Winter 12-15-2011

Children's Developing Understanding of Spatial Metaphors for Time

Lauren J. Stites
Georgia State University

CHILDREN'S DEVELOPING UNDERSTANDING OF SPATIAL METAPHORS FOR TIME

by

LAUREN JAMIESON STITES

Under the direction of Seyda Özçalışkan

ABSTRACT

Adults commonly use spatial motion to talk about time. These metaphors are of at least three different types: moving-time, moving-ego, and sequence-as-relative-position-on-a-path. But when children grasp the meaning of spatial metaphors for time and what cognitive factors account for this understanding? In this study, we aim to answer these questions by studying young children's comprehension of three different spatial metaphors for time. Our findings show that children begin to understand metaphors for time by age five and to explain the meaning of these different metaphors by age 6. Additionally, children's comprehension varied by metaphor type, with moving-time and moving-ego metaphors being mastered earlier than sequence-as-relative-position-on-a-path metaphors. Moreover, we found children's comprehension ability to be associated with their understanding of the time concept. Overall, these results suggest that comprehension of time metaphors is an early emerging linguistic ability that has strong ties to children's cognitive understanding of the time concept.

INDEX WORDS*:* Acquisition of metaphor, Time concept, Language development, Time metaphors, Spatial metaphors

CHILDREN'S DEVELOPING UNDERSTANDING OF SPATIAL METAPHORS FOR TIME

by

LAUREN JAMIESON STITES

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Arts

in the College of Arts and Sciences

Georgia State University

2011

CHILDREN'S DEVELOPING UNDERSTANDING OF SPATIAL METAPHORS FOR TIME

by

LAUREN JAMIESON STITES

Committee Chair: Seyda Özçalışkan

Committee: Lauren Adamson
Rebecca Williamson

Electronic version approved:

Office of Graduate Studies

College of Arts and Sciences

Georgia State University

December 2011

Acknowledgements

I would like to thank my committee chair, Seyda Özçalışkan for the tireless and skillful effort she put into this work. Thanks also to the other members of my committee, Lauren Adamson and Rebecca Williamson for their comments, critiques, and suggestions. My research assistant Tyler Hawkins also deserves a sincere thank you for his hard work and dedication to this project. I am grateful to Eric Wayne Moore for lending his artistic skills to the creation of all the pictorial stimuli for the project. Last but not least, I would like to thank the participants and their parents for their time and effort and the many schools that allowed me to take up their time and space, including Lynette L. Suttles Child Development Center, Capitol Hill Child Enrichment Center, International Preschools, and The Friends School of Atlanta.

Table of Contents

List of Tables

List of Figures

1. Introduction

Metaphor is a pervasive aspect of human communication. We rely on metaphors not only to *talk* about abstract concepts such as time, ideas or emotions, but also to *structure* and *understand* these abstract concepts (Lakoff & Johnson, 1980, 1999). Here we focus on one such commonly used metaphor type, namely spatial metaphors for time, and ask how early children understand the different spatial metaphors for time and what cognitive and linguistic factors might contribute to this understanding.

1.1 Spatial metaphors for time in adult language

English speakers routinely express and structure 'time' in terms 'spatial motion' (Boroditsky, 2001; Özçalışkan, 2003). That is, the metaphorical construal of time involves both a cognitive and a linguistic mapping from the source domain of 'motion' to the target domain of 'time'. For example, 'TIME PASSAGE IS MOTION ALONG A PATH' is a commonly used metaphorical mapping in English that can give rise to a wide range of metaphorical expressions, such as 'hours fly by', 'one moment follows another' and 'we have reached the end of the year' (Lakoff, 1993). This mapping is generative in the sense that it allows speakers to express as well as understand numerous instantiations of the TIME PASSAGE IS MOTION ALONG A PATH metaphor with relative ease. The mapping is also built on an asymmetry between source (motion) and target (time) concepts. That is, the mapping is unidirectional—from source to target—and the source concept is defined as being more closely related to physical experience than the target concept (Lakoff & Johnson, 1980). As such, we do *not* think or talk of spatial motion in terms of time, but we *do* think and talk of time in terms of spatial motion (Casasanto & Boroditsky, 2008; Bottini & Casasanto, 2010; Graf, 2011).

The formulation of metaphors as mappings from more physical to more abstract domains of experience is closely tied to an embodied view of cognition, which suggests that higher-order cognitive abilities (e.g., concept of time) have their roots in our everyday bodily experiences (Anderson, 2003; Barsalou, 2008; Lakoff & Johnson, 1999). Recent evidence (Miles, Nind, & Macrae, 2010) in fact suggests that our sensory experiences of moving forward or backward are closely associated with our concept of time. Blindfolded adults, when asked to visualize their *past* or *future* life experiences while standing upright, showed bodily sways in line with the location of time they were visualizing. That is, when thinking about the past they swayed backward and when thinking about the future they swayed forward. Moreover, almost all studied languages of the world suggests that time is structured on a back-to-front bodily axis, with the 'past behind us' and 'future in front of us,' suggesting once again a bodily basis for one's conceptualization of time (Casasanto, Fotakopoulou, & Boroditsky, 2010; Iwasaki, 2009; Moore, 2006; Nunez & Sweetser, 2006).[1]

English speakers use three distinct spatial metaphor types to express time. These include, moving-ego, moving-time, and sequence-as-relative-position-on-a-path (hereafter 'sequence-as-position') metaphors (Iwasaki, 2009; Moore, 2006; 2007).

Moving-ego metaphors regard time as stationary and the speaker (i.e., ego) as moving through it towards future times (Gentner, Imai, & Boroditsky, 2002; Moore, 2006), and rely on the perspective of the speaker to orient in time. For example, in the expression 'we have gotten through the winter and are now approaching the summer', the winter is in the speaker's past and the summer is in his future, and the speaker is moving away from the winter (past) towards the

[1] The one recorded exception to the "past is behind us" and "future is in front of us" rule is found in the South American language, Aymara, in which future events are referred exclusively as behind the speaker, and past events are placed in front of the speaker (Nunez & Sweetser, 2006). Interestingly, the word for 'past' in Aymara is the same word for 'front' and 'see.'

summer (future), while both winter and summer remain stationary (see Figure 1 for a schematic drawing of *moving-ego* metaphors, adapted from Moore, 2006, p. 203).

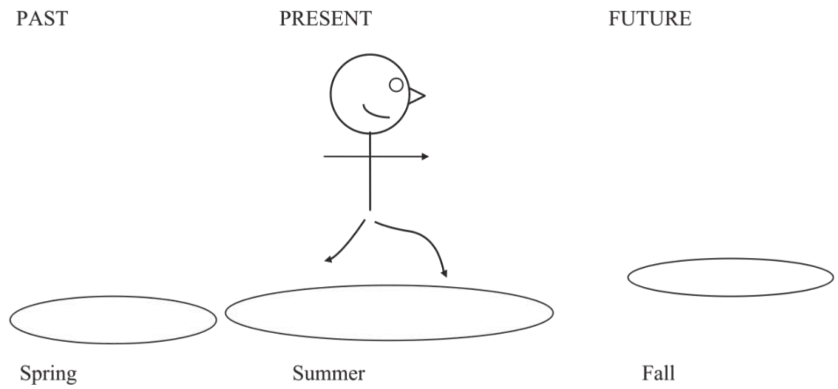


Fig. 1. Schematic drawing of moving ego metaphor

Moving-time metaphors also depend on the viewpoint of the speaker. However, in moving-time metaphors, the speaker is stationary and time moves either towards or away from the speaker. For example, in the expression 'the winter months have finally passed us and the summer months are quickly approaching' the winter moves *away from* the speaker while summer moves *towards* the speaker who himself remains stationary (see Figure 2 for a schematic drawing of *moving-time* metaphors; Moore, 2006, p. 204).

