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Shake, rattle, 'n' roll: The representation of motion in language and cognition

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The representation of motion in language and cognition

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Abstract

Languages vary strikingly in how they encode motion events. In some languages (e.g. English), manner of motion is typically encoded within the verb, while direction of motion information appears in modifiers. In other languages (e.g. Greek), the verb usually encodes the direction of motion, while the manner information is encoded in modifiers. We designed two studies to investigate whether these language-specific patterns affect speakers' reasoning about motion. We compared the performance of English and Greek children and adults (a) in non-linguistic (memory and categorization) tasks involving motion events, and (b) in their linguistic descriptions of these same motion events. Even though the two linguistic groups differed significantly in terms of their linguistic preferences, their performance in the non-linguistic tasks was identical. More surprisingly, the linguistic descriptions given by subjects *within language* also failed to correlate consistently with their memory and categorization performance in the relevant regards. For the domain studied, these results are consistent with the view that conceptual development and organization are largely independent of language-specific labeling practices. The discussion emphasizes that the necessarily sketchy nature of speech assures that it will be at best a crude index of thought.

1. Introduction

Little within the topic of language so excites the popular imagination as the question of how the forms and content of a particular language might influence the thought of its users. Rightly, this question has come to be associated with Benjamin Whorf (1939; 1941) and Edward Sapir (1941), linguists who, in the first half of the 20th century, investigated the languages and cultural practices of several Native American tribes. As Whorf and Sapir understood, the finding that cultural differences are often mirrored in linguistic differences leaves all causal questions unresolved, but these commentators laid their bets on the languages themselves as the more significant engines of cultural and cognitive disparity. In Whorf's words,

> Language and culture are constantly influencing each other. But in this partnership the nature of the language is the factor that limits free plasticity and rigidifies channels of development in the more autocratic way…We dissect nature along lines laid down by our native languages. The categories and types that we isolate from the world of phenomena we do not find there because they stare every observer in the face; on the contrary, the world is presented as a kaleidoscopic flux of impressions which has to be organized by our minds - and this means largely by the linguistic systems in our minds. (1956, p. 213).

And relatedly, from Sapir:

> Human beings do not live in the objective world alone, nor alone in the world of social activity as ordinarily understood, but are very much at the mercy of the particular language which has become the medium of expression…"the real world" is to a large extent unconsciously built up on the language habits of the group. (1941, p. 75)

It is fair to say that "linguistic determinism" in the sense implied in these quotes virtually vanished from mainstream linguistic and psychological discussion for several decades (though in some weaker versions, often called "linguistic relativity," this tradition has continued to thrive within anthropological linguistics). The replacement approaches have been versions of a universalist perspective that emphasizes cross-linguistic similarities, assigning these to our shared human nature. Noam Chomsky is the leading modern proponent and explicator of this universalist approach to language studies. In the following passage, he presents this vision as perhaps the most serious reason for studying language at all:

> …Language is a mirror of mind in a deep and significant sense. It is a product of human intelligence…By studying the properties of natural languages, their structure, organization, and use, we may hope to learn something about human nature; something significant, if it is true that human cognitive capacity is the truly distinctive and most remarkable characteristic of the species (1975, p. 4)

These two perspectives on the psychology of language and thought could not be more different. Both camps express the passionate conviction that our language and thought are inextricably bound up together; but cause for one camp is effect for the other. The issue is by no means decided. While the universalist view propounded by Chomsky is perhaps still dominant in linguistic circles, there has been something of a Renaissance of Whorfian theorizing in recent psychological discussion. The issue, in fact, is worse than undecided: Even the field of battle is in doubt, as investigators contend about where (in human perception and cognition) linguistic influences might be expected to surface. Worst of all, the very question of language-thought relations is variously definable, with the consequence that present-day investigators struggle even to identify - no less adjudicate - several "stronger" and "weaker" interpretations of the relativist position.

