Lexical and Structural Cues for Acquiring Motion Verbs Cross-Linguistically

Anna Papafragou and Stathis Selimis
University of Delaware and University of Athens

1 Motion in language and cognition

Languages differ systematically in how they map path and manner of motion onto lexical and grammatical structures (Talmy, 1985). *Manner* languages (e.g., English, German and Russian) typically code manner in the verb (cf. English *skip, run, hop, jog*), and path in a variety of other devices such as particles (*out*), adpositions (*into the room*), verb affixes, etc. *Path* languages (e.g., Modern Greek, Romance, Turkish, Japanese and Hebrew) typically code path in the verb (cf. Greek *vjeno* 'exit', *beno* 'enter', *ftano* 'reach', *aneveno* 'ascend', *diashizo* 'cross'), and manner in adverbials (*trexontas* 'running', *me ta podia* 'on foot', *jrigora* 'quickly'). The distinction is not meant to imply that the relevant languages lack certain kids of verb altogether. For instance, English has path verbs, such as *enter*, *exit*, *ascend* and *descend*, and Greek has manner verbs, such as *treho* 'run', *kilao* 'roll', *perpatao* 'walk', and *petao* 'fly'. But the most characteristic (i.e., colloquial, frequent and pervasive) way of describing motion in the two languages involves manner and path verbs respectively.

The manner/path asymmetry in verb use is made more salient by the following restriction: while in Manner languages, manner verbs seem to compose freely with different kinds of path modifiers, in many Path languages manner verbs cannot appear with resultative phrases to denote culminated motion (e.g., Snyder, 2001). Thus the compact way of expressing motion in the English example in (1) is unavailable in Greek; the PP in (2) can only have a locative (not a resultative/directional) interpretation:

(1) English

The bird	flew	out of	the cage.
FIGURE	MANNER	PATH	GROUND

(2) Modern Greek

*To puli	petakse	(ekso) apo	to kluvi.
the bird	flew	(out) from	the cage
FIGURE	MANNER	PATH	GROUND

In order to convey the culminated event in (1), Greek needs to either switch to a path verb and optionally encode manner in a modifier as in (3a), or break down the event into two separate clauses with a path and manner verb as in (3b). Since both options in (3) are marked, the default way of encoding this event would be (3a) without the manner participle. In effect, then, the

resultative frame constraint strengthens the manner/path asymmetry in the use of motion verbs across Manner and Path languages:

(3) a. To puli vjike (ekso) apo to kluvi (petontas).
the bird exited (out) from the cage (flying)
FIGURE PATH PATH GROUND (MANNER)

b. To puli petakse ke vjike (ekso) apo to kluvi.
the bird flew and exited (out) from the cage
FIGURE MANNER PATH PATH GROUND

Several psycholinguistic studies have confirmed the typological differences in the description of motion just documented using data from both adults and children across a variety of languages (Choi & Bowerman, 1991; Naigles, Eisenberg, Kako, Highter & McGraw, 1998; Papafragou, Massey & Gleitman, 2002, 2006; Selimis & Katis, 2003; Slobin 1996; among many others). Other studies have shown that lexical and structural considerations affect the way novel motion verbs are interpreted by adult (Naigles & Terrazas, 1998) and 7-year-old (Hohenstein, Naigles & Eisenberg, 2004) speakers of Manner and Path languages.

2 Goals and experimental prospectus

One question raised by these findings is whether different methods might reveal the presence of verb lexicalization biases in even younger learners. If they are sensitive to this kind of cue, children should often be led to hypothesize different meanings (path vs. manner) for novel verbs in Path vs. Manner languages, even when presented with what seem to be on the surface similar learning situations. A second question concerns how such lexical considerations might interact with syntactic cues such as the resultative frame constraint. Since this constraint can impose specific perspectives on scene conceptualization, it is important to find out (a) whether (and how early) children are sensitive to such syntactic restrictions, and (b) whether learners can combine such syntactic generalizations with the probabilistic statistics of motion lexicalization and observational/scene information when assigning an interpretation to a novel motion verb.