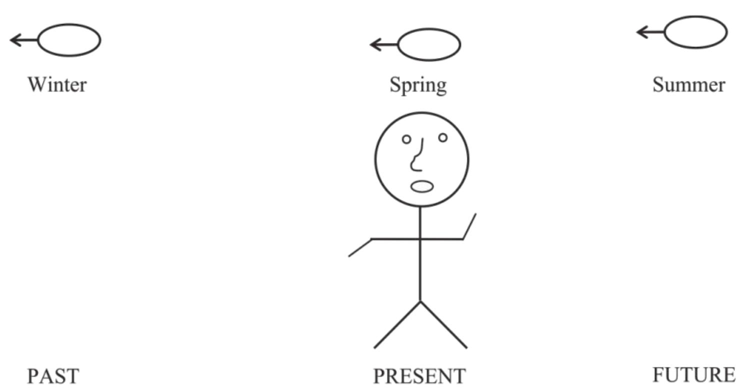


Fig 2. Schematic drawing of moving time metaphor

Sequences as Relative Position on a Path Metaphors differs from the previous two metaphors types in that it does not need the perspective of the speaker to infer the sequence of

unfolding events. Sequence-as-position metaphors construe time as a conveyor belt with different objects moving along it (Moore, 2006; Iwasaki, 2009). For example, in the expression 'the hot summer followed the cold winter' (Moore, 2006, p.205), 'winter' comes before the 'summer' in time, because the summer follows it. Similar to an object following another object along a path, different points in time follow each other (see Figure 3 for a schematic drawing of sequence-as-position metaphors)[2]

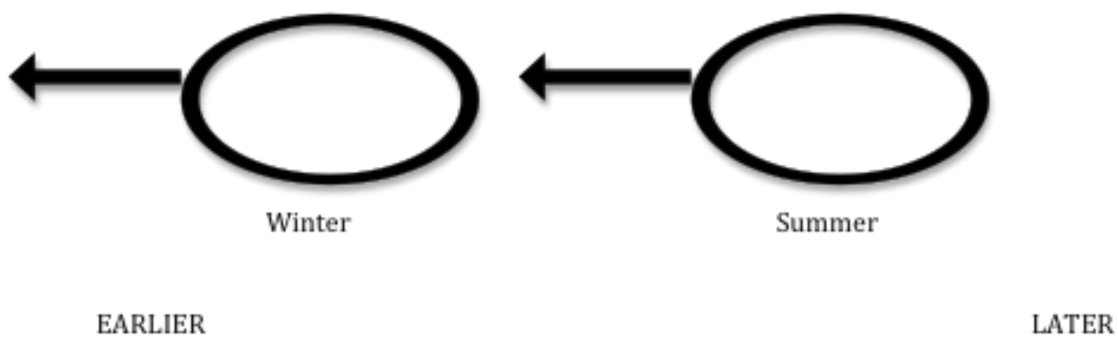


Fig 3. Schematic drawing of moving sequence-as-relative-position-on-a-path metaphor

These three spatial metaphors for time are observed commonly in adult language, with moving-ego metaphors being the most and the moving-time metaphors being the least frequent (Stites, in preparation). Moreover, there is evidence that suggests that these three metaphors evoke conceptually distinct ways of thinking about time (Boroditsky, 2000; Gentner, Imai, & Boroditsky, 2002). Adult speakers are likely to interpret ambiguous time metaphors (e.g., 'next Wednesday's meeting has been moved forward two days') in ways consistent with the motion

[2] Although researchers agree on the category of 'time is motion' metaphors in English, there is some disagreement about the categorization of this metaphor type (Lakoff, 1993; Moore, 2006). Previous research has divided spatial time metaphors into only two categories, as either 'moving-ego' or 'moving-time' (Boroditsky, 2000; Casasanto & Boroditsky, 2008). However, more recent work suggests dividing the 'moving-time' category further into two, as 'moving-time' and 'sequence-as-relative-position-on-a-path', to describe more accurately the way adult speakers think about and express these metaphors (Moore, 2006, 2007; Nunez, Motz & Teuscher, 2006).

primes that they observe (Boroditsky, 2000). For example, when given moving-ego primes (e.g., person moving towards flower), adults were more likely to say that the meeting has been moved to Friday; but when they were given time-moving primes (e.g., flower moving towards person), they were more likely to say that the meeting had been moved to Monday. Similar patterns have been observed even in everyday situations: people that have recently traveled are more likely to use a moving-ego framework in interpreting similar ambiguous time metaphors than people that have not traveled (Boroditsky & Ramscar, 2002; Nunez, Motz, Teuscher, 2006). Adults also show decreased reaction times in comprehension, when presented with motion primes inconsistent with the time metaphors that they hear (e.g., flower moving towards person followed by the statement 'we are approaching the weekend'; Gentner, Imai & Boroditsky, 2002). Overall, these results suggest that the three metaphor types elicit different ways of thinking about time in adult speakers.

In summary, previous work suggests that adults commonly describe time, using ego-moving, time-moving or sequence-as-position metaphors, and that each of these metaphors evokes distinct representations of time passage in the minds of adult speakers. However, we do not yet know the developmental trajectory that children follow in learning each of these time metaphors, the attainment of which constitutes a landmark achievement in approaching adult-like conception of time.

1.2 Children's developing understanding of spatial time metaphors

Metaphor comprehension and production constitute significant milestones in children's language development (Gardner et al, 1978, Lee & Kimhi, 1990; Özçalışkan, 2010). Previous research showed that the acquisition of metaphors begins with simple perceptual similarity comparisons of things that look alike or are functionally similar to one another (Billow, 1981;

Gentner, 1988; Özçalışkan, et al., 2009; Winner, 1988). For example, a child might say that 'a cherry lollipop is like a stop sign', because both of them are red, round, and attached to a stick (Mendelsohn, Robinson, Gardner, &Winner, 1984). Children then progress to more complex structural mappings, in which they typically map physical terms onto abstract concepts, such as referring to someone as 'cold as ice' to indicate how unemotional that person is (Gardner, et al., 1978, Waggoner & Palermo, 1989). The emergence of these structural metaphors can be observed as early as preschool age. In an earlier study, Özçalışkan (2005) asked three- to five-year-old children to interpret metaphorical expressions involving abstract concepts that are structured by motion (e.g., 'idea flies from the mind'). The results showed that four-year-old children can correctly identify (in a forced-choice task) the meaning of a structural metaphor embedded in a story, and five-year-old children can explain the underlying mappings for such metaphors (e.g., 'idea flies by means that you forget about your idea quickly'; Özçalışkan, 2005).

Despite the myriad of research on the children's developing understanding and production of metaphors that involve extensions of object properties (e.g., sweet person, warm person; Ashe & Nerlove, 1960; Waggoner & Palermo, 1989), little attention has been paid to children's developing understanding of spatial time metaphors that are so prevalent in adult language. One of the few existing studies is a study of 'moving-time' metaphors by Özçalışkan (2004). In this study, three- to five-year-old children listened to short stories, each containing a 'moving-time' metaphor. Then they were asked a question about the metaphor in the story, which was answered by two puppets. The child was asked to choose the puppet with the correct choice and justify the response. The three-year-olds in the study chose the correct answer at chance levels, suggesting that they were unable to interpret the metaphors in the stories. The four- and the five-year-olds, however, chose the puppet with the correct answer 70% and 74% of

the time, respectively. However, it was not before age 5 that children began successfully explaining their forced-choice responses.

In summary, it has been well documented that children begin to understand and use metaphors shortly after they begin to speak (Billow, 1981; Gardner, et al., 1978; Vosniadou, 1987), and that their understanding improves with age from simple perceptual metaphors to more complex structural metaphors (Özçalışkan, et al., 2009, see Özçalışkan, 2010 for a review). There is evidence that suggests that children as young as age four can understand time-moving metaphors (Özçalışkan, 2004) and can easily think of time in terms of spatial motion (Casasanto et al. 2010). However, to date, there is no research on when and how children begin to comprehend the three subtypes of spatial metaphors for time (time-moving, ego-moving, sequence-as-position-on-a-path). The proposed study aims to close this gap by studying the development of different spatial time metaphors in young children, between ages three and six, and the linguistic and cognitive underpinnings of this understanding.

1.3 The present study

Previous research has shown early emergence of time-moving metaphors: children can understand *time-moving* metaphors by age 4 in a story context, and can explain the underlying mappings for these metaphors by age 5 (Özçalışkan, 2005). However, we do not yet know when children begin to understand as well as explain the other two metaphor types for time and which aspects of children's metaphor comprehension are driven by cognitive and/or linguistic factors. In this study, we aim to explore both of these questions by studying a cross-sectional sample of 60 children from ages 3 to 6, along with a group of 15 adult English speakers as control. We have two aims: (1) Our first aim is to plot the developmental trajectory of children's overall understanding of spatial metaphors for time in relation to other closely related linguistic and

cognitive abilities. (2) Our second aim is to plot the developmental trajectory of children's understanding of each of the three different spatial metaphors for time (*moving-time, moving-ego,* and *sequence-as-position-on-a-path*).

