, 2004). Since contemporary research has shown that the “sensorimotor” period of conceptual development is not restricted to procedural memory, there is no longer a reason to suspect that children’s thinking, and therefore their language, is necessarily about the here-and-now.

The child’s initial temporal system (i.e., the event time [ET] system) is characterized by his/her capacity to express deictic relations between event time and speech time. The simple past tense provides evidence for the ET system, e.g., at 2;0, Bowerman’s Christy said, *I cried*, and *I did it* (Bowerman, 1981). The child’s advanced system (i.e., the reference time [RT] system) integrates the concept of reference time (Smith, 1980; Weist, 1986, 2002). When the RT system emerges, the child is able to establish a temporal context and relate the focal event to that context, e.g., at 2;7, Kuczaj’s Abe said, *I feeled better yesterday*, and at 2;9, he said, *I didn’t cry when I burned myself*, and *I can reach it after I get my chair right here* (Kuczaj, 1976). An essential property of autobiographical memory is subjective time and space reference. Regarding this temporal feature, past tense specifies that the event in focus occurred prior to speech time (i.e., prior to the deictic center). As the RT system emerges, children become more specific about the temporal location, e.g., during a specific daily cycle, within the scope of some experience, or before/after some event. Thus, subordinate clause constructions provide one type of evidence for the RT system, e.g., at 3;0, Nina said, *I was sleeping, and I had a dream, when I was sleeping* (Suppes, 1974).

Progressive aspect provides additional linguistic information that is relevant to the concept of autobiographical memory. According to Smith (1991) and others, progressive aspect specifies internal perspective as contrasted with perfective aspect which specifies external perspective. Whereas present progressive expresses internal perspective on an event that is unfolding simultaneously with speech time, past progressive codes an internal perspective on an event that was ongoing prior to speech time. According to Bauer, autobiographical memory is characterized by a sense of re-experiencing an event. The past progressive establishes a sufficient, but not a necessary condition for re-experiencing a memory, e.g., Sachs’s Naomi (2;4) said, *Kimb(erly) was playing on my swing* (Sachs, 1983). Brown (1973) showed that auxiliary deficient *verb-ing* forms emerge very early with dynamic verbs and that the progressive auxiliary

accompanies these forms somewhat later (Brown, 1973, p. 271, Figure 14). However, there is relatively little research on progressive aspect in general and the past progressive in particular. Weist et al. (2004) found that past progressive is acquired relatively late in comparison to other forms in the tense-aspect paradigm of English. The current research investigates how the past progressive fits into the acquisition sequence from the ET to RT systems and how this form is related to the development of autobiographical memory.

Autobiographical memory has been studied extensively in the context of parent-child co-constructed narratives about children's personal experiences (e.g., Farrant & Reese, 2000; Reese, Haden, & Fivush, 1993). Investigations of this type have often included some evaluation of linguistic competence (e.g., the MacArthur-Bates Communicative Development Inventory; Fenson et al., 1993, in Farrant & Reese, 2000, and MLU in Reese & Fivush, 1993). However, none of these studies included a longitudinal in-depth analysis of the acquisition of the syntactic structure of past reference. The present research investigated the relationship between the child's linguistic competence at the syntactic level and autobiographical memory. The research design involved a longitudinal study of caregiver-child interaction data spanning the emergence of the ET and RT linguistic systems. There were two kinds of analysis: the analysis of the syntactic form of past reference, and the analysis of discourse for evidence of autobiographical memory. In the linguistic analysis, we expected to find the following acquisition sequence: (1) the simple past tense form which is an essential component of the ET system, (2) the past progressive, and then (3) complex sentence constructions with the subordinate conjunction *when* and past time reference (i.e., "past *when*-sentences") which are characteristic of the RT system. For the sentences containing these primary target forms (i.e., simple past, past progressive, and past *when*-sentences), the conversational context was evaluated for evidence that the recollection had the features of autobiographical memory. This evidence included three elements: (1) reference time established, (2) a related supporting event expressed, and (3) reference to a self-relevant real-life situation. These criteria map to Bauer's (2007, p. 354) definition of autobiographical memory as follows: (1) "temporal location," (2) "a sense of 're-living' the event," and (3) "relevance to self." We expected to find that the acquisition of the morpho-syntax of past time reference is associated with the child's expression of autobiographical memories.