1.1 Choosing the field of battle

The studies we will present in this paper represent an attempt to contribute to this debate by comparing the way that linguistic representations and processes do – and do not – impact and guide other cognitive functions; here, memory and categorization. Any such investigation is perforce topically limited. This raises the specter that we might require a virtual infinity of such studies lest by focusing on any single conceptual or cognitive domain one misses potential influences that, though invisible in the present case, may show up in the very next study that is done. Because one cannot investigate everything, then, there is considerable motivation for picking the ground carefully.

Two interlocking factors seem to have motivated this choice in the earliest psycho-linguistic studies of the Sapir-Whorf hypothesis. First, of course, was that languages show variation on the chosen dimension. Second, there had to be some objective way to measure discrimination for the studied function. An obvious choice was *color* (usually *hue* but sometimes also *brightness*). Languages meet the first prerequisite by differing considerably in their color lexicons (Berlin and Kay, 1969). And physics provides the objective measure of a physical dimension (wavelength and intensity differences in radiant energy within the range detectable by the human visual system) against which human psychophysical performance (color discrimination and categorization) can be assessed. The question can now be posed: Do human psychophysical functions in this dimension vary as a function of the language-specific labelings? That is, do speakers of different languages perceive hue at all differently? Various measures for such a distinction have been taken, e.g. discrimination across hue boundaries (speed, accuracy, and confusability), memory, and comparison of normal versus defective ("color blind") similarity spaces. By and large the results of such investigations have been interpreted as favoring the independence of perceptual and linguistic categorization (see, e.g., Brown and Lenneberg, 1954; Heider and Oliver, 1972; Jameson and Hurvich, 1978). However, recent work from Kay and Kempton (1984) suggests that even for this apparently well-defined perceptual domain, labeling (categorical perception) effects are or are not obtained depending on very delicate choices as to experimental procedures and particular stimulus characteristics.

Even were such issues resolved, studies of color organization do not constitute a fair test of the Sapir-Whorf hypothesis on several grounds. For one thing, the last place

we might expect malleability of human thought is in domains involving sensory representations shared with many non-human species (for discussion, see Lucy, 1992). Moreover, hue does not seem to be so important or central a factor in the life of a culture, excepting maybe the subcultures of art classes and Montessori preschools.

Perhaps more promising as domains within which language might interestingly influence thought are higher-level cognitive representations and processes, for instance, the linguistic encoding of time and aspect, or of object and substance, where linguistic variation is apparent and has by some authors been interpreted as straightforward reflections of underlying differences in thought. An important example is Whorf's discussion of *concessives* in Hopi. Hopi, like many other languages (e.g. Turkish) but unlike English, expresses the speaker's evidence for what he is saying: Did he see it with his own eyes, did he infer it, or does he have it only on hearsay? While Hopi formally distinguishes via different complementizers among these sources of evidence, English speakers

> …fuse the …different types of relationship into a vague sort of connection… Does the Hopi language here show a higher plane of thinking, a more rational analysis of situations, than our vaunted English? Of course it does. In this field and in various others, English compared to Hopi is like a bludgeon compared to a rapier. (Whorf, 1956, p. 85).

Whorf himself didn't provide any systematic evidence that these features really legislated the thought of their users, and this is no surprise. A severe difficulty in

investigating how language interfaces thought at these more "significant" and "abstract" levels has been their intractability to assessment. As so often, the deeper and more culturally resonant the cognitive or social function, the harder it is to capture it with the measurement and categorization tools available to psychologists.[1]

1.2 Space as testbed

During the past several years, a certain consensus has been reached on a domain that may fall suitably between the two extremes of testability and ineffability; namely, spatial motion and location. This is a semantic dimension that (like hue perception) is fundamental to humans as well as all navigating creatures. Even so, the encoding of motion and space varies significantly across languages in ways that can be put under the psychologist's microscope. Much recent work in lexical semantics and psycholinguistics has been devoted to just this issue (see for example Levin, 1985; Talmy, 1985; Jackendoff, 1990; Choi and Bowerman, 1991; Slobin, 1991; 1996a; Bloom, Pederson, Nadel and Garrett, 1996; Levinson, 1996; Pederson, Danziger, Wilkins, Levinson, Kita

