

Children think and talk about time and space.¹

Richard M. Weist, State University of New York at Fredonia

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This chapter will show how conceptual development in the temporal and spatial domains provides a necessary condition for the linguistic expression of the location of events in time and objects in space, and how the acquisition of diverse temporal and spatial linguistic systems directs the child's attention to temporal and spatial relations. Child language research has shown that the structure of the target language shapes the pattern of the acquisition of the temporal and spatial linguistic systems. These variations in language acquisition patterns have the potential to alter the path of conceptual development. Hence, the chapter concerns the interaction of language and thought from a developmental perspective. The cognitive hypothesis argues that cognitive development controls language acquisition, and the linguistic relativity hypothesis proposes that cross-linguistic differences in language structure shape cognition. The cognitive hypothesis was reviewed by Cromer (1991) and criticized by Bowerman (1996), and the linguistic relativity hypothesis was reviewed by Lucy (1992) and rejected by Pinker (1994). Rather than returning to this debate, this chapter will focus on specific research that shows how cognitive development and language acquisition interact. Rather than providing the structure that linguistic systems are derived from, conceptual development forms a readiness to locate events in time and objects in space. On the other side of the interaction, language enables children to express temporal and spatial relations establishing either a variation on an existing theme or a new way of thinking about episodes in time and/or layouts in space. The organization

of the chapter is based on two phases in development, i.e., early and late, and two conceptual – linguistic domains of development, i.e., time and space. The early phase refers to the period from infancy into toddlerhood, and the late phase refers to the preschool period of development. Regarding the early phase, I will review four different kinds of research programs focusing on conceptual or linguistic development within the temporal or spatial domains. Regarding the later phase, I will review one extensive research program that integrated all four components of development. Language – thought interactions will be presented within this structure beginning with the temporal domain and the early phase of development.

Part 1: The Early Phase of Development

Early Conceptual Development in the Temporal Domain.

When children begin to utilize tense morphology, what are they expressing / what are they capable of expressing? For some of the pioneer researchers, the answer was that past tense coded perfective aspect (Aksu-Koç, 1988 for Turkish, Antinucci & Miller, 1976 for Italian and English, and Bronckart & Sinclair, 1973 for French). According to these linguists, tense could not be coding deictic relations (i.e., relating event time to speech time) because of a conceptual limitation, e.g., “...at this point the child lacks the cognitive capacities that are presumed to underlie the construction of such relations” (Aksu-Koç, 1988, p. 48). They were strongly influenced by the Piagetian explanation of conceptual development which was a dominant view at that time. According to Piaget (1952), representation was limited to action schemas during the first five sub-stages of the “sensorimotor” period, and the Piagetian framework provided no explanation for how symbolic thinking emerged in the sixth sub-stage, at about 18 to 24 months of age. Translated into current ideas about memory, children were credited with procedural (or

implicit) memory as contrasted with declarative (or explicit) memory. According to Tulving (1985), procedural memory, “provides a blueprint for future action without containing information about the past” (p. 387), and in contrast, episodic memory (i.e., a type of declarative memory) contains, “information about the relations of represented events to the rememberer’s personal identity as it exists in subjective time and space” (p. 388). With only procedural memory, children’s thinking would be limited to the here-and-now of the immediate perceptual environment where they might be able to think about a completed state or an ongoing action, but they would not be able to construct and retrieve a representation of an event in their lives. The Piagetian framework contained a hierarchical explanation of development with procedural memory emerging during the first five sensorimotor sub-stages and declarative memory beginning in the sixth and last sub-stage.

Contemporary investigations of infant memory have clearly demonstrated that the infant-toddler has the capacity for declarative memory before their temporal system emerges in their language. These investigations have utilized one of three experimental procedures: 1) paired comparison, 2) conjugate reinforcement, or 3) deferred imitation. Bahrnick and Pickens (1995) used the paired comparison procedure with 3-month-old infants. They familiarized the infants with a specific object motion, and then after a retention interval, they tested the infants with the paired presentation of the familiar motion together with a novel motion. After intervals of one or three months, the infants preferred to look at the familiar motion. Hence, the 3-month-old children demonstrated recognition memory for as long as three months. In Rovee-Collier’s conjugate reinforcement procedure, children learned to make a kicking (or lever pressing) response in order to create a crib-mobile (or toy-train) movement (see the Rovee-Collier & Barr, 2001 review). The fundamental mobile procedure contained the following phases: 1) *baseline*,

where spontaneous response rate is measured, 2) *acquisition*, where the connection is made between a ribbon attached to the infant's foot and a mobile, 3) *immediate retention test*, where the ribbon is no longer attached to the mobile, and 4) *delayed recognition test*, where the infant is presented with the same or a different mobile. Recognition memory was evaluated by comparing the response rates (e.g., kicking rates) before and after the acquisition phase. The recognition memory of children ranging in age from 2 to 18 months of age has been evaluated with the conjugate reinforcement procedure (see Rovee-Collier, 1997, Figure 4, p. 475). The maximum retention interval realized by the infants ranged from 1 week for the 3-month-olds to 13 weeks for the 18-month-olds, and the relationship between the age of the children and the interval of retention was linear. Rovee-Collier (1997, p. 491) argued that, "there is no empirical evidence that the implicit and explicit memory systems follow a hierarchical developmental sequence" (cf. Schacter & Moscovitch, 1984).

Within independent programs of research, Patricia Bauer and Andrew Meltzoff have demonstrated deferred imitation in relatively young infants (see Bauer, 2007 and Meltzoff, 2005 for reviews). Bauer's (1996) research paradigm requires infants to remember a sequence of actions. The basic procedure includes the following components: 1) spontaneous *manipulation* of props, 2) *modeling* a sequence of events, e.g., making a gong, 3) *immediate imitation* given the instructions, "Now you make / do X, just as I did", 4) a retention interval, and 5) opportunity for *deferred imitation*. Bauer and her colleagues found that the variables that influence declarative memory in older children and adults have a similar effect on the deferred imitation of toddlers. These variables include the retention interval, enablement relations, multiple experiences, and reminders. In one of their studies, Bauer, Hertsgaard, and Dow (1994) used an eight month delay in an experiment involving multiple experiences. Three experimental groups

experienced modeling at 13-, 16-, or 20-months, and then a final delayed testing at 21-, 24-, or 29-months. The retention of these children was compared with three age matched groups of naïve children, and they were always significantly better at producing the correct sequences than their naïve controls. Thus, having had two experiences with modeling and immediate imitation the children remembered an episode for approximately eight months. Considering their final testing ages, these children were in the age range where finite morphology is typically observed. When children begin to learn how to communicate their experiences, they have the potential to construct and to remember representations of those experiences.

Early Linguistic Development in the Temporal Domain.

The Event Time System. Smith (1980) and Weist (1986, 1989, 2002a) proposed that temporal reference in child language begins with the expression of deictic relations between speech time (ST) and event time (ET). Considering a wide range of cross-linguistic data, Weist (1986) argued that children process and integrate tense with lexical aspect, grammatical aspect and modality to form a tense-aspect-modality system (see Stephany's 1986 review of modality). The contemporary research on infant-toddler memory processes has made it very clear that young children can think about the past and careful observations of the context of early language shows that children can talk about the past and anticipate the future as well. Table 1 contains four examples taken from Melissa Bowerman's (1981) notes on the temporal properties of her daughter Christy's language. At 1;9 (i.e., 1 year; 9 months), Christy made reference to a personal experience that had occurred one day earlier, and she anticipated an event that she might have hoped to occur in the near future. Relatively typical of children learning English, the finite morphology was absent in her utterances. However, by 2-years-old, Christy marked her utterances for the deictic relations ET prior to and subsequent to ST. In general, cross-linguistic

research on language production (e.g., Pawlak, Oehlich, & Weist, 2006, Radford, 1990) and comprehension (e.g., Weist, Lyytinen, Wysocka, & Atanassova, 1997) has demonstrated that the ET system emerges at about 2 years of age. Two-year-old children are able to think about events in their lives, and as they acquire language, they talk about these events. However, they talk about these events in different ways depending on the morpho-syntactic structure of their language.