Based on earlier work (Özçalıskan, 2005, 2007) that showed better metaphor comprehension with increasing age, (1) we expect that children's overall understanding of spatial time metaphors will improve gradually with age with a significant shift around 4 to 5 years of age. Also, based on previous work that showed delayed metaphor comprehension in children with language and cognitive delays (Highnam, Wegmann, & Woods, 1999; Norbury, 2005), (2) we predict that children's level of metaphor understanding will be related to their language abilities, as well as to their understanding of other closely related conceptual domains, such as the concept of time. (3) We also predict that metaphor type will have an effect on comprehension. If relative frequency in adult use (Stites, in prep) is a predictor of the emergence of each of these metaphor types in children's speech, then we expect that children's mastery will proceed from moving-ego to sequence-as-position, and eventually to moving-time metaphors. If, on the other hand, bodily experience is a predictor of children's understanding of time metaphors, we would expect that ego-moving and time-moving metaphors will be mastered at a younger age as compared to sequence-as-position-on-a-path metaphors. This prediction is based on the idea that it might be easier for young children to understand metaphors that involve their immediate bodily experience (i.e., time moving towards body and body moving towards time) than metaphors that are further detached from their bodily experiences (i.e., sequence-as position on a path metaphors, e.g., 'lunch follows breakfast').

2. Methods

2.1 Participants

The participants consisted of 60 children, at the ages *three* (mean age = 3;5, range = 3;1-3;11), *four* (mean age = 4;6, range = 4;1-4;11), *five* (mean age = 5;6, range = 5;2-5;10), and *six* (mean age = 6;7, range = 6;3-6;11), with 15 participants in each age group, and 15 *adults* (mean age = 22;1, range = 17;9-49;7), all native speakers of English. There were roughly equal numbers of males and females in each age group. Child participants were predominantly Caucasian (62%) and African-American (27%); adult participants were predominantly African-American (60%), Caucasian (20%) or had mixed ethnic-racial backgrounds (20%).

2.2 Procedure for data collection

Children's comprehension of spatial metaphors for time was assessed in two ways: (1) in a *story comprehension task* that measured children's understanding of stories with time metaphors and (2) in an *open-ended interview* that elicited children's explanations for different time metaphors. We also assessed several child-based factors that might contribute to children's comprehension of time metaphors. These included: (3) *conservation of velocity of time task* that measured children's cognitive understanding of the time concept, (4) *Peabody Picture Vocabulary Test* that measured children's receptive language abilities, and (5) *physical motion comprehension* task that assessed children's understanding of the literal meanings of the metaphorical motion descriptions in the story comprehension task. Data collection always began with the story comprehension task, followed by the physical motion comprehension task. We varied the order of the remaining four tasks randomly across subjects. All responses were videotaped and transcribed for future analysis.

2.2.1 Story comprehension task. Story comprehension task always began with the warm-up task that helped build rapport between the child and the experimenter; the warm-up task also allowed the child to understand the procedure that would be used in the subsequent story comprehension task. The child was seated adjacent to the experimenter and then introduced to two hand puppets (Elmo and Grover). The experimenter then placed a large plastic animal in front of the child and the puppets and asked the puppets to guess which animal it was. Only one of the puppets produced the correct label and the child was asked to identify the puppet with the correct label. The same procedure was repeated three times with three different plastic animals (horse, pig, and cow). All children regardless of age were able to correctly identify the puppet with the correct label on all three trials. The warm-up task was not administered to the adults.

Upon completion of the warm up task, the child was told that s/he was going to help Elmo and Grover understand some stories, the same way that they helped them learn the names of animals. Each child was then presented with six short stories, each containing a spatial metaphor for time (2 *moving-ego*, 2 *moving-time*, and *2 sequence-as-position-on-a-path metaphors*). The stories were similar in linguistic complexity (MLU $_{range}$ = 4.2-5.6) and length (number of words $_{range}$ = 21-28); each story was also accompanied by black and white drawings of the two characters in the story. Before telling the story, the experimenter placed two pictures on an easel, depicting the two characters in the story (see Fig. 4 for a sample picture set). The experimenter then read each story aloud to the child. Each story ended with the experimenter asking the puppets a question about the meaning of the metaphors used in the story. One puppet always answered correctly and the other puppet answered incorrectly. The child was asked to pick the puppet with the correct answer and provide a justification for the choice. A sample story

is presented in example (1) (time metaphor is underlined; see Appendix A for all six stories used in the study.)

Fig. 4. Sample picture set used in the story comprehension task

(1) This is Rob [experimenter points to character on the left]. This is Rob's friend Kyle [experimenter points to character on the right]. Kyle tells Rob that he has a long way to go until his party. Rob is disappointed. He says "ugh".

Why is Rob disappointed?

A. His party is over

B. His party is later (√)

The presentation order of the six stories as well as the puppet providing the correct answer and the order of the correct answer (as first or second) were randomized across children within each age group, using an online randomizer program (randomizer.org). The data collection from adults followed the same procedure, except for the use of the puppets.

The stories were designed such that the child must have understood the metaphors in order to answer the forced-choice question correctly. To establish this, prior to being used as stimuli, all the stories were tested for their informativeness *without* the metaphors in them, with a separate group of English adult native speakers (N = 83, *mean age* = 25;2; 72 females, 11 males). For this test, the metaphorical statements were eliminated from the stories, and adults were asked to read the stories one by one and make a forced-choice decision for the question about each

story. Only stories that led to random forced-choice responses by adult speakers (50% correct, 50% incorrect) were selected, and included in the study as stimulus stories after the addition of metaphorical statements.

2.2.2 Physical motion comprehension task. The purpose of this task was to ensure that the child understood the literal meanings of the terms used in the metaphorical expressions in the story comprehension task. The children were shown six pairs of pictures, one pair at a time, and asked to choose the picture that matched the sentence produced by the experimenter. An example stimulus picture pair is provided in Figure 5; a complete set of all drawings and the accompanying physical motion descriptions can be found in Appendix B. Physical motion comprehension task was not administered to adults.

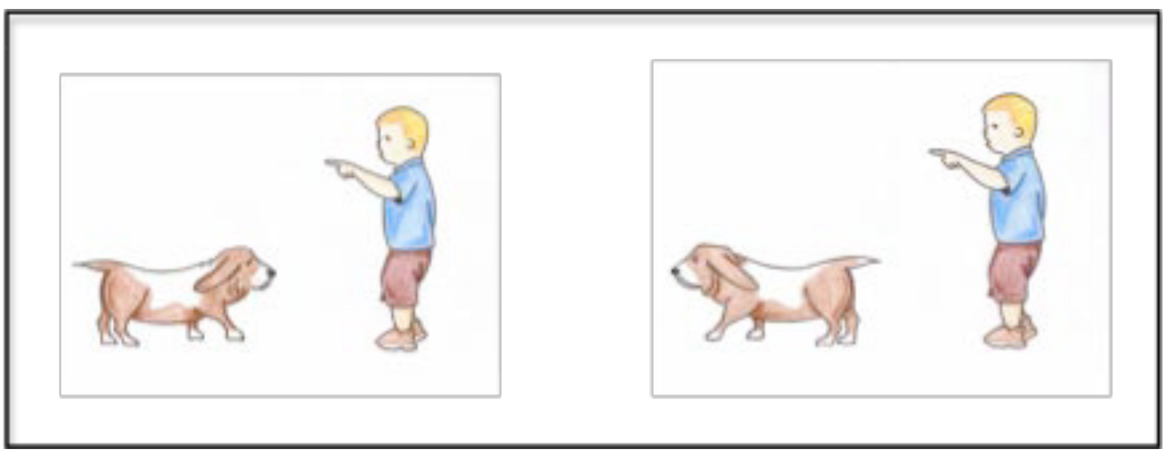


Fig. 5. Stimulus picture pair for the literal motion description: 'The dog is coming up to the boy'