[1] Returning for a moment to the topic of hue perception, Lucy (1992) has objected not so much to this perceptual domain itself as a test-bed for linguistic determinism, but rather that psychologists have studied hue terminology independent of its cultural use and significance; he questions the "theoretical vision of a decontextualized 'natural' word-object relationship." (p. 185). For instance, in some communities *purple* is associated with royalty; in others, with rage; in yet others, with prose (perhaps Lucy would not subscribe to these particular examples, but they seem in accord with the gist of his discussion). If this objection holds, then color terminology is the worst of both worlds for learning how language might and might not affect thought – there is no shared conception any more than there is a shared terminology, so one can't hold one of these invariant (or manipulate it) so as to assess its effect on the other. Notice, though, that the more correct Lucy is in adopting this stance the more difficult in general it will be to compare the causal relations amongst three covarying aspects of the human condition: language, social context, and concept. Indeed, much anthropological discussion is to the effect that parsing up the world to study such pieces of it inevitably disguises and distorts that which is to be studied. At the extreme, this stance threatens all positions with immunity.

and Senft, 1998; Gentner and Boroditsky, 2001; Munnich and Landau, in press; Li and Gleitman, 2000; Naigles and Terrazas, 1998).

Some of these studies of spatial encoding investigate relations that obtain between static objects, relations which languages encode quite variously (for example, even a single language may express the same or closely similar spatial relation by lexical items from different classes: Compare *at, abutting, touch*). Others pertain to the linguistic description of events and states of affairs in the observed environment, including their causes, intentions, and goals. As such, these latter seem to us particularly promising testbeds for investigating how language may influence our conceptualizations of the world. Not simply lexical options, the issues here concern linguistic machinery for how entities and their movements and relations are expressed as predicate-argument structures; that is, how motion is syntactically realized.

Accordingly, the experiments in parts 4 and 5 of this paper concern linguistic variability in the representation and expression of motion events. The remainder of this introduction lays out such a variant linguistic property with particular emphasis on the instances of English and Modern Greek (Section 2), and then returns to the question of how this might bear on the relativist/universalist controversy (Section 3).

2. The linguistic encoding of motion events

Consider a simple motion scene: A man is running across the street. Human languages offer the means to parse this scene into a number of distinct encodable parts. For instance, language after language makes it possible to refer to the man separately

from the ground he traverses (the street), to trace his trajectory (crossing), to comment on the details of his movement (running or hopping), to note whether the motion was externally caused or spontaneous (transitivity, *inter alia*), and so forth. The recurrence of certain meaning features in the linguistic description of motion has led to the supposition that the cognitive partitioning of motion events along certain dimensions is "natural," indeed universal (Miller and Johnson-Laird, 1976; Talmy, 1985; Landau and Jackendoff, 1993). On this view, widely accepted within cognitive science, linguistic representations of motion pick out a subset of the spatial-mechanical conceptual distinctions for which humans are cognitively prepared.

At the same time, along with this cross-linguistic identity of encoding there is systematic language-specific variance both in the motion vocabularies of languages, and in the ways that languages conflate the elements of motion events inside grammatical structures. We will concentrate experimental attention on one such distinction in the linguistic encoding of motion events: *the path/manner distinction*. This is a descriptive dimension which strikingly differs even between languages spoken in adjacent places and by peoples who share very similar sociocultural traditions.