A further question is whether the pervasive cross-linguistic differences we have detailed could affect the non-linguistic representation of motion. On such a *salience* hypothesis, manner and path components of motion scenes could be differentially accessible to speakers of Manner and Path languages even in situations that do not overtly involve linguistic communication (Bowerman & Choi, 2003; Levinson, 2003). Alternatively, on a *universalist* hypothesis, both manner and path may be available to an equal extent to speakers of different languages for purposes of categorization and memory, regardless of whether these are prominently and systematically encoded in the language (cf. Papafragou, to appear). Prior studies have offered evidence against the salience hypothesis in the domain of motion events (Papafragou, Massey & Gleitman, 2002; Gennari, Sloman,

Malt & Fitch, 2002). Nevertheless, it remains an open question whether linguistic distinctions might affect non-linguistic tasks such as categorization for dynamically evolving events, especially in younger learners: the available developmental data in support of the universalist hypothesis from Papafragou et al.'s (2002) study were based on static depictions of motion (series of digital photographs or line drawings). Unlike object categorization, event categorization with vs. without linguistic labels has not received much study in the developmental literature and some studies have claimed that event construals are particularly vulnerable to linguistic influences (Gentner & Boroditsky, 2001).

Here we take a closer look at how linguistic and non-linguistic representations of motion events come together during the acquisition of different languages. First, we look at how the lexical form and syntactic environment of a newly encountered motion verb are recorded by children and adults speaking English or Greek to yield language-specific meaning conjectures (Experiment 1). We expect children (and adults) in such contexts to weigh event components such as path and manner of motion differentially depending on whether their native language tends to encode the corresponding meaning elements in the main verb or not.

We also compare young children's (and adults') performance in situations where they categorize the same dynamically unfolding events in the ambient world without overtly labeling them linguistically (Experiments 1-2). Crucially, salience accounts predict that language-specific lexical and structural pressures should consistently affect event conceptualization, with English speakers being more likely to make manner choices than Greek speakers. On alternative, universalist accounts, such pressures should cease to exert their influence beyond situations of word learning.

3 Experiment 1

3.1 Participants

Participants were native speakers of either English or Modern Greek grouped into two general age groups. The Child group consisted of 30 English-speaking children between 4;5 and 5;9 years (mean age 5;0) and 30 Greek-speaking children between 4;1 and 5;10 (mean age 5;0). Children were recruited from daycares at Newark, Delaware (US) and Northern Evia (Greece) respectively. The Adult group consisted of 30 English-speaking adults and 36 Greek-speaking adults. Adults were mostly drawn from the undergraduate populations of the University of Delaware and the University of Athens respectively.

3.2 Method

Stimuli consisted of 48 short silent animated motion clips organized in 16 triads. Each triad consisted of a sample event (e.g., a turtle swimming out of an underwater cave) and two variants, a Same-Path one (the turtle jumping out of the cave) and a Same-Manner one (the turtle swimming past the cave). All sample motion scenes involved change-of-state (telic) events.

The motion stimuli were presented on two identical laptop computers placed next to each other. Each sample played twice, once on the screen on the left and once on the screen on the right. Then participants watched the two variants, one on the left and the other on the right screen, and had to match the sample to one of the variants.

Participants were randomly assigned to one of the three experimental conditions. In the Verb condition, children were introduced to a puppet from another planet who spoke a strange language. They were asked to help the experimenter understand what the puppet said. (No puppet was used for the adults.) While the sample event was playing, the puppet described the scene with a novel, 'mystery' verb (e.g., *Look! The turtle is rolting!*. The sentence was repeated while the sample played a second time. While watching the variants, children were asked: *Do you see the turtle rolting now? On which screen?*

In the Frame condition, the same procedure was followed, but mystery verbs were combined with directional PPs into resultative frames (e.g., *Look! The turtle is rolting out of the cave!*). Participants had to pick the scene that matched the mystery verb (*Do you see the turtle rolting now? On which screen?*

In the Non-Linguistic condition, while participants were shown the sample event, they heard a sentence which did not contain a specific verb (e.g., *Look! The turtle is doing something!*). Then they were shown the two variants and were asked to pick the one that best matched the sample (*Do you see the turtle doing the same thing now?*). At the end of this condition, participants were asked to view the scenes again and describe them.