Cross-linguistic Variations on the ET System: Polish versus English. Languages integrate their aspectual perspective on temporal contour with their expression of deictic relations in different ways, and these differences affect the acquisition patterns. Research contrasting the acquisition of Polish with English demonstrates such different patterns effectively. Both languages have a basic past versus non-past split, and they both have an aspectual contrast. This is where the similarity ends. Polish makes a distinction between perfective and imperfective grammatical aspect. Perfective aspect specifies a boundary, and the precise location of the boundary varies with the categories of lexical aspect. When the semantics of a stative verb is combined with perfective aspect, the boundary is on the inception of a dynamic process, e.g., *kocha-ć* ‘to love’ becomes *po-kocha-ć* ‘to fall in love’. Activity verbs have arbitrary beginnings and endings, e.g., *jecha-ć* ‘to go by vehicle’, but the perfective imposes limits creating a delimited form, i.e., *po-jecha-ć* ‘to go for a while’. Telic verbs have an inherent terminal point or goal, e.g., *lama-ć* ‘to break’, and the perfective form codes completion or the expectation of completion, i.e., *z-lama-ć* ‘to break’. Whereas the perfective clearly shapes the meaning, the imperfective is neutral. The imperfective embraces a variety of meanings such as continuous or ongoing.

The English progressive aspect specifies ongoing action. Technically, progressive is incompatible with the stative concept, since stative verbs lack a sense of progress through stages, e.g., *want*. Progressive is contrasted with non-progressive, and the non-progressive has a relatively wide semantic scope. Thus, in English, the internal aspectual perspective codes the specific meaning of ‘ongoing’, and in Polish the external aspectual perspective narrows the meaning to ‘completed’. These differences create three salient differences in the acquisition patterns (Weist, Pawlak, & Carapella, 2004). Children learning English are very unlikely to produce stative progressives, and children learning Polish don’t produce stative perfectives, as these combinations of aspect and lexical aspect are incompatible in the two languages. For children learning Polish, there is a strong interaction of grammatical and lexical aspect such that telic-perfective and atelic-imperfective forms are highly likely. There is a natural relationship between a verb whose meaning includes an inherent terminal point and the perfective aspect that codes a completed process. The interaction of non-progressive-telic forms and progressive-atelic forms is not as robust in English. Past tense imperfective verb forms emerge relatively early in Polish, but past tense progressive verb forms emerge relatively late in English. Since the imperfective in Polish is relatively neutral, the children can locate ET prior to ST and maintain their temporal point of reference at ST. In English, the argument can be made that the past progressive form is uttered when the speaker moves his/her point of temporal reference and re-experiences the remembered event. The capacity to shift RT to remote locations has implications for conceptual development (see Part 2 below).

Cross-linguistic Differences in the ET System: Inuktitut. What about languages with a greater difference in the organization of the tense-aspect-modality (TAM) system? Inuktitut is an Eskimo-Aleut language that has a future – non-future split and remote tenses. There is only

one investigation of the acquisition of the TAM system of a language with these properties, and that is a study by Mary Swift (2004) with related research by Shanley Allen (1997). Three important components of the Inuktitut verb are as follows: 1) base (or stem), 2) temporal suffixes which are optional for past and obligatory for future, and 3) obligatory inflections specifying agreement in person and number for a particular mood. Verb forms that contain the obligatory agreement morphology but do not contain the optional temporal morphology are called “zero-marked”. The temporal interpretation of zero-marked verbs depends entirely on lexical aspect and more specifically on the atelic – telic distinction. Atelic verbs carry the meaning imperfective aspect and present tense (e.g., Jini (1;8) *tiiturpuq* [tii-tuq-vuq] tea-consume-IND:3sS ‘She’s drinking tea’), and telic verbs are interpreted as perfective aspect and past tense (e.g., Elijah (2;9) *katappuq* [katak-vuq] fall-IND.3sS ‘It fell’)². In the examples, both of the verbs are inflected for the indicative mood and the 3rd person singular subject, however, neither verb contains a temporal suffix, i.e., they are “zero-marked”. The first and most frequent temporal suffix is the prospective aspect suffix *-si-* meaning ‘about to / going to’ (e.g., Tumasi (1;9) *ataisimmat* [atai-si-mmat] go:out-PRSP-CTG:3sS ‘He’s about to go out’). Children learning Inuktitut use other aspectual markers indicating ingressive, terminative and durative, but these are somewhat later and less frequent. At this early phase of acquisition, the children (like adults) use the property of telicity within lexical aspect to discriminate past from present, and they use prospective aspect (*-si-*) to code future (much like English *gonna / going to*).

The remote tense morphology of Inuktitut includes four temporal distinctions in the future and five distinctions in the past. In the future, there are two forms coding degrees of remoteness in the same day indicating sooner (i.e., a few hours) and later. The next degree of remoteness specifies one day or longer (i.e., tomorrow or later). The form indicating far in the

future was absent in the children's speech. The immediate future form appeared first and with the greatest frequency in the children's language followed in frequency by the next-day form and finally the later in the same-day form. Swift pointed out that the Inuit children "demonstrate facility" for the prospective *-si-* and the near future (or soon) *-langa-* "before they begin to use overt suffixes to mark past time reference" (p. 237).

Hence, the children used zero-marked verbs in combination with the lexical feature of telicity to code past and present, and they used prospective aspect and the near-future suffixes to code future. Since only events associated with a completed change of state were interpreted as prior to speech time, the missing element in the system was past reference to activities, e.g., utterances analogous to Christy's (2;0) *I cried* (Table 1). The initial overt past tense suffix to emerge in the children's language coded immediate past, and it was likely to be used with atelic verbs. Yesterday-past was the next most frequent followed by distant-past. Thus, in the past, like the future, the children were likely to code the concepts of immediate, one daily cycle removed and sometime in the temporal distance. The acquisition of future forms was facilitated by the fact that they are obligatory in Inuktitut whereas past forms are optional. The acquisition pattern was quite different from that of the typical Indo-European language reviewed by Harner (1982) or Weist (1986). The structure of the Inuktitut language shaped the acquisition pattern, and there was no evidence for a conceptual limitation on the Inuit child's capacity to think about and code future events. To the extent to which the linguistic relativity hypothesis might apply to Inuit children, they may develop a precocious and relatively accurate capacity to locate their episodic representations in time. However, the research with these children was limited to the linguistic component of development, and we lack independent evidence on their potential cognitive prowess with respect to temporal understanding.

While cross-linguistic evidence for relativity in the early phase of temporal development is absent in studies like Swift's, there is general evidence that the child's early capacity to talk about events in her/his life is related to the child's capacity to remember those events. Peterson and Rideout (1998) evaluated children's capacity to remember a medical emergency involving a trip to the emergency room. There were three groups of children with the following age ranges: 1) young toddlers (1;1 – 1;6), 2) older toddlers (1;8 – 2;1), and 3) 2-year-olds (2;2 – 2;10). The children were interviewed shortly after their accident and then after 6, 12, 18 and 24 months. Only a few of the young toddlers were able to report even isolated details of their experience. The nature of the reports of the older toddlers was quite variable ranging from no report to isolated details to partial reports. The 2-year-olds were able to give either partial or full reports. If the children could talk about the experience during the initial interview, they could remember the experience 18 to 24 months later. Hence, the capacity to use language to structure the memory of an experience provides the initial representation with additional properties facilitating subsequent recall. While this study does not show linguistic relativity, it does show a positive interaction of language acquisition and cognitive development partially due to the emergence of the initial temporal reference system.

Early Conceptual Development in the Spatial Domain.

Since Piagetian thinking had a considerable impact on the research in this area, many research projects were designed to identify a qualitative shift from “ego-centric to allo-centric” spatial representations (e.g., Acredolo, 1978). The Piagetian approach does not focus on either the domain-specific nature of spatial information processing or the gradual change in the spatial cues that children utilize, and Nora Newcombe and Janellen Huttenlocher (2003 review) took a different approach. They identified a set of four types of spatial coding that are part of the

adult's repertoire, and then they traced the emergence of these four types of information processing during development.