METHOD

Participants

This was a longitudinal investigation of 10 children who were learning English. The data for five of the children were found in the Child Language Data Exchange

System (CHILDES; MacWhinney, 2000). These children and their age span were as follows: Abe 2;4–4;11 (Kuczaj, 1976), Adam 2;3–4;10 (Brown, 1973), Naomi 1;2–4;9 (Sachs, 1983), Nina 1;11–3;3 (Suppes, 1974), and Sarah 2;3–4;11 (Brown, 1973). Eve's (Brown, 1973) data were also analyzed, but she was not included as she did not reach our criteria for the RT system. The remaining five children were part of the Fredonia Child Language Project. The goal of this longitudinal project was to obtain caregiver-child interaction data from children aged 2 to 5, in order to capture the children's language in an early phase of the acquisition of their ET system and continue observations through the emergence of their RT system. Whenever possible the children were audiotape recorded in either a laboratory setting or in their homes, twice a month for approximately 30 minutes. The audiotapes were transcribed into the CHAT format (MacWhinney, 2000), and then the transcriptions were completely checked for accuracy. The children are as follows together with their starting ages, ending ages, and number (*n*) of transcripts: Emily (2;6–4;5 *n* = 23), Emma (2;7–4;7 *n* = 28), Jillian (2;1–2;10 *n* = 22), Matty (2;3–5;0 *n* = 56), and Roman (2;2–4;7 *n* = 42).

The data from the children in the Fredonia Child Language Project have recently been included in the CHILDES archives. The developmental goals of the project were not met in two ways: Jillian's family left the area when she was close to 3-years-old, and our observations of Emily began relatively late for a precocious child. While the data from the children in the Fredonia Child Language Project and the existing data in the CHILDES archives did not always have the ideal developmental range, the primary acquisition sequence could be evaluated for every child. A sixth child in the Fredonia Project, Ben (2;4–3;3 *n* = 11), did not reach our criterion for the RT system, and his data (along with Eve's) were omitted from the design. All of the children in the Fredonia Child Language Project were residents of Chautauqua County in Western New York State. They came from middle class homes, and their parents were professionals.

Data Analysis: Linguistic Focus

There were two kinds of linguistic forms, which will be referred to as primary and secondary forms. The primary forms provide evidence for the emergence of the ET and RT systems and relate past progressive to the acquisition of temporal reference. The primary forms were as follows: (1) simple past tense, i.e., irregular and regular forms (e.g., Roman, 2;6, *It crashed*); (2) past progressive, i.e., singular and plural, affirmative and negative (e.g., Matty 2;8, *I was throwing up on the bed*); and (3) sentences with an adverbial clause having the subordinate conjunction, *when* and past time temporal reference (e.g., Sarah, 4;3, *When I got my birthday, they comed off*). These complex sentences were referred to as "past *when*-sentences." In order to further understand the relationship between the acquisition of linguistic forms and

semantic function, two secondary forms, present progressive and non-past *when*-sentences, were analyzed. The present progressive analysis included contracted and/or uncontracted forms with some measure of contrast, e.g., first versus third person. Non-past *when*-sentences were sentences with an adverbial clause having the subordinate conjunction, *when*, and non-past time temporal reference.¹ The rationale for the inclusion of non-past forms is that they are roughly matched for syntactic complexity with their past-tense counterparts. Therefore, if children acquire non-past forms earlier, we have some support for the hypothesis that the autobiographical component of the past forms is partially responsible for the time in development at which these forms are acquired.

Regarding adverbial clauses with *when*, sentences containing a single clause were omitted even when the linguistic context (e.g., Sentence 1a) or the nonlinguistic context (e.g., Sentence 1b) would allow a paraphrase of the complete sentence.²

1. Single clause, past *when*-sentences.

- 1a. Adam (3;5.0) Did my shoe break? (*one turn*) When I were walking.
 1b. Nina (3;0.10) When I was bigger. *Context: She pushed a child in a stroller.*

Regarding nonpast *when*-sentences, there were two kinds: sentences with timeless reference having the meaning “whenever” (e.g., Sentences 2a&b), and sentences with future time reference (e.g., Sentences 3a&b). Sentences 4a&b demonstrate that children sometimes fail to coordinate the tenses of the main and subordinate clauses when they are acquiring this sentence form (see also Pawlak, Oehrich, & Weist, 2006). This kind of sentence was included in the analysis.