We included a practice triad in the beginning of each session which did not involve pure motion/displacement events but showed a man manipulating a box. Three Greek-speaking and two English-speaking children who did not pass the practice triad were replaced.

Participants were tested individually in a single session (with the exception of four Greek-speaking children who were tested in two sessions on two consecutive days because the procedure could not be completed within the school day). Screen allocation (left-right) for Same-Path and Same-Manner variants was counterbalanced for each participant, with the constraint that consecutive variants playing on the same screen were never of the same type (i.e., Same-Path or Same-Manner). Order of presentation of the triads was counterbalanced within each condition.

3.3 Results

3.3.1 Linguistic production results (main verbs)

As shown in Table 1, English speakers used many more manner verbs than Greek speakers, and the opposite pattern holds for path verbs. We entered the proportion of responses containing exclusively manner verbs into an ANOVA with Language and Age as factors. The analysis returned a main effect of Language ($F(1, 2012)= 744.91$, $p<.0001$), a main effect of Age ($F(1, 2012)= 33.64$, $p<.0001$) and an interaction between Language and Age ($F(1, 2012) = 30.93$, $p<.0001$). The interaction was due to the fact that Greek children and adults were equally likely to produce a manner verb

(F(1, 1054)=.02, p=.86), while in English, children were less likely to do so than adults (F(1, 958)=67.01, p<.0001).

A similar analysis over the proportion of responses containing path verbs only returned a main effect of Language (F(1, 2012)= 477.24, p<.0001), a main effect of Age (F(1, 2012)=54.09, p<.0001), and a Language by Age interaction that just misses significance (F(1, 2012)=2.9, p=.08). Finally, an ANOVA over the proportion of Mixed responses (i.e., responses containing both a manner and a path verb) returned a main effect of Language (F(1, 2010)=111.29, p<.0001), a main effect of Age (F(1, 2010)=11.94, p=.0006) and a Language by Age interaction (F(1, 2010)=29.69, p<.0001). The interaction can be explained by the fact that Age appears to affect Mixed responses more dramatically in the case of the Greek-speaking population (with children producing them 8% and adults 18% of the time) than the English-speaking population where Mixed responses are vanishingly rare (2% and 0% of children's and adults' responses respectively).

Table 1. Linguistic production data.

	English		**Greek**	
Verb type	**Children**	**Adults**	**Children**	**Adults**
Path V	24.59	6.88	63.34	52.08
Manner V	66.46	87.92	25.42	25.87
Mixed Vs (2 clauses)	2.29	0	8.13	18.40
Other V	6.67	5.21	3.13	3.65
Total	**100**	**100**	**100**	**100**

3.3.2 Categorization results

The proportion of manner choices was entered into an omnibus ANOVA with Language (English, Greek), Age (Children, Adults), and Condition (Verb, Frame, Non-linguistic) as between-subjects factors. The analysis revealed a main effect of Language (F(1, 2005)=110, p<.0001), with English speakers overall more likely than Greek speakers to make manner choices (M = .51 vs. .29); a main effect of Age (F(1, 2005)= 8.5, p=.0034), with children more likely to make manner choices than adults (M = .43 vs. .36); and a Language by Age interaction (F(1, 2005)=12.64, p=.0004). The interaction was due to the fact that Greek speakers in the two Age groups did not differ in terms of their manner choices (M_{ch} =.28, M_{ad}=.29) while English speakers did (F(1, 957)=18.20, p<.0001; M_{ch}=.58, M_{ad}=.44).