The four potential types of spatial coding that they identified are as follows: 1) cue learning involves forming an association between the "to-be-located" (or primary) object and perceptually identifiable landmarks, 2) place learning involves, "using a system of distance and direction" relative to landmarks, 3) response learning involves establishing a relationship between a set of motor movements and a to-be-located object (i.e., a viewer-centered coding), and 4) dead reckoning involves monitoring one's own position in space, i.e., "coding distance and direction of one's own movement to update self-referenced location knowledge" (Newcombe & Huttenlocher, 2003, p. 23). Newcombe and Huttenlocher argued that the infant has access to the four types of spatial coding and the relative importance of these coding systems changes during development, i.e., there is a process of "re-weighting". Our understanding of the infant's capacity to relate their own position in space relative to landmarks is relevant to our understanding of the child's conceptual state of readiness to construct a linguistic spatial system.

In order for the child to utilize "dead reckoning" and "place learning", by definition, the child needs to be able to process distance and direction. In their basic research design (Huttenlocher, Newcombe, & Sandberg, 1994), an object was buried in a 1 by 5 foot sand box, the sand was made smooth, the child looked away to give their mother a kiss, and then they were asked to find the object from the same viewing perspective. Sixteen-month-old children were extremely accurate in finding the object, and they were as capable as 24-month-olds. Within a similar "continuous distance" paradigm, Newcombe, Huttenlocher, Drumme, and Wiley (1998) evaluated dead reckoning and place learning in 16- to 36-month-old children within the experimental context of their hide-and-seek task. First of all, they replicated the Huttenlocher et

al. (1994) finding. Secondly, after seeing the object hidden from one perspective, the children walked to the opposite side of the sandbox, and they searched for the hidden object from a 180 degree different perspective. The hide-and-seek task was conducted with or without visible external landmarks. When the landmarks were available, the potential for place learning existed. Otherwise, the children had to rely on dead reckoning. For the most critical comparisons, the investigators partitioned the children into the following age groups: 1) 16- to 21-months-old, 2) 22- to 24-months-old, and 3) 28- to 36-months-old. In general, the children's performance was above chance regardless of age or experimental condition. When the children moved to the mirror-image perspective, there was a dramatic difference between the performance of the 16- to 21-month-old children and the older children. The 16- to 21-month-olds did not utilize the landmarks to reduce their errors in the search task and the older children did. In summary, the preverbal child has a variety of ways to code spatial information, and they are able to utilize their information processing capacity to construct spatial representations. Children are conceptually ready for the challenges that language acquisition will bring as they acquire their spatial linguistic system. For Example, if a child were to acquire a language that placed a premium on dead-reckoning, the Newcombe-Huttenlocher research indicates that the child would be ready to acquire that spatial system during the early phase of acquisition. If, on the other hand, the child had to make the ego-centric to allo-centric transition following the Piagetian developmental calendar, the child would not be ready to deal with such a spatial system until the later phase of acquisition.

Early Linguistic Development in the Spatial Domain.

Language diversity and acquisition patterns: Motion. When considering the relationship between language and thought in the spatial domain, Soonja Choi and Melissa Bowerman's

research comparing the acquisition of Korean and English has been the most revealing (e.g., Choi & Bowerman, 1991 and Bowerman & Choi, 2001). Languages structure motion events in different ways. In general, the motion structure includes a “figure” (i.e., the moving object), a “ground” (i.e., the referent object), and a “path” (i.e., the trajectory of the figure relative to the ground). In English, the concept of motion is lexicalized (or conflated) together with one of the following concepts: 1) manner, e.g., *walk / swim*, 2) cause, e.g., *push / pull*, or 3) deixis, e.g., *come / go*, and the concept of path is expressed in a preposition or particle, e.g., *in / out*, or *up / down*. The structure is the same for intransitive sentences expressing spontaneous motion, e.g., *the child’s ball rolled into the street*, and transitive sentences expressing caused motion, e.g., *the child rolled the bowling ball into the pins*. The same pattern is used for general movement through space, e.g., *climb up / slide down*, as it is for changes in posture, e.g., *stand up / lie down*. Korean structures intransitive clauses expressing spontaneous motion differently from transitive clauses expressing caused motion. For spontaneous motion in Korean, the complete pattern includes three verbs expressing, manner, path, and motion together with deixis. The conflation pattern for caused motion contains two verbs, one expressing manner and cause, and the other motion, path, and ground (i.e., a property of the referent object). The basic clause sequence in Korean is subject-object-verb, and the verb integrating motion, path and ground has the sentence final position. The most pertinent child language data are focused on the transitive verbs concerning the concepts of joining and separating, and more specifically on the verbs *kkita / ppayta* ‘fit / unfit’ and *nehta / kkenayta*, ‘put in loosely in a container / take out from a loose container’. The verbs, *kkita / ppayta*, mean ‘to join / separate two objects with a tight fit’ without regards to the distinction between a container versus a surface. Hence, *kkita* will be used to describe inserting a button into a button hole as well as placing a Lego block on top of a

second Lego block. In contrast, *nehta* / *kkenayta* mean ‘to insert / remove an object into / out-of a loose container’ (see Bowerman & Choi, 2001, Figure 16.1, pp. 482-483). Therefore, *kkita* / *nehta* contrast a tight versus loose joining process exclusively within a transitive clause.

Choi and Bowerman (1991) evaluated motion expressions in the corpora of Bowerman’s diary study of her two daughters (Christy and Eva) learning English, and the video recordings of four children learning Korean between the ages of 14 to 24 – 28 months. During the period from 14 to 16 months, all of the children began to code motion events. By 19 to 20 months, the children learning English used the same words to express the concept of path in both spontaneous and caused motion, e.g., *up* / *down* and *in* / *out*. The acquisition pattern in Korean is quite different. Korean children observe the difference between spontaneous and caused motion from the beginning, and Choi and Bowerman note that, “they never violate the distinction between spontaneous and caused motion along a path through the entire developmental period observed” (p. 105). During the period from 14 to 16 months, *kkita* / *ppayta* ‘(tight) fit / unfit’ were the first productive transitive path verbs. In a few months, the verbs, *nehta* / *kkenayata* ‘put / take (loose joint / separation)’, were also productive. From a very early phase in the acquisition of Korean, the children discriminate tight from loose fit in the context of caused motion.

Another important difference concerns references to the vertical dimension. The children learning English used *up* and *down* to refer to spontaneous motion such as climbing up / down, and caused motion such as picking something up / putting something down. For children learning Korean, references to the vertical dimension were found to be restricted to spontaneous motion related to postural change, e.g., *ancta* ‘sit down’ and *ilenata* ‘get up’. It is very clear from these data that the pattern of acquisition is guided by the structure of the target language. While infants have undergone considerable development in the spatial domain (as described

earlier in this paper), they do not simply map words onto existing concepts when they acquire their language. According to Bowerman and Choi (2001, p. 488), "... from their first productive use of spatial words, children categorize spatial events language-specifically – there is no evidence that they rely on the same set of basic spatial concepts".

The child language data show that the structure of the spatial system of a language shapes the acquisition pattern of that language. While it appears that the language has made the children more sensitive to particular spatial relations, experimental evidence was needed to make this argument. Choi (2006) investigated this developmental process with a variation on the preferential looking procedure. She tested monolingual children learning either English or Korean in the following age groups: English; 18, 24, 29 & 36 months and Korean; 29 & 36 months. Two activities involving caused motion were presented to the children on a split screen. For one group of children (the tight-fit group), the stimulus pair demonstrated tight-fit containment, e.g., in the left side program, nested cups were inserted tightly into cups, and in the right side program, shaped blocks were inserted into the same shaped holes. For the second group (the loose-fit group), the stimulus pair demonstrated loose fit containment, e.g., putting wooden blocks in a basket versus putting bristle blocks in a bag. The children received six trials with different stimuli all demonstrating the same containment relation, i.e., tight-fit or loose-fit, and they became familiar with that containment relation. During the test phase of the procedure, the children observed a split screen program with a tight-fit containment demonstration on one side and a loose-fit containment demonstration on the other side. If the children had become familiar with the tight (or loose) containment relation during the first six trials, they should look longer at the matching tight (or loose) containment relation during testing. For children learning English, there was an interaction of age by looking bias such that 18-month-olds looked longer at

the program with the familiar relation but 36-month-olds did not do so. In contrast, both 29- and 36-month-old Korean learners looked longer at the relation-matching program. A parental analysis of vocabulary indicated that the presence of *in* increased dramatically from 18 to 36 months for the English learners, and the presence of *kkita* was already at quite a high level for the 29 and 36 month old Korean learners. Choi surmised that, “the results suggest that acquisition of language-specific semantics influences nonlinguistic sensitivity in the relevant cognitive domain” (p. 225). While the effect may be quite specific, Choi’s study may be the clearest demonstration of the linguistic relativity hypothesis as the acquisition of spatial morphology shaped one facet of cognition in the domain of visual information processing.