2.1 A cross-language difference: The manner-path distinction in motion event encoding

Building on initial suggestions by Talmy (1985), extensive work in lexical semantics has identified and discussed differences in how languages conflate the motion primitives inside the clause. In what we will call **Manner Languages** (e.g. English, German, Russian, Swedish, Chinese), manner of motion is typically encoded in the verb (e.g. *walk*,

run), while path information appears in nonverbal elements such as prepositional phrases (*across the street)*. In other **Path Languages** (e.g. Modern Greek, Spanish, Japanese, Turkish, Hindi), the verb usually encodes the direction of motion (e.g. *cross, ascend)*, while the manner information is (optionally) encoded in gerunds or prepositional phrases. Here are the typical renditions in the two languages we will investigate in the present paper:

(1) English

The man	walked	across	the street.
FIGURE	MOTION+MANNER	PATH	GROUND

(2) Modern Greek

O andras	diesxise	to dromo	(me ta podia).
'the man	crossed	the street	(on foot)'
FIGURE	MOTION+PATH	GROUND	(MANNER)

These are "typical" but not exclusionary ways of speaking (in Whorf's terminology, "fashions of speaking"*)* within languages. Manner languages do have common verbs which encode path information (e.g. English *enter, exit, ascend, descend, cross, turn*). And Path languages have common verbs encoding manner of motion (e.g. Greek *kolibo* 'swim', *trexo* 'run', *peto* 'fly', *xorevo* 'dance'). However, the *preferred* lexicalization of motion events differs in the two language groups. English, for instance, has a rich collection of verbs which convey manner, but not directionality (*slide, roll, bounce, jump,*

stumble, limp, rush, etc.); these verbs can be combined with a large set of adverbial or prepositional elements expressing path (*in, up to, across, out of,* etc.). By contrast, languages in the second group appear to make sparse use of manner-of-motion verbs.[2] In Greek, the task of expressing change of location is mostly taken over by path verbs such as *aneveno* ('ascend'), *kateveno* ('descend'), *beno* ('enter'), *bgeno* ('exit'), which are frequently combined with underspecified prepositions such as *se* ('in'), *apo* ('from'). Furthermore, the use of manner-of-motion verbs in Path languages is subject to an interesting constraint (initially proposed for Spanish; see Aske, 1989; Jackendoff, 1990; Slobin and Hoiting, 1994). Compare the pairs of English and Greek utterances in (3) and (4):

(3) a. The man walked towards the house.

b. O andras perpatise pros to spiti.

'the man walked towards the house'

(4) a. The man walked into the house.

b. *O andras perpatise sto spiti.

*'the man walked into.the house'

[2] Previous discussions have occasionally taken the stronger position that Greek-like languages have restricted motion verb vocabulary *in general* (the discrepancy with English-type languages being stronger in the case of manner-of-motion verbs). For instance, this is the conclusion reached by Sebastián and Slobin (1994) on the basis of a corpus count of attested verb types in English and Spanish narratives. But restricted usage does not necessarily imply impoverished linguistic resources; in order to establish the latter, one would have to perform nothing less than a dictionary count. In fact, even the usage data are equivocal. Naigles, Eisenbeg, Kako, Highter and McGraw (1998), drawing on elicited descriptions of motion, conclude that there is no evidence that Spanish speakers use overall fewer motion-verb types than English speakers.

In (3), a manner-of-motion verb is combined with a path PP which denotes a trajectory with a specific directionality. In (4), the same motion verb appears with a PP which denotes a trajectory with a specific endpoint (located inside the bounded surface of the house). Both structures are acceptable in English, while Greek licenses only the first one. More generally, Greek canonically disallows the co-occurrence of a manner-of-motion verb with a path PP within the same clause when the motion event involves some sort of bounded (completed, traversed) path. Typical examples of such events are entering, exiting, and other instances of crossing over a boundary or an edge of some sort. As a result, the Greek utterance in (4b) lacks the reading according to which the man started out outside the house and ended up inside it.[3] In contrast, in English, the use of a manner-of-motion verb plus a path PP to denote "boundary crossing" motion events is extremely productive:

(5) a. Mary danced/limped into the house.

b. The students drove/bicycled into the forest.

c. The smoke squeezed/swirled through the crack.