2.2.3 Open-ended interview about time metaphors. The interview consisted of three open-ended questions, each inquiring about one of the three different metaphors for time: (1) *moving-time* ('Let's say you are at home with mommy playing, and your mommy says summer is coming. What do you think she means?'), *(2) moving-ego* ('Let's say you are playing outside, and your daddy says we are getting closer to dinnertime. What do you think he means?'), and (3)

sequence-as-relative-position-on-a-path ('If I told you that following our time together, I will give you a sticker, when do you think you will get your sticker?'). The adults were asked slightly modified versions of the same three questions: 'What does it mean if someone says summer is coming (moving-time), 'What does it mean if someone says we are getting closer to dinnertime' (moving-ego), and 'If I told you that following our time together, I will give you your research credit, when do you think you will get your research credit?' (sequence-as-position)

2.2.4 Conservation of velocity of time task**.** This task was adapted from Piaget (1969) and used to assess children's understanding of the three dimensions of the time concept, including duration, distance and speed. Each child was first shown a 30-second sand timer filled with colored sand. The participants were then told that when the sand in the top falls down to the bottom, then the timer could be flipped over again and the sand that was in the bottom would now be in the top. Following this brief introduction, the experimenter placed the sand timer in a place where the child could see it. The experimenter then moved a stool to an open area and the children were asked to *walk as quickly as they could* around the stool until the sand ran all the way down. Once the sand ran down, the experimenter turned the sand timer over again, but this time the children were asked to *walk as slowly as they could* around the stool until the sand ran all the way down. When the child had finished walking both quickly and slowly around the stool, the experimenter asked the child three questions, all aimed at assessing the child's understanding of the time concept: (1) 'First you walked quickly around the stool, then you walked slowly around the stool. Did the sand fall quickly and slowly as well or did it fall the same way?' (2) 'When you walked quickly around the stool how did the sand run? and (3) 'when you walked slowly around the stool how did the sand run?' Data collection from the adults followed the same procedure.

2.2.5 Language assessment. Children's verbal ability was measured using the Peabody Picture Vocabulary Test-IV (PPVT-IV; Dunn & Dunn, 2007), which is a standardized measure of receptive language abilities. The administration of the task involves the experimenter presenting the child with a stimulus word and the child pointing to the object or the action that corresponds to the word from a choice of four pictures. The PPVT-IV was normed on a sample similar to the U.S. population in race/ethnicity, sex, geographic location, and socioeconomic status, thus rendering it an ideal instrument for our study. The PPVT-IV yields both raw scores as well as standard scores, the latter of which allows for reliable comparisons across age groups.

2.3 Procedure for data analysis:

2.3.1 Story Comprehension Task**.** We assessed participants' comprehension of spatial time metaphors by computing the number of correct responses they provided to the forced-choice questions in the story comprehension task, separately by age and by metaphor type. For each forced-choice response, each participant received a score of either 0 (incorrect) or 1 (correct). The numbers were tallied by metaphor type (score range= 0-2) as well as across all six stories (range= 0-6), separately for each age group. We then compared differences with a two-way ANOVA, with *age* (3-, 4-, 5-, 6-year-olds, adults) as a between subjects factor and *metaphor type* (time-moving, ego-moving, sequence-as-position-on-a-path) as a within subject factor.

In addition, we scored the justifications children provided to their forced-choice responses on a three-point scale: they received a score of '0' for *irrelevant justifications* ('because he was right'), a score of '1' for *incomplete justifications in the right direction* that typically involved repeating the correct choice in the forced-choice response ('because the party is soon') and a score of '2' for *complete and valid justifications* ('he says it is a long way, that means you have

to wait'; see appendix C for the coding manual). One coder coded all the justifications; a second coder recoded 50% of the data; the reliability between coders was 85% (*k*= .81; N=32).

The scores were tallied by metaphor type (score range= 0-4) as well as across all six stories (range= 0-12), separately for each age group. We then compared differences with a two-way ANOVA, with age (3-, 4-, 5-, 6-year-olds, adults) as a between subject and metaphor type (time-moving, ego-moving, sequence-as-position-on-a-path) as a within subject factor.

2.3.2 Physical motion comprehension task. Children were given a score of 1 (correct) or 0 (incorrect) in their performance in the literal motion task. A correct response meant that the child pointed to the picture that matched the verbal description; an incorrect response meant that the child pointed to the picture that did not match the verbal description. We computed the total score for each child (range= 0-6) and compared changes in children's performance using a one-way ANOVA, with age as a between subjects factor.

2.3.3 Open-ended interview about time metaphors**.** Children's responses in the open-ended interview were scored on a 3-point scale, with a score of '0' for irrelevant response, a score of '1' for incomplete responses in the right direction and a score of '2' for complete and valid justifications. A sample scoring of three different responses to one of the questions is provided in (2). One coder coded all the justifications; a second coder recoded 50% of the data; the reliability between coders was 80% (*k*= .75; N=30). Children who did not respond also received a score of '0'. The scores were tallied by metaphor type (score range= 0-2) as well as across all three questions (range= 0-6), separately for each age group. We then compared differences with a two-way ANOVA, with *age* (3-, 4-, 5-, 6-year-olds, adults) as a between subjects factor and *metaphor type* (time-moving, ego-moving, sequence-as-position-on-a-path) as a within subject factor.

(2) ‘Let’s say you are playing outside and your daddy says: ‘We are getting closer to dinnertime’. What do you think he means?’
Irrelevant response: ‘They would be happy because they would be hungry’
Relevant-incomplete response: ‘We have to wash our hands for dinner’
Relevant-complete response: ‘It means she is making dinner and dinner will be soon’

Conservation of velocity of time task. Children’s and adults’ responses in the time conservation task were scored on a nominal scale, as either a ‘pass’ or a ‘fail’. To receive a ‘pass’ the child had to answer all three questions correctly, or subsequently clarified their initial incorrect answer to show understanding of the concept. For example, if a child answered that the sand went slowly when they were moving their legs slowly, but later clarified that it just *felt* like it went slowly, then they would receive a ‘pass’ for the task. One coder coded all responses; a second coder re-coded 50% of the data; the reliability between coders was 95% (k= .92; N=60) . We computed the total score by age and analyzed the variance explained by performance on the time task on metaphor comprehension in the story comprehension task, using a linear regression equation.

2.3.4 Receptive language assessment**.** We assessed both raw and standard scores participants received in the receptive language test (PPVT-IV) and analyzed the variance explained by receptive vocabulary on children’s metaphor comprehension in the story comprehension task, using a linear regression equation. A second coder checked all scores and the agreement between coders was 100%.

3. Results

3.1 Overall changes in children’s metaphor comprehension by age (across metaphor types)

Children’s understanding of time metaphors improved over time (F(4,53.72)= 15.81, p<.001), from a mean correct response rate of 2.87 (48%) for the 3-year-olds, to a mean correct

response rate of 5.13 (86%) for the 6-year-olds. As can be seen in Figure 5 (panel A), both three- and four-year-olds were at chance in their forced-choice responses to the questions about the metaphors in the stories. In contrast, both five- and six-year-olds performed significantly above chance, ($t(14)=3.17$, $p=.007$, $t(14)=8.34$, $p<.001$, for the five- and six-year-olds, respectively), marking the onset of metaphor comprehension at age five. Metaphor comprehension continued to improve with age, with six-year-olds performing significantly better than the 5-year-olds ($p=.04$, *Games-Howell*) in their forced-choice responses. However, six-year-olds did *not* differ from adults in their rate of correct responses ($p= .247$, *Games-Howell*), suggesting emergence of adult-like metaphor comprehension abilities by age six.[3][4]

A. Forced-choice responses B. Justifications

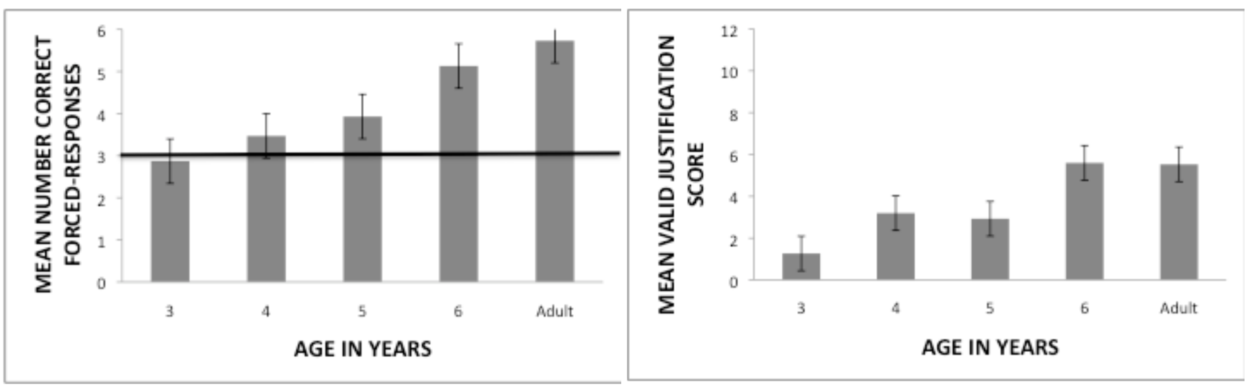


Figure 5. Mean number of correct forced-choice responses (Panel A; max possible score=6) and valid justifications (Panel B; max possible score=12) in the story comprehension task (black line indicates chance performance).