Language diversity and acquisition patterns: Perspective. The research on Korean shows that language-specific categories defined within transitive versus intransitive clause structure influence the child’s thinking about locative situations. This section concerns research on the acquisition of two Mayan languages; Penelope Brown’s research on Tzeltal and Lourdes de León’s research on Tzotzil. These languages are particularly interesting in the context of this paper because of a difference in spatial perspective that has the potential to shape children’s thinking in a relatively general manner. Languages differ in the way that they code spatial perspective. Three kinds of perspective are relevant: 1) object-centered (i.e., intrinsic), 2) viewer-centered (i.e., relative), and 3) environment-centered (i.e., absolute) (see Levinson, 1996, Figure 4.9, p. 139). All languages utilize object-centered perspective where the figure is located relative to the intrinsic properties of the referent object, e.g., the apple is in front of the camera if it is located along a vector extending outward from the lens. Many languages, e.g., English, Polish and Korean, code viewer-centered perspective where the position of the figure is related to the position of the observer, e.g., the apple is to the right / left of the camera if it is on the

observer's right / left side. Here, the location of the figure is determined relative to the position of the observer. Languages may have a conventional system that enables the speaker to establish environment-centered perspective, e.g., within the English language, there is the potential to utilize the cardinal directions; North versus South and East versus West. If the camera-apple layout was evaluated from this perspective, the apple might be located to the East or West of the camera. For children learning English, absolute spatial location is acquired relatively late (Weist, 2002b).

It is important to understand how such a layout is described when the observer's position is rotated 180 degrees because the description of the layout may or may not change. If in the initial camera-apple layout, the apple was: 1) in front of the camera, 2) on the right side of the camera, and 3) to the East of the camera, then after a 180 degree rotation of the observer's position, the apple would be: 1) still in front of the camera, 2) now on the left side of the camera, and 3) still to the East of the camera. Only the location relative to the perspective of the observer has changed. The fundamental perspectives taken by many languages include viewer-centered in addition to object-centered location, e.g., in English the distinction between *up* and *down* is determined by the viewer's (i.e., speaker's) vertical perspective, and the distinction between *in* and *on* depends on the property of containment versus support of the referent object. The Mayan languages, Tzeltal and Tzotzil, code environment-centered (i.e., "absolute") as well as object-centered location. These Mayan languages do not have the viewer-centered system. According to Levinson (1996, p.145), "People who speak such languages ... can dead reckon current location in unfamiliar territory with extraordinary accuracy." It seems that learning one of these Mayan languages "re-weights" the dead reckoning cues for spatial information processing.

According to Brown (2001, p. 515), in the absolute system of Tzeltal, “an ‘uphill / downhill’ coordinate abstracted from the lay of the land is used to reckon spatial relationships on the horizontal in both small-scale and long-distance space.” As the ‘uphill / downhill’ distinction relates to the cardinal directions in the cultural topography of this speech community in southeastern Mexico, uphill is approximately South and downhill roughly North. Included in the system are the intransitive verb roots *mo / ko* ‘ascend / descend’ and their transitive counterparts *mo-tes / ko-tes* ‘make ascend / descend’ that conflate motion and path (see Brown, 2001, Table 17.1, p. 515). The system is also applied to the vertical axis, and *mo / ko* can refer to motion upwards / downwards as well as Southwards / Northwards. A transverse axis is also coded with the verb *jelawel* ‘across-ways’, but it is not further specified for direction, i.e., East / West. Brown points out that the system, “requires speakers to maintain absolute orientation at all times” (p. 516). Within the scope of the research on conceptual development, the capacity to utilize the uphill / downhill system of Tzeltal would require a combination of dead-reckoning and place learning. Returning to the results of the Newcombe, et al. (1998) experiment, two findings are relevant here: 1) the searching performance of children from 16- to 36-months-old was above chance regardless of age or experimental condition, and 2) when the children moved to the mirror-image perspective (i.e., 180 degree rotation), the 16-/21-month-olds did not utilize the landmarks to reduce their errors in the search task and the older children did. Newcombe’s findings predict that toddlers have the conceptual means to acquire the absolute system of Tzeltal and that we can expect ongoing conceptual developments to influence the acquisition process.

From the earliest observations, children learning Tzeltal use motion-path verbs to code movement in the horizontal (i.e., land-slope) plane as well as the vertical dimension (see Table 2). In the horizontal plane, movement was described in reference to the household layout or

between houses in the wider landscape, and in the vertical dimension, references were made to self or object up / down movement, e.g., climbing trees. By 3-years-old, the children begin to use the up / down motion verbs in novel situations, and according to Brown (2001, p. 522), “The children appear to have mastered the semantic contrasts of the terms in the Absolute system by age 3.” Furthermore, “By about 3;6 children can use this system to relate objects and events spatially to places and people familiar to them ... when this extends to any place is still unclear” (p. 523). Relating again to Newcombe’s findings, the 3-year-old’s capacity to utilize place learning is relatively well established, and they should be able to take advantage of landmark information. On the other hand, we see again that the structure of the language is guiding the acquisition to the spatial system, and potentially re-weighting components of the spatial information processing system.

Language diversity and acquisition patterns: Specificity. Considering research within the areas of cognitive development and the acquisition of English, words with the semantics of *up* and *down* should be acquired during an early phase of the emergence of spatial location in child language for at least three reasons. First, children enter language acquisition with a concept of verticality, and they can simply map the operative words onto the pre-linguistic concept (e.g., Clark, 1973, p. 53, Mandler, 1992, p. 599, and McCune-Nicolich, 1981, p. 18). Second, children should produce semantically general words expressing motion before more specific ones, as they do when learning English (e.g., Clark, 1993, pp. 29 – 30). Third, closed class words (e.g., prepositions and particles) expressing containment, support, and verticality should be acquired before open-class words (e.g., motion verbs) (Sinha, et al. 1994). De León’s (2001) research on the acquisition of Tzotzil proved that none of these predictions were correct for that language. Children acquiring spatial location in Tzotzil demonstrate an entirely different pattern from the

English *up / down* prototype, and once again the structure of the language guides acquisition.

The Tzotzil data were obtained from de León's longitudinal study of two girls starting at 19 months and two boys starting at 24 months. Table 3 contains examples from Bowerman's diary study of her daughters and de León's longitudinal study (see de León 2001, Table 18.3, p. 553).

Whereas the children learning English used the directional particles *up* and *down* in both spontaneous and caused motion without specifying additional properties of the motion event, the children learning Tzotzil used verbs having a specific meaning. In fact, Tzotzil has the directional particles *muyel* 'ascending / going uphill' and *yalel* 'descending / going downhill' which have properties analogous to those of *up* and *down* and can express verticality. However, Tzotzil like Tzeltal has a system of environment-centered perspective, and the early use of *muyel* and *yalel* is dominated by the land-slope usage duplicating Brown's research described earlier in this paper. Once again, in order to predict the acquisition pattern in a language, one needs to understand the structure of the language that shapes the pattern.