It is worth pointing out that the "bounded path" restriction in Path languages is extremely idiosyncratic. First, there is a small class of manner-of-motion verbs that do allow bounded path readings. We estimate that, in Greek, this corresponds to one-third of the set of manner-of-motion verbs. However, it is not clear why verbs such as *sernome* ('crawl'), *pido* ('jump'), *trexo* ('run'), *mazevome* ('squeeze oneself'), or *ormo* ('rush') allow

[3] (4b) can have a reading on which the man is changing location while remaining within the house. In this case, the PP gets a purely locative interpretation.

bounded path readings but the majority of manner-of-motion verbs including *jlistro* ('slip'), *xorevo* ('dance'), *busulo* ('crawl on all fours'), *kolibo* ('swim'), or *kano ski* ('ski') do not. Second, under certain circumstances the restriction may be waived. For instance, *O Jannis petakse stin Evropi* ('John flew to Europe') is unacceptable on a bounded path reading (assuming, e.g., that John traveled from the States); however, *O Jannis petakse sta urania* ('John flew to heaven') is a perfectly acceptable (albeit figurative) way of conveying that John was overjoyed. Third, even though several (and possibly all) Path languages appear to pose a similar constraint, synonyms across languages do not necessarily behave identically with respect to the restriction. Thus, French allows *slipping into the closet,* while Greek does not (cf. Yoneyama, 1986 for Japanese; Carter, 1988 for French; Aske, 1989 for Spanish; Napoli, 1992 for Italian; Narasimhan, 1998 for Hindi).[4]

Despite the idiosyncrasies and fuzziness of the bounded path constraint,[5] its immediate consequences are easy to appreciate: Greek (and possibly all Path languages) lacks the option of linguistically packaging complex motion events in the compact way presented in (5a-c). As a result, there are three alternatives available for Greek speakers

[4] The presence of the bounded path restriction raises many interesting issues at the syntax-semantics interface. For instance, it presents a problem for the widely accepted assumption that verbs which are (near) synonyms map onto the same set of configurations in the syntax (or that a verb's semantics determines its argument structure in a way which is both uniform and universal). For some solutions, see Jackendoff (1990), Levin and Rapoport (1988), Levin and Rappaport Hovav (1995).

[5] How can such a constraint be explained? One possibility would be to link it with another well-known difference among Manner and Path languages. Consider certain pairs of verbs such as *beat-mix, wipe-clean, drag-bring*, in which the first verb denotes the manner and the second the direction/endpoint of an action. In English and related languages such as German or Dutch, it is possible to use such manner verbs in resultative constructions (Levin and Rappaport Hovav, 1992): *She beat the mixture smooth, She wiped the slate clean*. Such constructions are disallowed in Greek and other Path languages such as Hindi and Spanish. More generally, the Path class seems to dislike resultative non-verbal predicates, such as *She laughed herself senseless, She kicked the door open, She talked us into a stupor* (a fictive-motion case), where result is conflated with manner within the same clause. Still, there are complications: Korean, a Path language, has both resultatives and the boundedness constraint. For some suggestions about why Korean might actually belong to a mixed typological class, see Choi and Bowerman (1991).

for expressing culminated motion: they can select a path verb and express the manner-of-motion information as a modifier; they can break down the event into two separate clauses; or they can use a path verb and omit manner information altogether. Thus in Greek, the information communicated by the English utterances in (5a-c) can be conveyed by (6a-c) respectively:

(6) a. I Maria bike sto spiti xorevontas...
'Mary entered into.the house dancing...'

b. I fitites odifisan ke bikan sto dasos.
'The students drove and entered into.the forest'

c. O kapnos bgike apo ti sxismi.
'The smoke exited from the crack'

The manner-rich alternatives in (6a-b) are cumbersome, so unless there is specific reason for manner information to be mentioned, the preferred lexicalization of culminated motion in Greek involves simply the expression of direction as in (6c). The bounded path restriction thus indirectly contributes to the limited use of manner-of-motion verbs in Path languages.