The analysis further revealed a main effect of Condition (F(2, 2005)=13.53, p<.001), an interaction between Age and Condition (F(2, 2005)=4.28, p=.01) but no interaction between Language and Condition. Condition affected manner responses in both English-speaking and Greek-speaking adults (F(2, 476)=15.42, p<.001 and F(2, 570)=3.62, p=.02

respectively) but there was no effect of Condition on the proportion of manner responses in either English-speaking or Greek-speaking children. Pairwise comparisons showed that English-speaking adults treated each condition differently from either of the other two (all p's<.05). For Greek adults, however, the only significant difference was found between the Verb and the Non-linguistic condition ($F(1, 382)=7.28$, $p=.0073$).

Next we conducted a separate ANOVA on the proportion of manner matches for each of the three Conditions with Age and Language as between-subjects factors. In the Verb condition, the ANOVA returned a main effect of Language ($F(1, 670)=48.71$, $p<.001$, with English speakers offering manner guesses 60% of the time and Greek speakers 34% of the time. There was no effect of Age: adults offered manner matches 47% of the time and children 46% of the time. Finally, there was no interaction between Language and Age ($M_{ch}= .61$, $M_{ad}= .59$ for English vs. $M_{ch}= .32$, $M_{ad}= .35$ for Greek).

In the Frame condition, the ANOVA returned a main effect of Language ($F(1,670)=35.36$, $p<.0001$), with English speakers offering manner guesses 50% of the time and Greek speakers 28% of the time. The ANOVA found no effect of Age but a significant Language by Age interaction ($F(1,670)=4.1$, $p=.04$). The interaction was due to the fact that, in the Greek group, children did not differ from adults ($F(1, 350)=.3$, $p=.57$; $M_{ch}=.27$ vs. $M_{ad}=.30$), while in the English group, children were more likely than adults to offer manner conjectures ($F(1,317)=4.8$, $p=.02$; $M_{ch}=.56$ vs. $M_{ad}=.44$).

Finally, in the Nonlinguistic condition, the ANOVA yielded a main effect of Language ($F(1, 670)=27.10$, $p<.0001$), with English speakers offering manner matches 42% of the time and Greek speakers 24% of the time. The analysis further revealed a main effect of Age ($F(1,670)=17.12$, $p<.0001$), with children overall being more likely to offer manner choices than adults ($M_{ch}=.40$ and $M_{ad}=.26$). Finally, the ANOVA yielded an interaction between Language and Age ($F(1, 670)=12.35$, $p=.0005$). Pairwise comparisons revealed that, in the English group, children made more manner choices than adults ($F(1, 318)=25.32$, $p<.0001$, $M_{ch}=.56$ vs. $M_{ad}=.29$), while in the Greek group, children and adults did not differ ($M_{ch}=.25$ vs. $M_{ad}=.23$). Similarly, English-speaking children were more likely to make manner choices compared to the Greek-speaking children ($F(1, 318)=34.14$, $p<.0001$, $M=.56$ vs. $.25$ for English and Greek respectively), while adults did not differ across languages ($M=.29$ and $.23$ for English and Greek respectively).

3.5 Discussion

Our production data confirm the expected (path/manner) asymmetry in the type of motion verb found in the speech of English vs. Greek speakers. Crucially, our study provides evidence that such verb lexicalization biases shape motion verb learning cross-linguistically: when English and Greek speakers are presented with a motion verb in isolation (Verb condition) and asked to map it onto either the manner or the path of a motion event, their conjectures exhibit a manner/path asymmetry which mirrors verb preferences in the production data (English speakers prefer manner and

Greek speakers path conjectures). Effects of this lexicalization bias are already present in 5-year-old learners. These results confirm and extend earlier studies on the potency of lexicalization biases in speakers of Path or Manner languages (cf. Naigles & Terrazas, 1998; Hohenstein et al., 2004).[1]