Part 2: The Late Phase of Development

In the first part of this paper, I reviewed research on conceptual development making the case that children enter their language acquisition phase of development with the capacity to construct representations of events in their lives and representations of spatial layouts that they encounter. In short, they are conceptually ready to talk about those events and places. More specifically, they are ready to communicate the location of events relative to speech time and the location of primary objects relative to referent objects. In other words, they are ready to code what we have referred to as "mono-referential" relations, "Location in time and space was defined as mono-referential when the locative configuration requires a single referent time/object with sufficient inherent properties and a proximity relation, e.g., past/future tense or *into/out of*,"

(see examples in Table 4 and in Weist, Atanassova, Wysocka, & Pawlak, 1999, p. 269). The emerging temporal and spatial systems differ in their functional perspective. In the temporal system, the initial mono-referential perspective is viewer-centered as the primary event is located from the perspective of speech time, i.e., the deictic center. In the spatial system, the initial mono-referential relations express an object-centered perspective as the primary object (or figure) is related to a referent (or ground) with inherent features made salient by invariants across cultures, e.g., eyes define the front side, and culturally specific factors, e.g., the object accepts a tight fit³.

Furthermore, in Part I, I reviewed child language research from a wide variety of languages demonstrating that the pattern of language acquisition depends of the structure of the language as contrasted with some preconceived notion of how languages should emerge. The developmental process continues into childhood with the potential for language – thought interactions. During the preschool phase of development, temporal and spatial linguistic systems become more complex providing the child with the capacity to communicate higher order relationship and opening the possibility that linguistic innovation facilitates conceptual advancements (see Pawlak, et al. 2006 on temporal systems, and Internicola & Weist, 2003 on spatial systems). We referred to the relations expressed in the more complex systems as “bi-referential”, “... location was defined as bi-referential when two or more referent times/objects are required and a perspective relation, e.g., past perfect or *between*” (Weist, et al. 1999, p. 269). Weist (1986) referred to the more advanced temporal system as the “Reference Time (RT)” system as children acquired the capacity to relate event time to external referent points as well as to speech time. Regarding linguistic perspective, children add an “episode-centered” perspective to their “speech-act centered” perspective within their temporal system, and they add either a

viewer-centered or environment-centered perspective (or in some cases both) to their object-centered spatial system. In order to evaluate the potential language – thought interactions that occur during the emergence or bi-referential relations, I will focus discussion on a cross-linguistic research project that had its inception in Poznań in Poland and was extended to Jyväskylä in Finland and Fredonia in America.

The Polish, Finnish, English Project: Overall Design. In two cross-linguistic studies, Richard Weist and a cross-cultural research team investigated the relationship between language acquisition and conceptual development during the transition from mono-referential to bi-referential temporal and spatial systems (Weist, et al. 1997 & 1999). Children learning Polish, Finnish, and English were tested in both of the research projects. The research designs were cross-sectional, and the children in the 1997 study were tested at 2;6, 3;6, 4;6, and 5;6 (i.e., years; months). In the 1999 study, the children at each age level were approximately 6 months older at 3;0, 4;0, 5;0 and 6;0. Polish and Finnish are both highly inflected languages but with quite different temporal and spatial systems. In Polish, there is a relatively close correspondence between the morphology coding temporal concepts and the concepts being coded, e.g., tense morphology is separate from aspect and there is one relatively invariant way to code past reference. In Finnish, there is a relatively close correspondence between the morphology coding spatial concepts and the concepts being coded, i.e., Finnish has six cases designed primarily to specify spatial concepts. Hence, the relationship between morphological structure and semantic function approaches 1-to-1 in the Polish temporal system and in the Finnish spatial system (Weist, 2008). Table 5 summarizes the 1-to-1 versus many-to-one mappings in Polish and Finnish, and Table 4 contains sentence examples. On the hypothesis that 1-to-1 form-to-function mapping facilitates acquisition, it was proposed that children learning Polish would excel on tests

evaluating the emerging temporal system, and children learning Finnish would excel on tests designed to evaluate the emerging spatial system.

Conceptual and Linguistic Development: The Weist, et al. (1997) Study.

Conceptual Spatial Test. All of the children were given tests designed to evaluate conceptual and linguistic development in the spatial and temporal domains, and within the linguistic tests, comprehension and production were evaluated. Starting with the 1997 study, the spatial conceptual test required the children to remember the relationship between a target object and a referent object within a model layout. The children viewed a picture of the floor plan of a 4-room house where one piece of furniture was labeled, and then, they were asked to find the marked item in the actual model. In the third and final phase, the model was covered, and one of the other pieces of furniture (i.e., the referent object) in the layout was placed above its location in the covered layout. Using a doll with its arm extended, the child was asked to rotate the doll so that it would be pointing at the location that they remembered for the target (i.e., to-be-located) piece of furniture. The children had to construct a coordinated representation of the spatial layout to succeed on the task. The error in the degrees of azimuth was measured, and during the age span from 2;6 to 5;6, there was a significant decrease in the children's location errors.

Conceptual Temporal Tests. There were two related tests of temporal conceptual development; immediate imitation of a modeled episode and a story-card arrangement task. In the imitation procedure, the experimenter modeled an episode containing three arbitrary events while narrating the actions, and then the child was given the toys and asked to duplicate the episode. In the story-card arrangement task, the children were presented with a triangular

arrangement of three picture cards representing the beginning, middle, and end of an episode. First, they were asked to sequence the pictures on a three place story board, and then the picture representing the middle of the story was presented on the left of right side of a two place story board, and the children were asked to move the story forward or backward respectively. The card arrangement task was more difficult than the imitation task especially for the 2- and 3-year-olds, but there was significant improvement approaching asymptotic level by 5-years-old. The spatial and temporal conceptual tests required the children to go beyond the capacity to construct spatial or temporal representations to some higher level of thinking about those representations. In space, they had to remember how the items in the layout were arranged, and in time, they had to apply their understanding of scripts and / or the logical structure of a unique episode.

Spatial and Temporal Conceptual Results. Like the children learning English, the performance of the children learning Polish and Finnish on the spatial and temporal conceptual tasks improved with age. The overall performance of the Finnish children exceeded that of the Polish children, and they demonstrated a greater advantage on the spatial task. While there was an interaction, it was not a cross-over interaction as the Polish children did not do better on the temporal task. If 1-to-1 mapping facilitates the acquisition of the Finnish spatial system and the Polish temporal system, and if the linguistic relativity hypothesis holds for higher order thinking in the domains of space and time, there should have been a cross-over interaction.

Linguistic Spatial and Temporal Tests. On the linguistic side, the comprehension tests involved a sentence-picture matching-procedure. All of the children received the static (i.e., drawn illustrations) version of the test, and the children learning English also received a dynamic (i.e., video) version. The static test included the following categories of items: 1) space & mono-referential; **in / on* and inherent (or featured) *front / back*, 2) space & bi-referential; *between*

x&y / between y&z and deictic (or featureless) **front / back*, 3) time & mono-referential; **past / future* tense and internal / external viewpoint aspect, and 4) time & bi-referential; remote / immediate adverbs and **before / after* (see Weist, et al., 1997, Appendix B). The category of problems marked with an asterisk made up the dynamic test. In the static test, two picture alternatives were presented to the child in a book. The experimenter read two contrasting sentences, and then she re-read the test sentence. The children were asked to point to the matching picture. The video procedure included a sequence of three presentations. One scene was shown on the left monitor while the right was blank, and then the contrasting scene was presented on the right monitor while the left monitor was blank. During these single monitor presentations, the experimenter drew the child's attention to important features of the scenes. Finally, the contrasting scenes were presented together while the experimenter read the test sentence, and the child was asked to point to the matching scene.

Spatial and Temporal linguistic Results. In time and space, the children in all four age groups exceeded chance expectations on the mono-referential problems (i.e., passed the test items), and they progressed toward asymptotic level with age. The 2- and 3-year-olds failed the bi-referential tests in time and space and the 4- and 5-year-olds passed them. Considering only the static comprehension test for the children learning Polish and Finnish, there was an interaction of language by dimension (i.e., time / space). The Polish children demonstrated better comprehension on the temporal problems and the Finnish children performed better on the spatial problems as predicted by the 1-to-1 mapping hypothesis.