2. Non-past *when*-sentences: “whenever” meaning.

- 2a. Emma (3;1.26) I wear it when I’m, I’m cold, but I don’t wear it when I’m hot.
 2b. Naomi (3;3.27) You spank me when I do things on purpose and you spank me and that makes me sleepy too!

¹In order to provide additional context for the ET system, we also analyzed the regular (-ed) past form alone, and for added context for the RT system we evaluated the acquisition of the deictic adverbs: yesterday, today, and tomorrow. The regular past form was acquired at 2;6, and deictic adverbs were acquired at 3;4, i.e., their acquisition was linked to their related systems: ET and RT, respectively.

²In her monologues, Nelson’s Emily expressed sequences of events where one event provided a point of reference for other events. Nelson (1996, p. 282) analyzed the first event as establishing reference time for the following event, thus providing evidence for the RT system. Along these lines, the accumulation of clauses over discourse segments to derive past *when*-sentences would have produced more precocious estimates of acquisition in the current study.

3. Non-past *when*-sentences: future meaning.
 - 3a. Abe (2;8.23) I want to see it when mommy, when the sun goes down and my mommy comes home.
 - 3b. Emily (2;6.06) When I'm done playing, then I can have my sucker!
4. Past *when*-sentences: tense not coordinated.
 - 4a. Jillian (2;5.26) Now, when she was running with tissues, she get them to do it.
 - 4b. Roman (3;6.02) I found one at Julie's house, when you go for a walk.

In order to obtain a reasonable measure of productivity, we searched for five examples of each target form; i.e., we analyzed successive transcripts until the child had accumulated five target forms. Hence, the acquisition criterion is based on the accumulation of five target forms, as contrasted with five observations in a single transcript. Furthermore, for simple past tense, past progressive and present progressive, five different verbs were required. When a child met our criterion for productivity, we referred to that form as "acquired," recognizing that more stringent measures of acquisition are possible (cf. Weist et al., 2004). The age of each observation was measured to the nearest month for the purpose of the analysis.

Data Analysis: Autobiographical Memory Focus

The data analysis with linguistic focus yielded five examples of the three primary measures: simple past, past progressive, and past *when*-sentences, for each child. The product of the linguistic analysis formed the data for the autobiographical memory analysis. The memory analysis involved a search for discourse segments with the following properties: (1) the reference time context is established by the interlocutor or the child with reference to a prior event and/or the use of a temporal adverb/adverbial clause; (2) in the discourse segment (i.e., an interaction focused on a relatively stable topic), the child must also refer to an additional (i.e., supporting) event related to the same episode; and (3) the target event must have potentially occurred in the real world and be relevant to the child. References to pretend play and impossible events (e.g., Emily (2;9) said, "*I died when I was sick*") were excluded. The first criterion establishes the time and sometimes the place of the target event. To meet the second criterion, the child's thinking about the event had to be minimally extended beyond an isolated thought. The third criterion was designed to insure that the event was part of the child's life story. Discourse segments 5 through 7 demonstrate the application of these criteria. Segment *a* satisfied the research criteria and segment *b* did not. The expression [turns] indicates that a portion of the dialog was omitted from the example. Segments 5a&b include simple past targets, Segments 6a&b past progressive forms, and Segments 7a&b past *when*-sentences.

5. Simple past.

- 5a. Mother: What were the elephants doing in the elephant house? Mother: They were throwing hay on their back. Nina (2;1) They got dirty. [turns] Nina: there was monkeys; was monkeys climb on that, balloon.
- 5b. Naomi (1;11): I throwed it. [turns] Father: You throwed it. Naomi: I throwed it.

In Segment 5a Nina's mother established the reference event as prior to speech time and in the elephant house. Nina produced the past form of the verb *to get*, and she expanded on the episode with reference to the monkeys. Segment 5b was a relatively isolated reference to an event which was void of reference time.

6. Past progressive.

- 6a. Mother: Abe was "it," and he counted and came and looked for us.
Abe (2;8): I finded Renee. [turns] Abe: Tom was hiding front of a tree.
Mother: Where did you hide when you weren't "it"?
- 6b. Father: And what were you wearing on your head today?
Roman (2;5): I was pretending. Father: Were you ah, maybe a robot? Roman: Robot.