2.2 Navigating between Path and Manner languages: Problems of translation

A first indication that the path/manner distinction "matters," in terms of how a scene is to be conceptualized and represented is that translators notoriously run into trouble on

this issue. For one thing, as we saw, literally translating a manner verb onto a Path language characteristically requires inclusion of optional information ("by foot," "swimming") that is obtrusive or stilted. Slobin (1996a) provides a very useful and psycholinguistically relevant analysis of such translation glitches. He showed (using the English-Spanish contrast in describing movement in space) that the greatest source of difficulty for Spanish translators was to retain an accurate version of the manner-of-motion descriptions of the English original. English translators could with lesser effort be more faithful to the Spanish text. In general, the prominent structural patterns of the two languages gave rise to different ways of packaging information in the text. While English allowed greater conflation of motion elements in a single clause, Spanish allocated them more sparsely in separate clausal forms. Moreover, English translators were found to add manner information to the Spanish original, while Spanish translators often omitted manner information provided in the English text.

Greek patterns with Spanish in this respect. Consider the following examples. The first two come from the Greek translation of *The Hobbit* (Tolkien, 1982), the last pair from the English translation of a Greek novel, *Achilles' Fiancée* (Zei, 1991):

(7) a. ...and most of them were hustling back...

b. ...arxisan na opisthoxorun ke na trexun parapatontas piso...

'started to back off and to run stumbling back'

(8) a. ...they stumbled into a big cavern.

b. ...eftasan parapatontas mesa s' ena megalo spileo.

'arrived stumbling in to a big cavern'

(9) a. ...ixe bgi xoris kaltses....

'(she) had exited without stockings'

b. ...She'd come out without stockings....

(10) a. ...aneveni tis skales...

'ascend the stairs'

b. ...climb the stairs...

(7)-(8) illustrate the familiar pattern of clause conflation (manner verb plus path PP) which is available in English but dispreferred or impossible in Greek: the translator accommodates the informational demands of the text by adding separate clauses to the description. (9)-(10) give an illustration of how English encoding preferences find their way into the translated text either by reorganizing or by adding information to the target text. But all too often the translation job is botched or at best awkward. The manifest difficulties of rendering an event description "in exactly the same way" is a first hint that, after all, the forms of language itself may constrain and restrict how we conceptualize the flux of bodies located in and moving through space.

2.3 Elicitation studies of the path-manner typological distinction

What goes for translators seems to go for ordinary users as well. Several recent

studies show that speakers of Path and Manner languages characteristically describe different aspects of the same motion scenarios. These studies compare the linguistic behavior of adult speakers (usually of Spanish versus English) in a variety of tasks involving the description of pictorially presented motion scenes. The findings reported by Slobin (1991), Berman and Slobin (1994), and Naigles, Eisenberg, Kako, Highter and McGraw (1998) confirm that English speakers tend to describe motion with manner verbs, while Spanish speakers use predominantly path verbs. As we have implied earlier, this is no mere tautology: English certainly has path verbs and Spanish certainly has manner verbs and these subjects are free to use them. Perhaps (see again footnote 2) there is not even a numerical difference in how many such verbs "exist" in these two languages. Yet speakers let loose to speak of a depicted series of events make choices among these available linguistic resources that conform to the typological distinction that is made by linguists and that discomforts the translators: just the kind of *habitus*, or preferred usage, distinction of which Whorf famously made us aware. These preferences among available linguistic options confirm the potency of the path/manner distinction in general, and also its finer details. Spanish speakers in these studies are even more likely to use path verbs when there is a bounded path. And they use more bare path and manner verbs than English speakers (see also Naigles and Terrazas, 1998). Similar preferences are attested in a corpus of children's narratives: after surveying this body of data, Sebastián and Slobin (1994, p. 262) concluded that, in Spanish, "manner is rarely attended to, at any age".