In the production test, the experimenter utilized toy layouts and actions in order to elicit utterances including bi-referential relations. Considering the data from all three languages, The average percentage of children that produced at least one bi-referential relationship was as

follows: 1) space; 2;6 = 9%, 3;6 = 54%, 4;6 = 75%, and 5;6 = 89%, and 2) time; 2;6 = 9%, 3;6 = 35%, 4;6 = 64%, and 5;6 = 80%. Similar to the comprehension tests, the knowledge of bi-referential relations was not successfully brought out until about 4-years-old. For every child, a composite linguistic and conceptual score was determined, and these language – thought measures were correlated. The correlations were significant. As language acquisition progresses into more complex ways of locating events in time and objects in space, the capacity to think about temporal and spatial representation also changes. Furthermore, the developments in the spatial and temporal domains run parallel.

Conceptual and Linguistic Development: The Weist, et al. (1999) Study.

Conceptual Tests. The experimental design in the Weist, et al. (1999) was the same as the (1997) study; however, all of the tests were redesigned. Development was evaluated in the conceptual and linguistic domains on the spatial and temporal dimensions. Within the linguistic domain, we tested comprehension and production, and there were two comprehension tests; static and dynamic. Beginning on the conceptual side with the spatial test, the children were presented with an arrangement of toys, and they observed the experimenter acting out a simple scenario in the layout to draw attention to the elements of the scene. The toys were removed as the child changed perspective on the scene by 180 degrees. Finally, the child tried to reconstruct the original arrangement. The temporal-conceptual test involved story-card arrangement and narrative construction. We created eleven 3-picture-card stories (3 practice & 8 test), each one having an illustration depicting a setting, focal point (or complication), and resolution. As in the previous study, in the first phase of testing the children were asked to place the story-cards on a three place story-board. However, now the stories were recorded for structural analysis. In the second phase, the focal-point card was placed on the left or right side of a two place story-board,

and the children advanced the story to the resolution or reversed the story to the setting. Ten properties of the story were analyzed as follows: 1) establishing and tracking a main character, 2) transitioning from less to more definite, 3) including multiple components, 4) including a setting, 5) including a focal point, 6) including a resolution, 7) shifting from internal to external aspectual perspective (i.e., imperfective back-grounding to perfective foregrounding), 8) temporal structuring, 9) personal perspective or evaluation, and 10) causality coding (Weist, et al., 1999, pp. 277 – 278 definitions). Some of these properties pertain to narrative structure and others concern narrative cohesion.

Conceptual Results. On the spatial and temporal dimensions, there was a significant developmental pattern that was very similar across the three languages, i.e., there was no language by dimension interaction. Specifically, regarding the evaluation of the development of narrative structure and cohesion, the percentage of the inclusion of the structural variable #5 (i.e., a narrative focal point) and the cohesion variable #8 (i.e., temporal structuring) was as follows (summed across the three languages): 1) focal point inclusion; 3;0 = 16%, 4;0 = 40%, 5;0 = 63%, and 6;0 = 79%, and 2) temporally structured; 3;0 = 26%, 4;0 = 63%, 5;0 = 74%, and 6;0 = 88% (cf. Berman & Slobin, 1994). We found the greatest developmental change in these variables, and they may be the most salient indicators of structure and cohesion. The story-card arrangement and narration was referred to as an evaluation of conceptual development. Obviously, this “conceptual diagnostic” requires (i.e., is inherently linked to) language. We found that there is a close relationship between the transition from mono- to bi-referential spatial and temporal linguistic systems and the emergence of narrative structure.

Linguistic Tests. The linguistic evaluation included static and dynamic comprehension tests and an elicitation test. The static and dynamic comprehension tests included the space and

time dimensions and the mono- and bi-referential levels of complexity as follows: A) space; 1) mono-referential; *into / onto* and *into / out-of*, 2) bi-referential; *between x/y / between y/z* and deictic *front / back*, B) time; 1) mono-referential; past / future and internal / external aspectual perspective, and 2) bi-referential; *then / when* and *before / after* (see Weist, et al., 1999, Figures 3a&b and 4a&b). The prototypical aspect problem contained a verb having an activity and a change component in its predicate structure, e.g., creation verbs (e.g., *to draw*) and consumption verbs (e.g., *to drink*). Given a problem like, *the girl (drew / was drawing) the flower*, the non-progressive past best fits the illustration with the complete flower and the progressive past necessarily fits the illustration with ongoing action.

In this study, we tried to extend the semantic range of the verbs in the study to activity verbs, e.g., *play*, and we included the following problem: *the girl (played / was playing) with the teddy-bear*. Given a choice between one picture where the girl interacted with the doll and another picture where she walked away from the doll, the children always chose the interactive illustration. This rendered the aspect subtest unreliable. Thus, in the static test, an analysis was conducted on one rather than two kinds of distinctions as follows: A) space; 1) mono-; *into / onto*, 2) bi-; deictic *front / back*, and B) time; 1) mono-; past / future, and 2) bi-; *then / when*.

Linguistic Results. The production test also included the space / time and mono- / bi-referential distinctions. In general, the children performed better on mono- than bi-referential problems, and there was a significant developmental trend. Children learning Polish were consistently better on temporal problems, but Finnish children only produced a spatial advantage on the dynamic comprehension test. The children learning English produced a relatively even performance on the comprehension test, and they were much better on the spatial production test than the temporal production task. Once again, the individual child's conceptual and bi-

referential linguistic capacity was compared producing highly significant correlations. Higher-order thinking in space and time co-varies with the emergence of complex spatial and temporal language systems.

When the results of these two studies are taken together, there is some evidence that the structure of language influences language acquisition as 1-to-1 form-to-function mapping facilitates the child's capacity to construct his/her temporal or spatial system. It is very clear that complex temporal and spatial linguistic systems emerge together with relatively advanced thinking. While there was no compelling evidence for linguistic relativity during preschool phase of development, there were three consistent cross-linguistic findings: 1) the youngest children tested comprehended and produced mono-referential relations in time and space, 2) during the preschool period of development, the children acquired the linguistic capacity to comprehend and produce bi-referential relations, and 3) innovations in the temporal and spatial linguistic systems was closely related to conceptual development.

Narrative Structure and Conceptual Structure: Language in General.

Embedded in the Weist, et al. (1999) study, there was an evaluation of the development of narrative structure and cohesion. Across the three cultures (i.e., Polish, Finnish, & American), there was a substantial improvement approaching canonical narrative form. Fivush, Haden, and Adam (1995) proposed that developments in the child's knowledge of language change the child's potential for structuring episodic memories. They made the following argument, "It is the canonical narrative form that gives personal memories their structure and allows them to be integrated into the developing life story" (Fivush, Haden, & Adam, 1995, p. 34). According to Nelson and Fivush (2004, p. 486), children develop a more structured memory system which

they called “autobiographical” memory, and they defined this system as follows: “a functionally new human memory system, one that emerges gradually across the preschool years in the context of developments in language, memory, and self, supplementing the memory systems of early life.” Fivush, et al. (1995) investigated the relationship between memory and narrative structure in an extensive longitudinal study. The participants in the study were interviewed about novel past events at the ages of 3;4, 3;10, 4;10, and 5;10. With information provided by the parents, the children were asked to recall three novel events, such as, a visit to a circus as follows: “Your Mom tells me you went to the circus. Can you tell me about that?” Given that a novel experience was not repeated during the interval between interviews, a question regarding one of the three events was repeated. The investigators analyzed the structure and cohesion of the personal narratives. They examined three categories of structure; orientation (providing spatial-temporal context or background), referential (specifying actions), and evaluation. Included in narrative cohesion, they examined simple and complex temporal markers. During the period from 3-years-old to approaching 6-years-old, the children’s personal narratives became more elaborate, detailed, and complex, and this was true if the retention interval was as long as a year. According to Fivush (1995, p. 102) “Narratives provide cohesion and meaning to event memories, and memories that conform to canonical {‘simplest’} narratives will be stable and resistant to suggestion.” In short, memories become immune to “childhood amnesia” if they are transformed into narrative structure. This line of research demonstrates the potential for language to influence cognitive development in a relatively general manner.