In Segment 6a Abe's mother introduced the hide-and-seek game and, more specifically, the time when Abe had the role of the seeker. The target form was found in Abe's reference to Tom's location. The supporting event involved Renee's discovery. In Segment 6b Roman's father established reference time as earlier in the day. While Roman recalls the situation, he only makes an isolated reference to it.

7. Past *when*-sentences.

- 7a. Mother: What did we do after we went swimming hmm?
Matty (3;0): Yeah but when trying to catch daddy, daddy put me under the water.
- 7b. Emily (2;11): I did this when I was in my toaster, and, and I said ow!

In Segment 7a Matty's mother introduced the topic. Matty established the specific reference time as during his pursuit of his father, and he explained what happened during that activity. We know that the swimming episode was part of his life story, and his past-*when* sentence satisfied the remaining criteria. In Segment 7b Emily established reference time and embedded an event within this context. However, she was referring to an imaginary situation.

In this discourse analysis the dependent measure was the number of discourse segments, out of the set of five, which satisfied the three criteria for autobiographical memory. Since the analysis of the discourse segments required judgments, the analysis was replicated. The second investigator was given the 150 target sentences (i.e., three types of past reference, five sentences for each type, and ten children) with their transcript and line number identifications.

Given the three criteria, the replication involved returning to the discourse context and determining the status of each sentence. Each sentence was judged separately with a yes/no decision (i.e., “yes” meaning that the sentence did meet the criteria for autobiographical memory), and there was an agreement on 129 out of 150 sentences, yielding a reliability of 86%. The points of disagreement were resolved by jointly reviewing the discourse context for each disparity.

RESULTS

Three Primary Linguistic Forms

Table 1 contains the age of acquisition for the three primary linguistic forms, simple past, past progressive, and past *when*-sentences. All of the children acquired the simple past prior to the past progressive, and eight of the children acquired the past progressive before the past *when*-sentences. For Abe, past progressive became productive one month after the past *when*-sentences, and for Emily the past progressive and the past *when*-sentences were acquired at the same time. The average ages of acquisition were as follows: (1) simple past, 2;4; (2) past progressive, 2;10; and (3) past *when*-sentences, 3;6. Thus, there was a 6 to 8 month interval between the acquisitions of these forms of past time reference. Table 2 contains the MLU findings for the transcripts that contained the fifth target sentence (i.e., the point considered acquisition), and the average values are as follows: (1) simple past, 2.705; (2) past progressive, 3.745; and (3) past *when*-sentences, 4.317. With age as the dependent measure, a repeated measures analysis of variance

TABLE 1
The Age (Years; Months) of the Acquisition of the Three
Primary Forms for Ten Children

<i>Child</i>	<i>Simple Past Ir- / regular</i>	<i>Past Progressive</i>	<i>Past When-sentence</i>
Abe	2;5	2;10	2;9
Adam	2;5	3;1	3;5
Emily	2;6	2;7	3;3
Emma	2;8	3;0	3;8
Jillian	2;1	2;4	2;6
Matty	2;4	3;0	3;5
Naomi	1;11	2;5	4;9
Nina	2;1	2;6	3;0
Roman	2;5	2;10	4;2
Sarah	2;6	3;6	4;4
<i>Average Age</i>	<i>2;4</i>	<i>2;10</i>	<i>3;6</i>

TABLE 2
The MLU Values for the Acquisition of the Three Primary
Forms for Ten Children

<i>Child</i>	<i>Simple Past Ir- / regular</i>	<i>Past Progressive</i>	<i>Past When-sentence</i>
Abe	3.851	5.754	6.608
Adam	2.288	3.720	3.803
Emily	3.366	3.634	5.046
Emma	3.362	4.263	3.752
Jillian	2.391	3.580	3.107
Matty	2.825	4.228	4.270
Naomi	2.234	3.320	3.533
Nina	2.327	2.761	3.175
Roman	2.651	3.293	5.870
Sarah	1.757	2.901	3.556
<i>Average</i>	<i>2.705</i>	<i>3.745</i>	<i>4.317</i>

yielded a significant difference in the mean age of the acquisition of the three primary forms, $F(2, 18) = 19.6$, $p < .001$. With MLU as the dependent measure, the parallel analysis produced a similarly significant outcome, $F(2, 18) = 21.6$, $p < .001$.