Our design anticipated a difference between the Verb and Frame condition for Greek but not for English speakers, since the Frame Condition involved resultative structures where manner verbs are mostly ungrammatical in Greek. This prediction was not confirmed for the Greek population, where learning outcomes did not substantially change between the two conditions (presumably because manner guesses were already relatively low in the Verb condition – corresponding to about 32% of adult and 35% of child responses). We did observe a change in the English group, whereby adults became somewhat less likely to offer manner conjectures in the Frame condition than in the Verb condition (44% vs. 59% respectively). This was probably due to the addition of a directional modifier in the Frame condition, which may have encouraged participants to focus on the direction of the moving object rather than the details of the manner of motion.

Finally, and importantly, in the Non-Linguistic condition, our categorization task results show that adult speakers of different languages do not differ from each other (they broadly make path-based choices when categorizing motion events), but children do. Moreover, children's performance seems to split along typological lines, with English-speaking children making many more manner choices than Greek-speaking children of the same age when categorizing motion stimuli. One might be tempted to interpret these effects as evidence supporting the salience hypothesis since, at least for children, motion categorization preferences pattern along language-specific lines. Nevertheless, the specific pattern observed is exactly the opposite from what salience accounts typically posit (e.g., Lucy, 1992): the expectation in such models is that children start out alike in their core cognitive abilities and representations but diverge in their cognitive preferences as they grow older and more proficient in language. In our data, however, it is children who are 'Whorfian' and adults who are universal.

---

1. Using a task similar to ours, Naigles and Terrazas (1998, Exp.1) found that novel bare motion verbs were interpreted as manner Vs by both English- and Spanish-speaking adults. N&T interpret their results as a reflection of the semantic implications of the intransitive frames (*Look! She's kradding!*) used to introduce the novel verbs: they reason that intransitive frames favor manner verb interpretations across languages unlike transitive frames with direct objects (*Look! She's kradding the tree!*) which accept path interpretations (cf. *approaching/leaving the tree*). These findings (and their explanation) are inconsistent with the fact that Greek speakers in our study offer predominantly path conjectures for bare Vs in intransitive frames (Verb condition). We propose that subtle differences between Greek and Spanish may be responsible for these differences in findings. Specifically, production studies with adults have found that, in Spanish, bare-verb sentences are respectably frequent (6-26% of subjects' responses depending on the task) and are more likely to contain manner than path verbs (Naigles et al., 1998). In the speech of Greek adults, however, bare-verb sentences are vanishingly rare and the manner advantage in this corpus is minute or nonexistent (Papafragou et al., 2006).

An alternative explanation for children's categorization performance is that children implicitly used verbal labels for events to cope with the memory demands of the task. Support for this hypothesis comes from the fact that our verbal prompt accompanying the sample in the Nonlinguistic condition (*Look! He's doing something!*) may have implicitly encouraged children to label the event ("He's Ving") in their native language. If so, it is particularly interesting that English-speaking children, who are vastly more likely than the other three Age-Language groups to describe the target events using a single manner verb, are also vastly more likely to pick manner matches in the triad task.

To test the hypothesis that task demands may have increased language-based responses, at least from child participants, in the next study we replicated the Nonlinguistic condition of Experiment 1 but changed the biasing linguistic prompt (Experiment 2a) and, in a further modification, the presentation of the stimulus events (Experiment 2b). We anticipated that, if memory demands are responsible for the observed cross-linguistic differences in children's performance, these manipulations would make children less likely to use language as a way of encoding the stimuli. As a result, differences between English-speaking and Greek-speaking children in motion categorization would diminish or disappear.

4 Experiment 2a

4.1 Participants

Participants consisted of a new group of native speakers of either English or Modern Greek. The Child group consisted of 8 English-speaking children between 4;10 and 5;10 years (mean age 5;0) and 8 Greek-speaking children between 4;7 and 5;10 (mean age 5;0). The Adult group consisted of 10 English-speaking and 10 Greek-speaking adults.