---

[3] The assumption of homogeneity of variance was violated for children's forced choice responses, as indicated by a significant Levene statistic, $p=.02$. Therefore, the Brown-Forsythe F-ratio is reported for main effects, and the post hoc test results were obtained by the Games-Howell Procedure.

[4] The lower mean score for adults' justifications (M=5.53 out of a possible maximum score of 12) was mainly an outcome of the greater tendency of the adults to justify the *emotional states* of the story characters rather than their forced choice responses. (e.g., "He seems disappointed that he has to go to sleep").

Similar to their forced-choice responses, children's ability to provide relevant justifications also improved over time ($F(4,70)=8.39$, $p<.001$), with a significant shift at age 6 (p=.03, *Tukey*). At the same time, six-year-olds did *not* differ reliably from adults in the quality of their justifications ($p=1$, *Tukey*), suggesting that children begin to show adult-like reasoning patterns in their justifications for their choices as early as age six. Two sample responses are presented in (3); both children answered the forced-choice question correctly (i.e., chose Elmo as the puppet with the correct choice), but it was only the six-year-old who provided a valid justification.

(3) *This is Rob. This is Rob's friend Kyle. Kyle tells Rob that he has a long way to go until his party. Rob is disappointed. He says "Ugh". Why is Rob disappointed?*
Grover: His party is later
Elmo: His party is over

Experimenter: *Can you tell Elmo why he is right?*
Child (5;9): *This guy was disappointed that his brother is going far away to a party*
Child (6;10): *It is later because a long way means you have to wait*

Children's responses in the open-ended interview followed a similar pattern to their performance in the story comprehension task. Children produced reliably more relevant answers to the questions about the different time metaphors with increasing age ($F(4, 49.89)=22.59$, $p<.001$), with a significant difference between four- and six–year-olds ($p=.02$, *Games-Howell*).[5] Adults were also significantly better than children in each age group in explaining the different time metaphors (p's<.05) . Sample responses by three-, five-, and six-year-old children as well as adult participants are presented below, separately for the time-moving (4) and ego-moving (5)

[5] The assumption of homogeneity of variance was violated for interview scores, as indicated by a significant Levene statistic, $p=.004$. Therefore, the Brown-Forsythe F-ratio is reported for main effects; the post hoc test results were obtained by the Games-Howell Procedure.

and sequence-as-position (6) metaphors (child age is indicated in parentheses, metaphors are underlined).

(4) Experimenter: *If your mommy told you that summer is coming, what do you think she means?*
Child 1 (3;8): *It is time to go to school and to the playground.*
Child 2 (5;4): *The sun is going to get stronger.*
Child 3 (6;8): *That summer is like in a month.*
Adult (19;6): *It will be here shortly, or in the next couple of days. The next season up.*

(5) Experimenter: *If your mommy said that we are getting closer to dinnertime, what do you think she means?*
Child 1 (3;8): *Need to eat your food.*
Child 2 (5;4): *We get to eat at dinner and then we get to go upstairs to our beds.*
Child 3 (6;8): *That she would mean dinner is going to be here soon*
Adult (19;6): *A couple of hours to go until dinner.*

(6) Experimenter: *If I told you that following our time together, I will give you a sticker, when do you think you will get your sticker?*

Child 1 (3;11): *When I be good.*

Child 2 (4;3): *Because I be getting good.*

Child 3 (5;4): *At the end.*

Child 4 (6;10): *In a little while.*

Adult (20;2): *As soon as I leave.*[6]

Our results also showed no differences in children's understanding of the literal motion descriptions, $F(3,58)=2.66$, $p=.057$, indicating that the difference in children's understanding of

[6] For the adults the question was about receiving research participation credit instead of a sticker.

spatial metaphors for time is not due to their lack of knowledge of the literal meaning of the phrases used in the story comprehension task.

In summary, children's comprehension of time metaphors improved over time, with a significant shift at age 5. Five-year-old children were able to both *understand* as well as *explain* spatial metaphors for time. Children nonetheless continued to improve their understanding of time metaphors from age 5 to age 6, the age at which their comprehension and metaphorical reasoning abilities approximated adult-like levels.

3.2 <u>Changes in children's metaphor comprehension by metaphor type</u>

We next asked whether children would show differences in their understanding of the three metaphor types for time (ego-moving, time-moving, sequence-as-position-on-a-path) and found that to be true.

A. Forced-choice responses B. Justifications

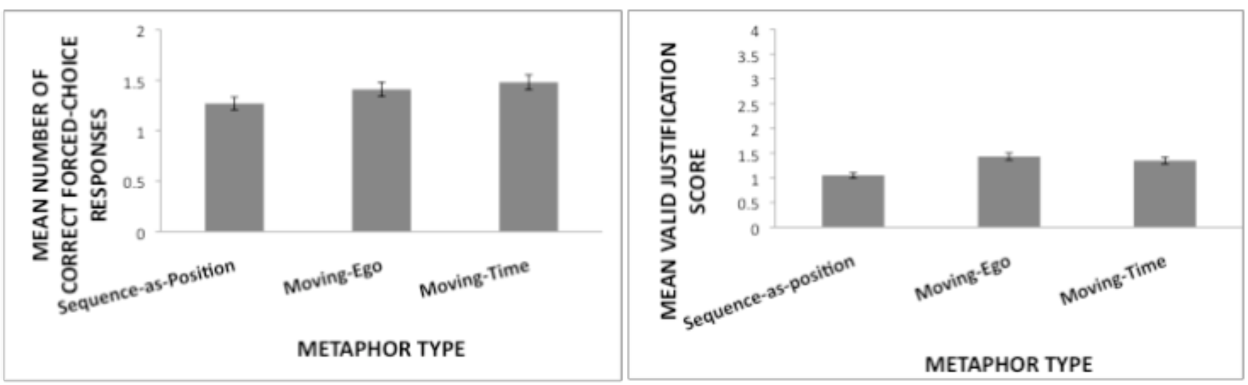


Figure 6. *Mean number of forced choice responses (panel A, max possible score=2) and valid justifications (panel B, max possible score=4) by metaphor type*

As can be seen in Figure 6 (Panel A), children's responses to the forced-choice questions in the story comprehension task showed a significant main effect of both *metaphor type* ($F(2,140)=3.24$, $p=.042$), and *age* ($F(4,70)=16.38$, $p<.001$), but no interaction ($F(8, 140)=.419$, $p=.908$). Contrasts revealed that overall, children were worse in grasping the meaning of sequence-as-position-on-a-path metaphors than both moving-time (p =.01, *LSD)* and moving-

ego (*p* =.09, *LSD*) metaphors. However, they did not differ reliably (*p* =.45, *LSD*) in their comprehension of the moving-time and moving-ego metaphors

Children's justifications in the story comprehension task followed a similar pattern. As can be seen in Figure 6 (Panel B), children's justifications for their forced-choice responses in the story comprehension task showed a significant main effect of *metaphor type*, ($F(2,70)=6.46$, $p=.003$), a significant main effect of age ($F(4,70)=166.11$, $p<.001$), and a significant *interaction* ($F(6, 70)=3.67$, $p=.001$). Overall, participants did worse in justifying their responses to the questions about the meaning of sequence-as-position-on-a-path metaphors than both moving-time ($p=.018$) and moving-ego ($p=.007$) metaphors, and this pattern was particularly pronounced both for the five-year-olds (moving-ego *vs*. sequence-as position: $p<.05$) and the six-year-olds (moving-ego or moving time *vs.* sequence as position: *p's*<=.01). However, children did not differ reliably in their justifications for the moving-time and moving-ego metaphors at any age (*p*. 528,see Figure 7, Panel B).