Form—Function Comparison

In order to produce progressive forms, the child must be able to code agreement as well as tense on the auxiliary. The analysis of the present progressive provides information relevant to this accomplishment. Like the analysis of simple past and past progressive, we required five different verbs be inflected for present progressive. In addition, all of the children produced some form of contrast, i.e., contracted first versus contracted third person, contracted versus uncontracted forms, and/or singular versus plural. The average age of the acquisition of present progressive was 2;5 (i.e., five months before past progressive which was 2;10) (see Table 3). A paired observation t -test revealed a significant difference between the means, $t(9) = 10.61$, $p < .001$. At least in theory, the past progressive requires internal perspective on an event that has occurred prior to speech time. In other words, the child would have to displace his/her point of temporal reference away from the deictic center of speech time.

We analyzed the emergence of subordinate clause constructions with the temporal adverbial *when* and non-past reference. The average age of acquisition of non-past *when*-sentences was 3;4 which is two months prior to the acquisition of past *when*-sentences at 3;6 (see Table 3). A paired observation t -test indicated this difference was significant with $t(9) = 2.28$, $p < .048$. The acquisition of the capacity to form subordinate clause constructions emerged more rapidly with

TABLE 3
 The Comparison of the Acquisition of Present Versus Past Progressive
 and Non-past Versus Past *When*-sentences; the Past Reference
 Data Duplicated from Table 1

<i>Child</i>	<i>Present Progressive</i>	<i>Past Progressive</i>	<i>Non-past When-sentence</i>	<i>Past When-sentence</i>
Abe	2;6	2;10	2;8	2;9
Adam	2;6	3;1	3;2	3;5
Emily	2;6	2;7	2;9	3;3
Emma	2;8	3;0	3;7	3;8
Jillian	2;1	2;4	2;5	2;6
Matty	2;7	3;0	3;8	3;5
Naomi	1;11	2;5	4;9	4;9
Nina	2;1	2;6	2;10	3;0
Roman	2;3	2;10	3;7	4;2
Sarah	3;2	3;6	3;9	4;4
<i>Average Age</i>	<i>2;5</i>	<i>2;10</i>	<i>3;4</i>	<i>3;6</i>

non-past reference than with past reference. Hence, with variable gaps, the acquisition of syntactic forms preceded semantic function.

Discourse Segments and Autobiographical Memory

Since the data are based on caregiver-child interactions, every sentence in the corpora of the 10 children is embedded in a discourse context. The richness of the discourse context varied from relatively isolated utterances to utterances that were integrated into a relevant and sometimes extensive interaction. Some dyads/triads promoted discussions of everyday life as contrasted with pretend play. The mean number of discourse segments that met the three criteria for autobiographical memory (i.e., reference time context, supporting event, and self-relevant real-life event) was as follows: (1) 1.2 for simple past, (2) 2.2 for past progressive, and (3) 3.4 for past *when*-sentences (see Table 4). When these data were entered into an analysis of variance having repeated measures on the type of past reference, the results indicated a significant difference in the mean number of target discourse segments which met the criteria for autobiographical memory, $F(2, 18) = 7.03$, $p < .006$. Five of the ten children demonstrated a consistent increment in discourse segments meeting criteria for autobiographical memory; as language acquisition proceeded towards more complex forms of temporal reference, two children produced relatively little change, and three children had some reversals in relation to the overall pattern (i.e., see Table 4; Emily's simple past utterances met the criteria quite frequently, Emma's past progressive utterances never met the criteria, and Naomi's past *when*-sentences infrequently met the criteria).

TABLE 4
 The Number of Discourse Segments Having the Three Criteria
 Elements: 1) Reference Time Established, 2) Supporting Event
 Included, & 3) Self-Relevant Real-world Referenced

<i>Child</i>	<i>Simple Past Ir- / regular</i>	<i>Past Progressive</i>	<i>Past When-sentences</i>
Abe	1	3	5
Adam	2	2	2
Emily	4	3	3
Emma	3	0	4
Jillian	0	2	2
Matty	0	3	5
Naomi	0	3	1
Nina	2	4	5
Roman	0	1	3
Sarah	0	1	4
Average	1.2	2.2	3.4

For control purposes, we applied the three criteria for autobiographical memory to the present progressive forms and the non-past *when*-sentences. With a single exception, the children used the present progressive primarily to code speech time activity. At 2;7, Matty used a present progressive form with past time reference that met our discourse criteria for autobiographical memory. The children used non-past *when*-sentences primarily for future or timeless reference with a ratio of approximately 3:2, respectively. However, two utterances were detected that referred to autobiographical memories; one from Sarah and one from Roman (e.g., Roman [3;3] *When ring, we go back out. When doesn't ring, go back in!* within the discourse context of his father's initial utterance, *When the bell [fire alarm] went off, right?*). Thus, out of 100 utterances analyzed in discourse context, three involved past reference and autobiographical memory. The analysis of the discourse segments was replicated by the second author. The only ambiguity concerned the judgment of future versus timeless reference for the non-past *when*-sentences where there was 90% agreement. In short, the children were very unlikely to use non-past morphology to make past time references.