4.2 Method

Materials and procedure were the same as in Experiment 1 (Non-linguistic condition) with the following changes. Participants heard a simple prompt (*Look!*) upon the presentation of the samples. Their similarity judgments were now elicited by using the prompt *Do you see the same thing now?*. Participants were not asked to describe the clips.

4.3 Results and Discussion

The proportion of manner choices was entered into an ANOVA with Language (English, Greek) and Age (Children, Adults) as factors. The analysis revealed no main effect of Language ($F(1, 524)=2.59$, $p=.1$), with English speakers offering manner matches 40% and Greek speakers 34% of the time. The analysis revealed a main effect of Age ($F(1, 524)=8.8$, $p=.0031$), with children offering manner matches 31% and adults 43% of the time. There was also an interaction between Language and Age ($F(1, 524)=6.1$, $p=.01$). Closer inspection of the data reveals that, in the English group, the proportion of manner matches does not differ significantly between adults and children ($M= .41$ and $.39$ respectively) but in the Greek

group, adults are more likely than children to make manner choices (M = .45 and .22 respectively, $F(1, 286)=10.05$, $p=.0017$). Finally, adults' performance is similar in the two languages while children's performance differs ($F(1, 254) = 9.04$, $p=.0029$).

In sum, the pattern of results broadly replicated that in Experiment 1: adults did not differ in their categorization preferences depending on the language they spoke, but children did. Specifically, manner of motion seemed to be less salient a categorization dimension for young Greek speakers, perhaps in accordance with verb typological features in the motion domain in Greek. Still, it is possible that the present version of the event categorization task allowed linguistic intrusions, even though it simply instructed participants to find 'the same event'. To test this hypothesis, one would have to remove all memory components from the categorization task by making both the sample and variants constantly available to perception.

Experiment 2b introduced just such a task by replacing the sequential presentation of the sample events and variants with a simultaneous presentation. We reasoned that, since the simultaneous presentation alleviates the pressure for linguistically or otherwise encoding and retaining the scenes in memory, it could lead to more uniform responses across languages driven mostly by perceptual similarities in the target events.

5 Experiment 2b

5.1 Participants

Participants were native speakers of either English or Modern Greek falling into two age groups. The Child group included 10 English-speaking children between 4;5 and 5;9 years (mean age 5;4) and 10 Greek-speaking children between 4;6 and 5;7 (mean age 5;4). The Adult group consisted of 10 English-speaking adults and 10 Greek-speaking adults. Children and adults were recruited from the same populations as in Experiments 1 and 2a. None of them had taken part in those earlier Experiments.

5.2 Method

The same materials and procedure as in Experiment 2a were used but now participants saw a continuous display of both the sample and the two variants. Stimuli were presented on three laptop computers placed side by side. The middle laptop which displayed the sample event was placed further away from the participant, and the other two screens were placed to the left and right side and slightly closer to the subject. Participants were told that they would watch three similar clips on the three screens and they would have to pick the screen which showed the same thing as the middle screen. They were also told that the clips would go on playing until they made their choice.

At the beginning of each triad, participants were given the opportunity to inspect the first (frozen) frames of each event to familiarize themselves with the event participants. Then the sample started playing and participants' attention was drawn to the middle screen. About 3s later, the two variants started playing. This step-wise presentation of the stimuli was

done to facilitate processing (and comparison) of three ongoing events. The three events continued to play in a loop until participants responded.

5.3 Results and Discussion

When presented with motion events running simultaneously, both age groups in both languages performed identically. An ANOVA with Language and Age as factors returned no main effect of Language ($F(1, 636)=.52$, $p=.47$, $M_{Eng}= .57$and $M_{Gr}=.60$), or Age ($F(1, 636)=2.84$, $p=.09$, $M_{ad}= .55$ and $M_{ch}= .61$), and no interaction between Language and Age ($F(1, 636)=.31$, $p=.57$). As anticipated, participants were more likely to offer manner guesses in Experiment 2b than 2a (58% vs. 36% of responses). This difference between Experiments 2a and 2b was confirmed in an ANOVA which returned a main effect of Experiment ($F(1, 1213)=63.76$, $p<.0001$). Pairwise comparisons revealed statistically different performance for each of the four groups of participants between the two Experiments (Eng adults: $F(1, 318)=4$, $p=.04$; Gr adults: $F(1, 318)=10.8$, $p=.011$; Eng children: $F(1, 285)=19.56$, $p<.0001$; Gr children: $F(1, 285)=53.87$, $p<.0001$).