A. Forced-choice responses B. Justifications

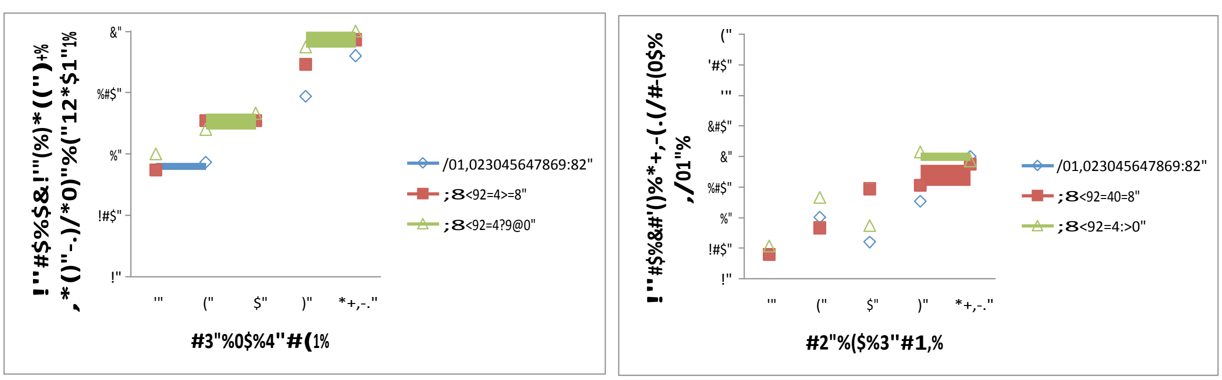


Figure 7. Mean valid forced choice responses (Panel A, max possible score=2) and justification scores (Panel B, max possible score = 4) in the story comprehension task by age and metaphor type.[7]

[7] *Line graphs are used for clarity of presentation, not to denote a longitudinal design.*

In summary, children's comprehension as well as explanations of time metaphors showed differences by metaphor type. Children were significantly worse in grasping the meaning of sequence-as-position metaphors than both moving-time and moving-ego metaphors. These differences were particularly pronounced in the responses of 5- to 6-year-old children, and were nonexistent in the younger children as well as the adults.

3.3 Factors that contribute to children's understanding of time metaphors

We next looked at the factors that best explain overall developmental changes in children's comprehension of time metaphors. One possibility is that changes in children's metaphor comprehension can be explained by changes in their understanding of the time concept, namely the target domain of the metaphor. An alternative, yet equally likely possibility, is that changes in metaphor comprehension is closely tied to changes in children's verbal abilities.

Table 1. Descriptive statistics for the time conservation task by pass or fail

	Pass N=22 (54% male)	Fail N=34 (50% male)
Mean age	5;2	5;1
Mean correct forced-choice responses	4.32	3.56
Mean valid justification score	4.00	3.09

To examine the first possibility, we regressed age and children's performance on the time conservation task on children's correct forced-choice response rate and their justification scores in the story comprehension task. We found that children's grasp of the time concept, as measured by their performance in the conservation of velocity of time task, was a significant predictor of their performance in the forced choice task, even after controlling for age, ($B(55)=.678$, $p=.042$) (fig. 8, panel A), but *not* a reliable predictor of their justification scores ($B(57)=.007$, $p=.426$).

To examine the second possibility, we regressed children's receptive vocabulary score on children's correct forced-choice response rate and their justification scores in the story comprehension task. We found receptive language ability to be a significant predictor of children's justifications (*B*(59)=2.01, *p*=.005)(fig.8, panel B), but *not* their forced choice responses *B*(59)=1.11, *p*=.272.

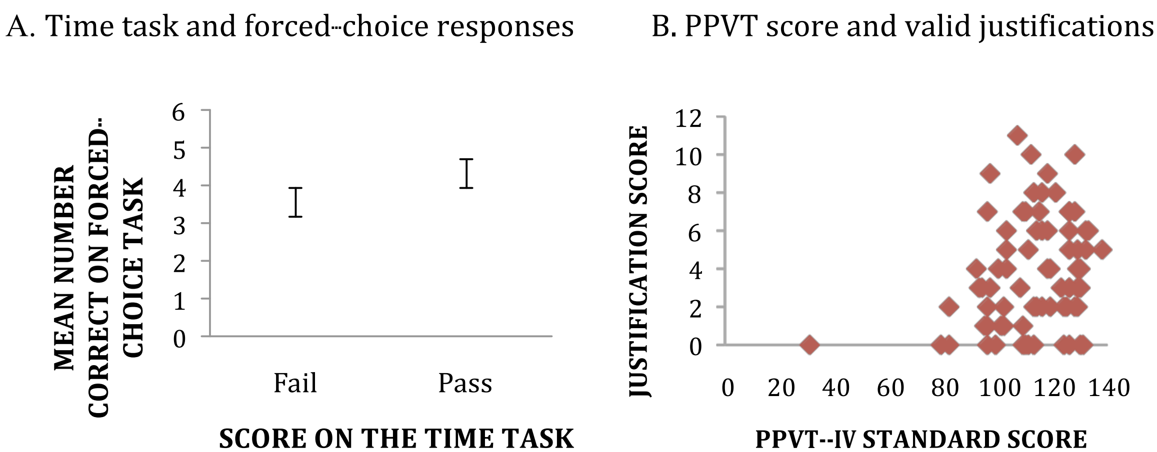


Figure 8. Time-task performance and mean number correct on the forced-choice task (Panel A) and PPVT-IV standard score and valid justification score for each child (Panel B)

These results thus suggest that the grasp of the time concept, but not verbal ability per se, is a strong predictor of whether or not a child will understand time metaphors. Verbal ability, on the other hand, is a reliable predictor of how well a child can explain a particular instantiation of a time metaphor.

4. Discussion

Spatial metaphors for time are frequent in the adult language that surrounds the child. But how early do children grasp the meaning of the different metaphors for time and what cognitive

and/or linguistic factors might contribute to this understanding? In this study, we explored these questions by assessing three- to six-year-old children's comprehension of three different metaphors for time, which included *ego-moving* ('we approach winter'), *time-moving* ('winter approaches') and *sequence-as-position-on-a-path* ('winter follows autumn') metaphors. In line with our expectations, we found a reliable increase in children's metaphor comprehension with age: children were able to understand the meaning of spatial metaphors for time by age 5 and showed beginnings of the ability to provide relevant explanations for the different time metaphors by age 6. These findings thus support and further extend previous work on metaphor comprehension in young children (e.g., Özçalışkan 2005, 2007); this earlier work showed a similar developmental trajectory for moving-time metaphors, from comprehending metaphors in a story context at age 4 to explaining metaphorical meanings by age 5. Our findings showed the developmental pattern to be true for the other two spatial metaphors for time (*ego-moving, sequence-as-position-on-a-path*), albeit with a delay of one year in achieving each milestone. The difference in children's performance between the two studies is likely to be an outcome of the difficulty associated with the sequence-as-position-on-a-path metaphors for young children. In fact, our results showed that children at each age tended to perform worse in deciphering the meaning of sequence-as-position-on-a-path metaphors for time as compared to moving-ego and moving-time metaphors. Nonetheless, children's overall performance in understanding all three spatial metaphors for time showed significant advances at the early ages, marking age 5 as the onset time for childen's comprehension of the different spatial meaphors for time.

We also predicted that children's understanding of each metaphor type might follow one of two directions, with moving-time metaphors being either the *first* or the *last* to be mastered. Our results provided support for the former prediction: children in our study performed

significantly better in their comprehension of moving-time and moving-ego metaphors than sequence-as- position metaphors. What makes sequence-as-position metaphors more difficult for children? One possibility is that the sequence-as-position metaphor is cognitively more challenging than other spatial metaphors for time because it draws on the child's experience as an *observer* of time concept's movement through space. Indeed, previous work by Gentner, Imai, & Boroditsky (2002), which showed longer reaction times in adults' responses to questions about sequence as position metaphors than to questions about moving-ego metaphors, provides support for this possibility. Gentner and colleagues (2002) argued that sequence-as-position metaphors[8] are more difficult for adults because they typically contain a temporal relationship between two events and an implicit observer, whereas moving-ego metaphors contain just the relationship between an event and an observer.