DISCUSSION

Temporal Systems and Conceptual Development

In general, the sequence in the acquisition of the morpho-syntax of past time reference found in children learning English, began with simple past forms (at 2;4), progressed to past progressive forms (at 2;10), and continued on to subordinate

clause constructions (at 3;6). The present progressive form that included either a contracted or uncontracted auxiliary was acquired (at 2;5) during approximately the same phase of acquisition as the simple past and well ahead of the past progressive. Subordinate clause constructions with either future time or timeless reference (i.e., non-past *when*-sentences) were (on the average) acquired a few months prior to (at 3;4) complex sentences of similar form and past time reference (i.e., past *when*-sentences). The discourse contextual analysis of these data revealed a gradual increase in the number of past time references that met the definition of autobiographical memory.

Children's capacity to communicate their autobiographical memories increases as they acquire a RT temporal system. In a language with a progressive aspect, the initial indication that children can displace their point of temporal reference can be found in their use of past progressive tense-aspect forms. Nine of the 10 children in this study produced past progressive verb forms in the context of a conversation during which they shared an autobiographical memory (see Table 4). Matty's conversation with his mother about a trip was typical. Matty's mother asked, *Do you remember, when did you get that?* Matty (2;7) replied, *Going on the plane*, and his mother expanded, *Going on the plane, yes*. Matty continued the conversation with the statement, *Plane was flying*. Matty's mother probed further, *Who went on the plane?* to which Matty replied, *Matthew and you*. This interaction can be compared with one that occurred four months earlier as follows: Matty's mother inquired, *What'd you do today at school?* and Matty (2;3) replied, *We played toys*, which was followed by a change in topics. Matty's mother established the time-space referent. Matty's simple past reply located the activity in the past with the least semantically marked aspectual perspective.

When children acquire the linguistic capacity to produce subordinate clause constructions, they are ready to make explicit reference to the temporal coordinates of the event in focus in the sentence. The following conversation between Nina and her mother was typical. Nina's mother established reference time in her question: *Did you have a splinter yesterday?* Nina (2;11) replied: *I wasn't crying when you did it*, and then Nina clarified: *When you did take my splinter out*. The temporal properties of the event are well defined. In this case, the child explains what didn't occur during that episode. The event is obviously part of Nina's life story, and that fact is signaled linguistically with the first person pronoun in the nominative case. At this phase of language acquisition, all of the children produced evidence for autobiographical memory in their past *when*-sentences; in general, this occurred with greater frequency.

Language Acquisition, the Self-Concept, and Autobiographical Memory

What additional evidence is needed to claim that the memories children share are "autobiographical"? In addition to time and space reference, the concept

of self is very important. As with the concept of declarative memory, the concept of self can be traced back into infancy (see Howe, Courage, & Edison, 2003, and Meltzoff, 2005 for reviews). The research has shown that children are likely to pass the mirror self-recognition task (i.e., they point to a rouge mark on their face while looking in a mirror) when they are about 1;6 to 2;0, but Povinelli, Landau, and Perilloux (1996) found that children are unlikely to pass a video-delayed self-recognition test until they are between 3 and 4 years old. In Povinelli's procedure, the investigator surreptitiously applied a sticker to a toddler's head during a search game. When later viewing a video of the search game, children with a "temporally extended" sense of self reached for the sticker on their head. Relating to language acquisition, while children are acquiring a RT system, they are also developing a "temporally extended" concept of self.