Results from this Experiment confirm the hypothesis that differences in motion categorization preferences between English- and Greek-speaking children observed in previous versions of this task (Experiments 1 and 2a) were due to memory effects and do not generalize to all categorization tasks involving motion events. When English and Greek speakers (both children and adults) view unfolding motion scenes, they are drawn to the same event components in deciding what counts as 'the same' event; most of the time, the event components that determine event identity have to do with the way the agent is moving, rather than the path he or she is following. This overwhelming reliance on manner is presumably dictated by perceptual features of the dynamic event and is independent of the way motion is encoded cross-linguistically.

6 General Discussion

6.1 Acquiring motion verbs cross-linguistically

Our linguistic production data confirm and extend a growing body of work which suggests that children quickly grasp and follow language-specific patterns for the expression of spatial relations and events. Furthermore, our results offer support to the idea that such biases shape early lexical learning: when exposed to a 'bare' new motion verb (in an intransitive frame), adults' and children's conjectures about its meaning are consistent with the way motion is lexicalized in their native language: English speakers generally interpret it as a manner and Greek speakers as a path verb. Perhaps because of the potency of the lexicalization bias, additional effects of language-specific syntactic (e.g. resultative) constraints were not detected.

Naturally, the observed lexical generalizations have limitations: since their role is to privilege certain lexical candidates over others (path vs. manner verbs) within the semantic field of motion, they cannot tell us how the semantic field of motion is chosen over other possible semantic

hypotheses when a new verb is encountered. Furthermore, there is evidence that such biases are malleable and flexible, at least in adults: after being exposed to brief training on corpora of verbs with different manner-path compositions, English-speaking adults adapted their generalizations of novel motion verb meanings to the statistics of the training corpus, and were able to learn path verbs if such verbs were dominant in the training set (Havasi & Snedeker, 2004). Similarly, there is preliminary evidence that English learners at the age of five can form path lexicalization biases in response to a clear category structure (Havasi & Snedeker, 2004). It is therefore likely that these verb lexicalization biases in the domain of motion emerge as a consequence of experience with previously learned motion verbs, and can change as a function of the input. This leads to the prediction that different Path languages may give rise to slightly different lexicalization biases depending on the specific frequency with which manner and path verbs are distributed in the language. This prediction is confirmed in our data, which point to subtle differences between Greek and Spanish, another Path language, in terms of the hypotheses entertained about the meaning of novel bare motion verbs (cf. fn.1).

6.2 Event cognition and language

We began by considering two hypotheses about the relationship between linguistic and conceptual representations. According to the salience hypothesis, linguistic dimensions prominent in lexicalization patterns can shape the non-linguistic processes of segmenting and mentally 'packaging' events. On an alternative, universalist hypothesis, linguistic representations are not isomorphic to non-linguistic (conceptual) representations: in other words, the representation of space and events is not constrained by categories and distinctions provided by one's native language.

To test these two hypotheses, we compared the non-linguistic categorization of motion events by speakers of English and Greek who, as previously described, differ in the way they encode manner and path of motion. Our findings reveal an intriguing asymmetry: while adults behave identically in their categorization preferences, 5-year-olds diverge along language-specific lines, with English-speaking children being more likely than Greek-speaking children to take manner identity as the basis for judging motion event identity (Exps. 1 and 2a). These data are hard to reconcile with the classic version of the salience hypothesis, according to which cognition is more likely to be reorganized along language-based lines with age and increased exposure to (and familiarity with) one's native language (Lucy, 1992). A more likely explanation of the disparity in the child data is that children might have used language as a way of organizing and remembering the motion stimuli in our experimental setting.