Another likely, but not mutually exclusive, possibility is that the moving-ego and moving-time metaphors present a more embodied conception of time. Humans have a myriad of experience with their body's movement through space; and moving-ego and moving-time metaphors are based on this experience in framing time as either moving toward or away from a stationary self or the self moving toward or away from a stationary point in time. Moving-time and moving-ego metaphors thus rely only on our first person perspective, something with which all humans have a great deal of experience, whereas sequence-as-position metaphors rely on the observation of the relational movement of external events that are independent from the self (i.e., ego or observer of time).

[8] In the Gentner et al. (2002) study, sequence--as--position metaphors were given the label 'moving--time' metaphors based on earlier categorization of such time metaphors. However, nearly all the moving--time metaphors used in the Gentner et al. (2002) study were instances of the sequence--as--position metaphors.

In line with our hypothesis, we also found that children's understanding of the time concept (i.e., the target domain of the metaphorical mapping) was a significant predictor of children's comprehension of metaphors for time, even after controlling for age. That is, children who were more likely to understand the metaphorical meaning in the stories were also the ones who had a better grasp of the time concept. This might suggest that a working knowledge of the target domain and its dimensions (velocity, speed) is critical to understanding the metaphorical expressions that are structured by this target domain. This finding parallels earlier work that showed that children's understanding of the target domain might play an important role in understanding metaphors (Keil, 1986). In this earlier work, five-year-old children could correctly map animate terms onto cars ('the car is thirsty')—a domain that they knew well, but had difficulty in understanding metaphors that involved mappings between taste terms and personality ('she is a sweet person')—a domain that they had limited knowledge, highlighting the effect of target domain knowledge on metaphor comprehension (Keil).   Similar to these earlier findings, in this study, children who had a better grasp of the time concept were also better able to understand the spatial metaphors for time. However, understanding of the time concept did not predict their ability to *explain* time metaphors. Instead, it was the receptive language ability that was a significant predictor of children's explanations for their forced-choice responses. Receptive language is strongly tied to expressive language, so it is possible that this difference is an artifact of more highly developed expressive language ability. In other words, children who had better receptive language skills were also likely to be the ones who could express themselves better in the justification task.

In summary, our results show early understanding of spatial metaphors for time. Children can grasp the meaning of the ego-moving, time-moving and sequence-as-position-on-a-path

metaphors by age *five* and begin to verbally explain their metaphorical interpretations by age *six*. Children's emerging ability to understand the three spatial metaphors for time follows a developmental progression from moving-time to moving ego and eventually to sequence-as-relative-position-on-a-path metaphors. Moreover, children's comprehension abilities are closely associated with their knowledge of the target domain of time, and their verbal explanations are strongly related to their receptive language abilities. Overall, these results indicate that metaphor comprehension is an early emerging cognitive and linguistic ability that has strong ties with child's knowledge of related cognitive domains as well receptive language skills.

4.1 Limitations and future directions

The data for our study come from a cross-sectional design, which constrains us in drawing conclusions about the developmental trajectory of children's metaphor understanding at the early ages. A longitudinal design examining changes in children's metaphorical abilities from 4 to 6 years of age, with closely timed observations could illuminate whether changes in metaphor comprehension and production occur in qualitative shifts or follow a more incremental pattern of development. Our study also looked at two different factors in children's metaphor understanding at the early ages. Future studies that examine the contribution of a wider array of cognitive (e.g., seriation tasks, spatial relations tasks) and linguistic (e.g., expressive language) factors to children's metaphor comprehension could further explain the underpinnings of changes in children's early metaphorical abilities.

The findings of this study could also be extended to different populations, including children with specific language delay or autism spectrum disorders. Examining factors such as theory of mind understanding, social communication, and expressive language deficits in relation to metaphor acquisition in these populations could lead to a better understanding of cognitive and

linguistic abilities necessary for metaphor development; this knowledge can in turn allow us to develop more efficient strategies and/or interventions that could be used in educational contexts.

References

Anderson, M.L. (2003). Embodied cognition: A field guide. *Artificial Intelligence, 149,* 91-130.

Asch, S.E. & Nerlove, H. (1960). The development of double function terms in children. In Bernard Kaplan and Seymour Wapner (Ed.s), *Perspectives in Psychological Theory: Esays in Honor of Heinz Werner.* New York: International Universities Press, Inc.

Billow, R.M. (1975). A cognitive developmental study of metaphor comprehension. *Developmental Psychology, 11,* 415-423.

Billow, R.M. (1981). Observing spontaneous metaphor in children. *Journal of Experimental Child Psychology, 31*, 430-445.

Boroditsky, L. (2000). Metaphoric structuring: Understanding time through spatial metaphors. *Cognition, 75,* 1-28.

Boroditsky, L. (2001) Does language shape thought?: Mandarin and English speakers' conceptions of time. *Cognitive Science, 43,* 1-22.

Boroditsky, L. & Ramscar, M. (2002). The roles of body and mind in abstract thought. *Psychological Science, 13*, 185-189.

Bottini, R. & Casasanto, D. (2010). Implicit spatial length modulates time estimates, but not vice versa. *Spatial Cognition, 8,* 152-162.

Cameron, L. (2008). Metaphor and talk. In R. Gibbs (Ed.), *The Cambridge handbook of metaphor and thought*. New York: Cambridge University Press.

Casasanto, D. & Boroditsky, L. (2008). Time in mind: using space to think about time. *Cognition, 106,* 579-593.

Casasanto, D., Fotakopoulou, O., & Boroditsky, L. (2010). Space and time in the child's mind: evidence for a cross-dimensional asymmetry. *Cognitive Science, 34,* 387-405.

Dunn, L.M. & Dunn, D.M. (2007). *Peabody Picture Vocabulary Test-IV.* San Antonio, TX: Pearson.

Gardner, H., Winner, E., Bechhofer, R., & Wolf, D. (1978). The development of figurative language. In K. Nelson (ed) *Children's Language, Volume 1*. New York: Gardner Prep, Inc.

Graf, E.-M. (2011). Adolescents' use of spatial TIME metaphors: A matter of cognition or sociocommunicative practice? *Journal of Pragmatics,43,* 723-734.

Gentner, D. (2001). Spatial metaphors in temporal reasoning. In Merideth Gattis (Ed.), *Spatial Schemas and Abstract Thought* (203-222). Cambridge, Massachusetts: The MIT Press

Gentner, D., Imai, M., & Boroditsky, L. (2002). As time goes by: Evidence for two systems in processing space time metaphors. *Language and Cognitive Processes,17,* 537-565.

Highnam, C.,Wegmann, J., & Woods, J. (1999). Visual and verbal metaphors among children with typical language and language disorders. *Journal of Communication Disorders, 32,* 25-35.

Iwasaki, S. (2009). A cognitive grammar account of time motion 'metaphors': A view from Japanese. *Cognitive Linguistics, 20*, 341-366.

Keil, F. (1986). Conceptual domains and the acquisition of metaphor. Cognitive Development, 1, 73-96.

Kovecses, Z. (2002) *Metaphor: A practical introduction*. New York: Oxford University Press

Lakoff, G. (1993). The Contemporary Theory of Metaphor. In A. Ortony (ed.), *Metaphor and Thought*. New York, New York: Cambridge University Press.

Lakoff, G. & Johnson, M. (1980). Conceptual metaphor in everyday language. *Journal of Philosophy, 77,* 453-486.

Lakoff, G. & Johnson, M. (1999). Philosophy in the Flesh. In *Philosophy in the Flesh: Embodies Mind and it's Challenge to Western Thought*. New York: Basic Books.

Lee, R.F. & Kamhi, A.G. (1990). Metaphoric competence in children with learning disabilties. *Journal of Learning Disabilities, 23,* 476-482.

Mendelsohn, E., Robinson, S., Gardner, H., & Winner, E. (1984). Are preschoolers' renamings intentional category violations?. *Developmental Psychology*, *20(2),* 187-192.

Miles, L.K., Nind, L.K., & Macrae, N. (2010a). Moving through time. *Psychological Science,* doi:10.1177/095679760935933.