Beginning with the early transcripts, all of the children in this study produced linguistic evidence for the concept of self, e.g., Abe (2;5) *I cried*, Adam (2;3) *Adam fell down*, Emily (2;6) *And I turned over like this*, Emma (2;7) *We forgot Nuclear*, Jillian (2;1) *I dropped it*, Matty (2;4) *I carved a big big sad pumpkin*, Naomi (1;10) *I throwed it*, Nina (2;1) *I made a table*, Roman (2;5) *I did that*, and Sarah (2;3) *I went boom*. However, in spite of the fact that all of the children referred to themselves, the children were generally unlikely to produce sufficient evidence for autobiographical memory until later, as shown in the analysis of discourse segments (see Table 4).

Language Acquisition, Narrative Structure, and Autobiographical Memory

Investigations of narrative structure and cohesion have consistently found a significant developmental trend from about three to five years of age with personal experience narratives (e.g., Fivush, Haden, & Adams, 1995) and storytelling narratives (e.g., Berman & Slobin, 1994). According to Fivush et al. (1995, p. 34), "It is the canonical narrative form that gives personal memories their structure and allows them to be integrated into the developing life story." Furthermore, Nelson and Fivush (2004) argued that memories receiving narrative structure were more likely to be remembered later in life, i.e., these memories become immune to "childhood amnesia." One of the prototypical measures of narrative cohesion is the expression of subordinate clause constructions with past time reference, i.e., referred to here as past *when*-sentences. In the current study, past *when*-sentences were acquired at 3;6, which is consistent with recent cross-linguistic findings (Pawlak et al., 2006). As children acquire the capacity to integrate reference time into their system of temporal reference, they are more likely to effectively express their autobiographical memories (see Table 4). This aspect of linguistic ability may facilitate the structuring of the child's autobiographical memories.

Summary and Conclusion

As evidence for past reference emerges in child language, children construct two relatively distinct temporal systems. The ET system is characterized by the expression of deictic relation between speech time and event time. In English, children utilize the simple past for past reference during this phase of development. In the prototypical discourse segment, the interlocutor introduces a past time context, and the child responds with a relatively isolated past reference. During this phase of the acquisition of language, children have also integrated aspect into their temporal system, and they have the capacity to code temporal contour such as ongoing activity. Since pre-verbal children are able to construct declarative memory representations and to retain these memories for an appreciable interval in time, conceptual development has established a readiness for past time reference (e.g., Bauer et al., 2000).

Children's next major innovation in the emergence of past reference involves the integration of reference time into their temporal system, i.e., the RT system. Temporal adverbs and adverbial clauses provide the most compelling evidence for the RT system. In this research, the focus was on complex sentences with subordinate clauses, specifically with the subordinate conjunction *when*, i.e., "past *when*-sentences" (see Table 1). In addition to these complex sentences with past time reference, complex sentences of the same form with non-past time reference were analyzed, i.e., "non-past *when*-sentences" (see Table 3). Children acquired the syntactic capacity to form complex sentences with subordinate clauses prior to their application to past time reference. Hence, the developmental process involves conceptual as well as linguistic innovation. When past *when*-sentences were being acquired, the analysis of the surrounding discourse segments provided evidence for autobiographical memory; i.e., these segments included the defining features of autobiographical memory (see Table 4).

Children learning English acquire the past progressive form during a period of development found between the initial expression of deictic relations and the integration of reference time. The past progressive specifies internal perspective on a prior situation. Progressive aspect requires the progressive auxiliary, and the progressive auxiliary has purely syntactic function carrying information about tense and agreement. The children in this study acquired the present progressive before they acquired the past progressive. The knowledge of finite morphology preceded past referential function. The analysis of the discourse segments revealed that the children were more likely to exhibit an internal perspective on a past event when the verb form was past progressive, as contrasted with the simple past. Hence, when discourse analysis is combined with the analysis of morpho-syntactic form, child language data provide an insightful window on the development of memory processes.

The morpho-syntactic structure that children utilize to make past time reference is acquired either as maturation unfolds genetic programs (e.g., Radford's 1990, I-system and C-system) or as children apply their information processing capacity to language during social interaction (e.g., Tomasello's 2003, usage based grammar). This research does not discriminate between these two ways of explaining the dynamics of the acquisition process. However, the acquisition of the finite morphology of the ET system and the complex sentence structures of the RT system are *not* explained by innovations in memory processes. These linguistic milestones provide children with the tools for effective conversations. When the interlocutor in those conversations presses for new information, children provide new information, and when the conversation concerns previous experiences, autobiographical memories surface. As children acquire the morpho-syntactic structure for past reference, the caregiver-child interactions become more successful at revealing these memories.

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