Further experimentation offers support to this explanation: if the need to keep in mind and compare the triad of motion events is eliminated, both children and adults in the two language groups behave identically when asked to decide which of the triad events are 'the same' (Exp.2b). This last finding is also consistent with data from Papafragou et al. (2002), who asked English- and Greek-speaking adults and 8-year-olds to categorize motion

events in a triad task similar to the present one. Crucially, in that work, each of the motion events was presented as a series of digital photographs, and (just like the present study) all of the events within a triad were laid out in such a way that they could be inspected in parallel by participants. With memory load removed from the event categorization process, both children and adults behaved identically in the two languages. Taken together with these prior data, results from the present research show that language effects on spatial categorization are fleeting and momentary and do not lead to a permanent reorganization of spatial representation (see Landau, Dessalegn & Goldberg, in press, for a related perspective).

References

Bowerman, M. & Choi, S. (2003). Space under construction. In D. Gentner & S. Goldin-Meadow (Eds.), *Language in mind*. Cambridge, MA: MIT Press.

Choi, S. & Bowerman, M. (1991). Learning to express motion events in English and Korean. *Cognition*, 41, 83-122.

Gennari, S., Sloman, S., Malt, B., & Fitch W. (2002). Motion events in language and cognition. *Cognition*, 83, 49-79.

Gentner, D., & Boroditsky, L. (2001). Individuation, relativity, and early word learning. In M. Bowerman and S. Levinson (eds.), *Language acquisition and conceptual development.* Cambridge: CUP.

Havasi, C., & Snedeker, J. (2004). The adaptability of language specific verb lexicalization biases. *Proceedings from the 26th Annual Meeting of the Cognitive Science Society.* Mahwah, NJ: Erlbaum.

Hohenstein, J., Naigles, L., & Eisenberg, A. (2004). Keeping verb acquisition in motion. In D. G. Hall & S. Waxman (eds.), *Weaving a lexicon*. Cambridge, MA: MIT Press.

Landau, B., Dessalegn, B., & Goldberg, A. (in press), Language and space. In P. Chilton & V. Evans (eds.), *Language, cognition and space.* London: Equinox.

Levinson, S. (2003). *Space in language and cognition.* Cambridge: CUP.

Lucy, J. (1992). *Grammatical categories and cognition*. Cambridge: CUP.

Naigles, L., Eisenberg, A., Kako, E., Highter, M., & McGraw, N. (1998). Speaking of motion. *Language and Cognitive Processes*, 13, 521-549.

Naigles, L. & Terrazas, P. (1998). Motion-verb generalizations in English and Spanish. *Psychological Science*, 9, 363-369.

Papafragou, A. (to appear). Space and the language-cognition interface. In P. Carruthers, S. Laurence & S. Stich (eds.), *The innate mind, Vol.3.* Oxford: OUP.

Papafragou, A., Massey, C., & Gleitman, L. (2002). Shake, rattle, 'n' roll: the representation of motion in language and cognition. *Cognition*, 84, 189-219.

Papafragou, A., Massey, C., & Gleitman, L. (2006). When English proposes what Greek presupposes. *Cognition*, 98, B75-87.

Selimis, S., & Katis, D. (2003). Reference to physical and abstract motion in child language. *Proceedings of the 6th International Conference of Greek Linguistics*.

Slobin, D. (1996). From 'thought and language' to 'thinking for speaking'. In J. Gumperz & S. Levinson (eds.), *Rethinking linguistic relativity*. NY: CUP.

Snyder, W. (2001). On the nature of syntactic variation. *Language*, 77, 324-342.

Talmy, L. (1985). Lexicalization patterns: Semantic structure in lexical forms. In T. Shopen (ed.), *Language typology and syntactic description*. New York: CUP.