Concluding Remarks

The research on the cognitive development in infants and toddlers demonstrates that children have a relatively robust capacity to construct representations of episodes in their lives.

When children begin to organize the temporal and spatial systems within their language, they are already conceptually prepared to relate events in time and objects in space, i.e., to express mono-referential relationships. In general, the capacity to talk about their experiences changes the way those experiences are conceptually represented, adding a layer of structure and increasing the likelihood of retention. Furthermore, the language that a child learns shapes the pattern of acquisition. When the structure the temporal or spatial system matches the child's linguistic information processing strategies, the acquisition process is facilitated. The unique organization of the target language guides the pattern of acquisition providing the potential to influence conceptual development⁴. As children acquire language, their temporal and spatial systems become more complex, and children express bi-referential relationships creating the potential for language to influence thinking in new ways.

End Notes

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2. The following symbols were used in the glosses related to examples from Polish and Inuktitut: 3 third person, CTG contingent, FUT future, IND indicative mood, INF infinitive, IPFV imperfective aspect, PFV perfective aspect, PP past participle, PRSP prospective, S subject, and s singular.
3. When our research on time and space began, some of the key terms used to describe temporal and spatial concepts in language were used differently in the temporal and spatial domains. Regarding time, Comrie (1985: 122 - 126) referred to ST – ET relations (e.g., simple past, ET before ST) as “absolute” tense, ET – RT relations as “relative” tense, and the combination as “absolute-relative” (e.g., past perfect, ET before RT before ST). Regarding space, Levinson (1996) referred to environment-centered perspective as “absolute”, viewer-centered perspective as “relative” and object-centered perspective as “intrinsic” (see Levinson’s review of terms, 1996: Table 4.1). In order to investigate a basic distinction in time and space with neutral terms, we introduced the terms mono- and bi-referential.
4. Benjamin Whorf (1956: 138) posed the following question, “Are our own concepts of ‘time’, ‘space’, and ‘matter’ given in substantially the same form by experience to all men, or are they in part conditioned by the structure of particular languages?” While this chapter focused on time

and space, other developmental research has investigated concepts related to “matter”, e.g., Lucy and Gaskins (2001).

References

- Acredolo, L. (1978). Development of spatial orientation in infancy. *Developmental Psychology*, 14, 224 – 234.
- Aksu-Koç, A. (1988). *The acquisition of aspect and modality: The case of past reference in Turkish*. Cambridge: Cambridge University Press.
- Allen, S. E. M. (1997). *Aspects of argument structure acquisition in Inuktitut*. Amsterdam: John Benjamins.
- Antinucci, F. & Miller, R. (1976). How children talk about what happened. *Journal of Child Language*, 3, 167 – 190.
- Bahrack, L. E., & Pickens, J. N. (1995). Infant memory for object motion across a period of three months: Implications for a four-phase attention function. *Journal of Experimental Child Psychology*, 59, 343 – 371.
- Bauer, P. J. (1996). What do infants recall of their lives? Memory for specific events by one- to two-year-olds. *American Psychologist*, 51, 29 – 41.
- Bauer, P. J. (2007). *Remembering the times of our lives: Memory in infancy and beyond*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Bauer, P. J., Hertsgaard, L. A. & Dow, G. A. (1994). After 8 months have passed: Long-term recall of events by 1- to 2-year-old children. *Memory*, 2, 353 – 382.

Berman, R.A. & Slobin, D. I. (1994). Narrative structure. In R. A. Berman & D. I. Slobin (Eds.) *Relating events in narrative: A crosslinguistic developmental study* (pp. 39 – 84).

Hillsdale, N.J.: Lawrence Erlbaum Associates.

Bowerman, M. (1981). *Notes for the Nijmegen workshop*. MPI, Nijmegen, Netherlands.

Bowerman, M. (1996). The origin of children's spatial semantic categories: Cognitive versus linguistic determinants. In J. J. Gumperz & S. C. Levinson (Eds.) *Rethinking linguistic relativity*. (145 – 176). Cambridge, UK: Cambridge University Press.

Bowerman, M. & Choi, S. (2001). Shaping meanings of language: Universal and language-specific in the acquisition of spatial semantic categories. In M. Bowerman & S. C. Levinson (Eds.). *Language acquisition and conceptual development* (pp. 475 – 511). Cambridge, UK: Cambridge University Press.

Bronckart, L., & Sinclair, H. (1973). Time, tense, and aspect. *Cognition*, 2, 107 – 130.

Brown, P. (2001). Learning to talk about motion UP and DOWN in Tzeltal: Is there a language-specific bias for verb learning. In M. Bowerman & S. C. Levinson (Eds.). *Language acquisition and conceptual development* (pp. 512 – 543). Cambridge, UK: Cambridge University Press.

Choi, S. (2006). Influence of language-specific input on spatial cognition: Categories of containment. *First Language*, 77, 207 – 232.

Choi, S. & Bowerman, M. (1991). Learning to express motion events in English and Korean: The influence of language-specific lexication patterns. *Cognition*, 41, 83 – 121.

Clark, E. V. (1993). *The lexicon in acquisition*. Cambridge, UK: Cambridge University Press.

- Clark, H. H. (1973). Space, time, semantics and the child. In T. E. Moore (Ed). *Cognitive development and the acquisition of language* (pp. 27 – 63). New York: Academic Press.
- Comrie, B. (1985). *Tense*. Cambridge: Cambridge University Press.
- De León, L. (2001). Finding the richest path: Language and cognition in the acquisition of verticality in Tzotzil (Mayan). In M. Bowerman & S. C. Levinson (Eds.). *Language acquisition and conceptual development* (pp. 544 – 565). Cambridge, UK: Cambridge University Press.
- Fivush, R. (1995). Language, narrative, and autobiography. *Consciousness and cognition*, 4, 100 – 103.
- Fivush, R., Haden, C., & Adam, S. (1995). Structure and coherence of the preschoolers' personal narratives over time: Implications for childhood amnesia. *Journal of Experimental Child Psychology*, 60, 32 – 56.
- Harner, L. (1982). Talking about past and future. In W. J. Friedman (Ed.) *The developmental psychology of time* (pp. 141 – 170). New York: Academic Press.
- Huttenlocher, J. Newcombe, N., & Sandberg, E. H. (1994). The coding of spatial location in young children. *Cognitive Psychology*, 27, 115 – 148.
- Internicola, R. & Weist, R. M. (2003). The acquisition of simple and complex spatial locatives in English: A longitudinal investigation. *First Language*, 23, 239 -248.
- Levinson, S. C. (1996). Frames of reference and Molyneux's question: Crosslinguistic evidence. In P. Bloom, M. A. Peterson, L. Nadel, & M. F. Garrett (Eds.). *Language and space* (pp. 109 – 170). Cambridge, MA: MIT Press.

- Lucy, J. A. (1992). *Language diversity and thought: A reformulation of the linguistic relativity hypothesis*. Cambridge, UK: Cambridge University Press.
- Lucy, J. A. & Gaskins, S. (2001). Grammatical categories and the development of classification preferences: a comparative approach. In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development* (pp. 257 - 283). Cambridge, UK: Cambridge University Press.
- Mandler, J. M. (1992). How to build a baby: II Conceptual primitives. *Psychological Review*, 99, 587 – 604.
- McCune-Nicolich, L. (1981). The cognitive basis of relational words in the single word period. *Journal of Child Language*, 8, 15 -34.
- Meltzoff, A. M. (2005). Imitation and other minds: The “Like Me” hypothesis. In S. Hurley & N. Chater (Eds.), *Perspective on imitation: From neuroscience to social science* (Vol. 2, pp. 55 -77). Cambridge, MA: MIT Press.
- Nelson, K. & Fivush, R. (2004). The emergence of autobiographical memory: A social cultural developmental theory. *Psychological Review*, 111, 486 – 511.
- Nelson, K. & Ross, G. (1980). The generalities and specifics of long-term memory in infants and young children. *New directions for child development*, 10, 87 – 101.
- Newcombe, N. & Huttenlocher, J. (2003). *Making space: The development of spatial representation and reasoning*. Cambridge, MA: MIT Press.