Miles, L.K., Betka, E., Pendry, L.F., & Macrae, C.N. (2010b). Mapping temporal constructs: Actions reveal that time is a place. *The Quarterly Journal of Experimental Psychology, 63 (11),* 2113-2119.

Moore, K. E. (2006). Space-to-time mappings and temporal concepts. *Cognitive Linguistics, 17,* 199-244.

Moore, K.E. (2007). Lexical resources in Wolof and English for talking of time in terms of space. In Payne, D.L. & Peña, J. (Ed.s), 37th Annual Conference on African Linguistics (pp. 111-124). Somerville, MA: Cascadilla Proceedings Project.

Nippold, M.A. & Uhden, L.D. (1997). Proverb explanation through the lifespan: a developmental study of adolescents and adults. *Journal of Speech, Language, & Hearing Research, 40,* 245-254.

Norbury, C. (2005). The relationship between theory of mind and metaphor: Evidence from children with language impairment and autistic spectrum disorder. *British Journal of Developmental Psychology*, 23(3), 383-399.

Núñez, R. E. & Sweetser, E. (2006). With the future behind them: convergent evidence from Aymara language and gesture in the crosslinguistic comparison of spatial construals of time, *Cognitive Science, 30*, 401-450.

Núñez, R. E., Motz, B.A., & Teuscher, U. (2006). Time after time: The psychological reality of the ego-and time- reference-point distinction in metaphorical construals of time. *Metaphor and Symbol, 21,* 133-146.

Özçalışkan, S. (2003). Metaphorical motion in crosslinguistic perspective: A comparision of English and Turkish. *Metaphor and Symbol, 18*, 189-228

Özçalışkan, S. (2004). Time can't fly, but a bird can: learning to think and talk about time as spatial motion in English and in Turkish. *European Journal of English Studies, 8,* 309-336.

Özçalışkan, S. (2007). Metaphors we move by: Children's developing understanding of metaphorical motion in typologically distinct languages. *Metaphor and Symbol, 22,* 147-168

Özçalışkan, S. (2010). Acquisition of metaphor. In Patrick Hogan (Ed.), *Cambridge Encyclopedia of Language Sciences*. Cambridge, MA: Cambridge University Press.

Özçalışkan, S. & Goldin-Meadow, S. (2005). Gesture is at the cutting edge of early language development. *Cognition, 96,* B101-B113.

Özçalışkan, Ş.; Goldin-Meadow, S.; Gentner, D. & Mylander, C. (2009). Does language about similarity foster similarity comparisons in children? *Cognition, 112* (2), 217-228

Piaget, J. (1969) *Child's conception of time.* New York: Basic Books.

Utsumi, A. (2011). Computational exploration of metaphor comprehension processes using semantic space model. *Cognitive Science, 35(2), 251-296.*

Vosniadou, S. & Ortony, A. (1983). The Emergence of the literal-metaphorical distinction in young children. *Child Development, 53,* 154-161.

Waggoner, *I.E.* & Palermo, D.S. (1989). Betty is a bouncing bubble: children's comprehension of emotion-descriptive metaphors. *Developmental Psychology, 25,* 152-163.

Appendix A

Stories with time metaphors

Story One-- Moving Time

This is Patrick. This is Patrick's Mom. Patrick's mom tells him that his trip to the zoo is coming up. Patrick gets really excited! He shouts "YEAH!"

Why is Patrick excited?
A. His trip to the zoo is now.
B. His trip to the zoo is soon.

Story Two-- Moving-Ego

This is Rob. This is Rob's friend Kyle. Kyle tells Rob that he has to long way to go until his party. Rob is disappointed. He says "Ugh".

Why is Rob disappointed?
A. His party is later
B. His party is over

Story Three-- Sequence is Relative Position on a Path

This is Stacy. This is Stacy's sister Carol. Carol says that ice cream follows lunch. Stacy is excited. She's says "Yippee!"

Why is Stacy excited?
A. Ice cream is now
B. Ice cream is soon

Story Four-- Moving Time

This is Ed. This is Ed's sister Ann. Ann tells him that the time for bed has come. Ed is sad. He says "Ugh!"

Why is Ed sad?
A. He has to get up now
B. He has to go to sleep now

Story Five-- Moving Ego
This is Erin. This is Erin's teacher. Erin's teacher tells her that they are coming up on recess. Erin is happy. She says "alright!"

Why is Erin happy?
A. Recess is now
B. Recess is soon

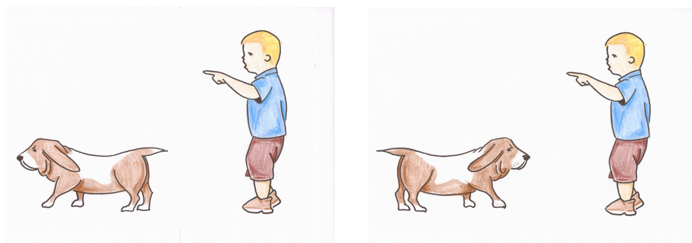
Story Six-- Sequence is Relative Position on a Path
This is Polly. This is Polly's dad. Polly's dad tells Polly lunch follows washing up. Polly is disappointed. She says "oh."

Why is Polly disappointed?
A. Lunch is over
B. Washing-up is now

Appendix B-

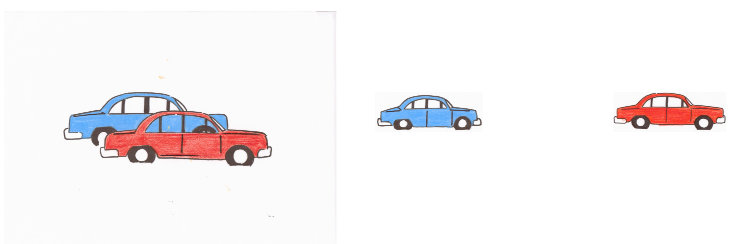
Phrases and pictures used in the literal motion task

1. The dog is **coming up** to the boy



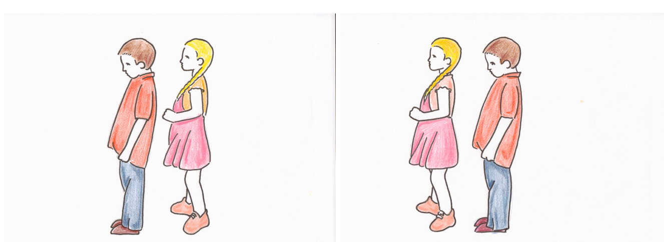
√

2. The blue car **has a long way to go** to get to the red car



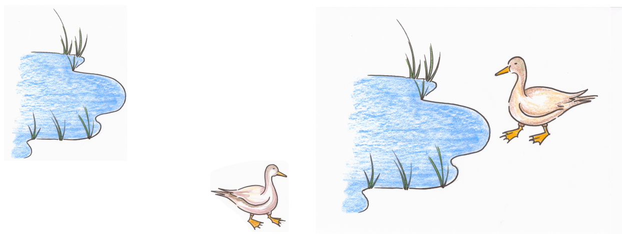
√

3. The boy is **follows** the girl in line



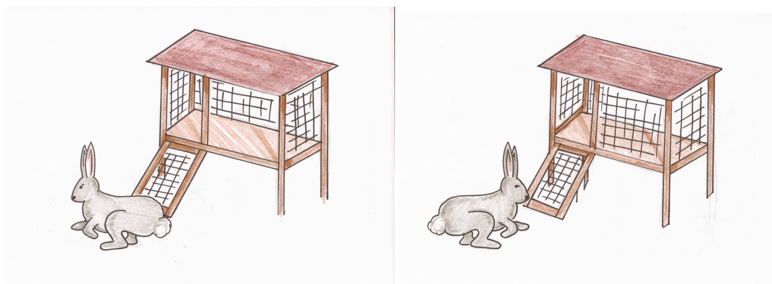
√

4. The duck **has come** to the pond



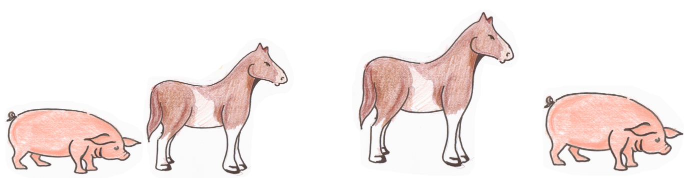
√

5. The rabbit is **coming up to** his cage



√

6. The horse **follows** the pig



√