Newcombe, N., Huttenlocher, J., Drumme, A. B., & Wiley, J. (1998). The development of spatial location: Place learning and dead reckoning in the second and third years.

Cognitive Development, 13, 185 – 200.

Piaget, J. (1952). *The origin of intelligence in children*. New York: Norton.

Pawlak, A., Oehlrich, J., & Weist, R. M. (2006). Reference time in child English and Polish.

First Language, 78, 281 – 298.

Pinker, S. (1994). *The language instinct: How the mind creates language*. New York, NY:

Morrow.

Radford, A. (1990). *Syntactic theory and the acquisition of English syntax*. Oxford, UK:

Blackwell.

Rovee-Collier, C. K. (1997). Dissociations in infant memory: Rethinking the development of implicit and explicit memory. *Psychological Review, 104*, 467 – 498.

Rovee-Collier, C. K. & Barr, R. (2001). Infant learning and memory. In G. Bremner & A. Fogel (Eds.) *Blackwell handbook of infant development* (pp. 139 – 168). Oxford, UK:

Blackwell.

Schacter, D. L., & Moscovitch, M. (1984). Infants, amnesics, and dissociable memory systems.

In M. Moscovitch (Ed.), *Infant memory: Its relation to normal and pathological memory in humans and other animals* (pp. 173 – 216). New York: Plenum.

Sinha, C., Thorseng, L. A., Hayashi, M., & Plunkett, K. (1994). Comparative spatial semantics and language acquisition: Evidence from Danish, English, and Japanese. *Journal of*

Semantics, 11, 253 – 287.

Smith, C. (1980). The acquisition of time talk: relations between child and adult grammars.

Journal of Child Language, 7, 263 – 278.

Stephany, U. (1986). Modality. In P. Fletcher & M. Garman (eds.), *Language Acquisition*. (pp.

375-400). Cambridge: Cambridge University Press.

Swift, M. D. (2004). *Time in child Inuktitut: A developmental study of an Eskimo-Aleut*

language. Berlin: Mouton de Gruyter.

Tulving, E. (1985). How many memory systems are there? *American Psychologist*, 40, 385 –

398.

Weist, R. M. (1986). Tense and aspect. In P. Fletcher and M. Garman (Eds.), *Language*

acquisition (pp. 356-374). Cambridge: Cambridge University Press.

Weist, R.M. (1989). Time concepts in language and thought: Filling the Piagetian void from two

to five years (pp. 63-118). In I. Levin & D. Zakay (Eds.), *Time and Human Cognition: A*

Life Span Perspective. Amsterdam: North-Holland.

Weist, R. M. (2002a). Space and time in first and second language acquisition: A tribute to

Henning Wode (pp. 79–108). In P. Burmeister, T. Piske, A. Rohde (Eds.) *An integrated*

view of language development: Papers in honor of Henning Wode. Trier:

Wissenschaftlicher Verlag Trier (WVT).

Weist, R. M. (2002b). Temporal and spatial concepts in child language: Conventional and

configurational. *Journal of Psycholinguistic Research*, 31, 195 – 210.

Weist, R. M. (2008). One-to-one mapping of temporal and spatial relations. In J. Guo, E. Lieven,

S. Ervin-Tripp, N. Budwig, S. Özçalışkan, K. Nakamura (Eds.) *Crosslinguistic*

approaches to the psychology of language: Research in the tradition of Dan Isaac Slobin.

Hillsdale, NJ: Lawrence Erlbaum Ass.

Weist, R. M., Atanassova, M., Wysocka, H., & Pawlak, A. (1999). Spatial and temporal systems in child language and thought: A cross-linguistic study. *First Language, 19*, 267-312.

Weist, R.M., Lyytinen, P., Wysocka, J. & Atanassova M. (1997). The interaction of language and thought in children's language acquisition: a crosslinguistic study. *Journal of Child Language, 24*, 81-121.

Weist, R. M., Pawlak, A, & Carapella, J. (2004). Syntactic-semantic interface in the acquisition of verb morphology. *Journal of Child language, 31*, 31 – 60.

Whorf, B. L. (1956). *Language thought and reality: Selected writings of Benjamin Lee Whorf* (J. B. Carroll, Ed.). Cambridge, MA: MIT press.

Table 1

Christy's early references to the past and to the future in context (Bowerman, 1981).

Time	Age	Utterance	Context
Past (-Ø)	1;9	<i>Sipi wa</i>	Walking past a puddle where she had fallen yesterday.
Past (-ed)	2;0	<i>I cried</i>	Recalling a ride on her uncle's back earlier in the day.
Future (Ø)	1;9	<i>Pie open later</i>	Said while observing an unopened pie.
Future (aux)	2;1	<i>She's won't get wet.</i>	Said while sitting on the potty and holding her doll.

Table 2

Uphill / downhill utterances with horizontal (i.e., land-slope) and vertical reference:

(Brown, 2001, Table 17.2, p. 519 and Table 17.3, p. 521)

Child Age	Utterance	Context: Horizontal
Xan 2;4	Ya koon 'I'm descending'	Announcing intentions to go to downhill house.
Pet 2;4	Kuchoj bel i alal i ya mo bel. 'doll was carried away, ascends away'	Claiming his imaginary wife has gone "uphill-wards".
Xan 2;5	Ya x moon ek .. koixix tal 'I'll go up too ..They have come down'	Between lower (North) and upper (South) houses.
Child Age	Utterance	Context: Vertical
Lus 2;6	Kojtes yakan i 'make it descend' (lower its foot)	Related to the leg of a camera's tripod.
Lus 2;7	Moix tal 'they have ascended coming'	Toy animals move up onto a table and into a corral.
Pet 2;7	Moik laj ta te' .. moon ta te', koon tal They ascended the tree ... I climb the tree, I descend.	Up and down into trees.

Table 3

Comparison of motion utterances in English and Tzotzil used in similar context.

Context	English	Tzotzil
Asking adult to lift the child up.	<i>up</i>	<i>Kuch</i> 'hold on back' <i>Pet</i> 'hold in arm'
Asking adult to sit or kneel down.	<i>down</i>	<i>Chot</i> 'sit' <i>Kej</i> 'kneel'
Putting an object on a raised surface.	<i>up</i>	<i>Kaj</i> 'locate on raised surface' <i>Pach</i> 'locate on surface of bowl'
Setting objects on the floor or ground.	<i>down</i>	<i>Pak</i> 'be located on ground carelessly' <i>Vuch</i> 'locating object base down mouth up'

Table 4

Mono- and bi-referential spatial and temporal contrasts from the static comprehension test

(Weist, et al. 1999: 282 – 283).

Language	Sentence Example
Space + Mono-referential + Direction (toward / away)	
English	The cat is jumping (off of / onto) the chair.
Polish	Kotek (zeskakuje z krzesła / wskakuje na krzesło).
Finnish	Kissa hyppää (tuolita / tuolille).
Space + Bi-referential + Between (X and Y / Y and Z)	
English	The dog is between mother and (father / the boy).
Polish	Piesek jest między mamą i (tatą / chłopcem).
Finnish	Koira on äidin ja (isän / pojan) välissä.
Time + Mono-referential + Tense (future / past)	
English	The monkey (will eat / ate) the banana.
Polish	Małpka (zje / zjadła) banana.
Finnish	Apina (syö / on syönyt) banaanin.
Time + Bi-referential + (before / after)	
English	The boy put on his pants (before / after) he put on his boots.
Polish	Chłopiec założył spodnie (zanim / po tym jak) założył buty.
Finnish	Poika laittoi housut jalkaan (ennen kuin laitto saappaat / sitten kun oli laittanut saappaat).

Table 5

Prototypical morpheme – concept mapping patterns for Finnish and Polish (Weist, 2008).

Domain	Language	morpheme X	morpheme Y	morpheme Z
Space	Finnish	Noun / Postposition -suffix		
	Polish	(Verb-prefix)	Preposition	Noun-suffix
Time	Finnish	(Auxiliary-suffix)	Verb-suffix	Noun-suffix
	Polish	Verb-affixes		