3. Mental organization and the language of space

3.1 Previous proposals

The findings just cited interface only tangentially, if at all, with full-blooded Sapir-Whorf doctrines of linguistic determinism: The position (sometimes expressed by Slobin as "thinking for speaking") that learners (and adult speakers) mobilize language-specific categories so as to talk and understand is not controversial and is explicit in any information-processing approach to speech and comprehension, at all levels from lowliest to highest. After all, the very musculature of the vocal tract must be mobilized differently to express the same concepts, from language to language. One must round the lips in Greek (*arostos)* to speak of illness, but not so in English. Just so, as Slobin notes, the thoughts about the things and their comings and goings need to be organized in accord with the word-forms and the phrasal organizations of the particular tongue if its users are to speak at all.

However, it is possible to take a much stronger stand; namely, that such variations have a pervasive effect on nonlinguistic thought. It is often a short hop from noticing that linguistic usage differs crosslinguistically to drawing nonlinguistic implications. Berman and Slobin (1994), commenting on possible consequences of the cross-language path/manner distinction, suggest that "…children's attention is heavily channeled in the direction of those semantic distinctions that are grammatically marked in the language" (p. 622). Similarly, in a study of English and Korean motion expressions, Choi and Bowerman (1991) suggest that the expression of conceptual elements (such as path) in

the linguistic input may prompt or encourage children to pay special attention to them. For instance, Spanish or Greek children might especially notice paths upon encountering motion scenes; by contrast, the absence of clear and consistent linguistic marking of path might delay formation or deployment of the relevant conceptual distinctions in Manner languages.

3.2 An experimental prospectus: Issues and predictions

There is certainly plausibility in the idea that differences in the linguistic encoding of motion events will have nonlinguistic effects on both learners and mature users. After all, even within a language the very same motion event is variably describable and perhaps concentrates the mind's eye on different aspects of it. For instance, *The mouse chased the elephant* and *The elephant fled (from) the mouse* describe the same action scenario and yet the two sentences bring the mouse and the elephant into differential focus (Gleitman, 1990; Fisher, Hall, Rakowitz and Gleitman, 1994). What if, in this or a related regard, two languages disagreed *systematically and regularly* on how to frame events? Might this not train users to represent the world of locations and movements, actions and re-actions, doers and done-to's in contrasting ways? It certainly has seemed plausible to many recent commentators that such crosslinguistic encoding preferences would influence the construction of cognitive categories during, and as a consequence of, learning. Gentner and Boroditsky put it this way:

> Verbs and other relational terms – including those concerned with spatial relations – provide framing structures for the encoding of events and experience; hence a linguistic effect on these categories could reasonably be expected to have cognitive consequences (2001, p. 247).

But reasonableness is not sufficiency, as Gentner and Boroditsky also acknowledge. The claim that language influences nonlinguistic thought can never be decided by pointing to the linguistic facts alone. Granted that speakers of Path and Manner languages habitually *talk* differently. Granted therefore that their listeners would have to recover representations of the reference world from these variant language-specific encodings (as in Slobin's formulation). It still remains to ask whether the cognitive structures and representations achieved would vary too.

3.2.1 Recall and categorization in Greek versus English. In the studies now presented, we will try to provide some evidence about whether such effects of language on nonlinguistic cognition actually exist in the motion domain. Specifically, we ask whether the systematically differing preferences between English and Modern Greek in expressing paths and manners affect the way their speakers remember and classify motion events. Furthermore, we investigate whether such nonlinguistic performance is affected by degree of exposure to the target language. We do this by comparing the behavior of children and adult speakers of the two languages – who have been infected, so to speak, with their native tongues for varying lengths of time.

What particular effects (if any) should we expect the path/manner distinction to have on conceptual structure or processes? One prediction could focus on the lexical verb

itself as the "informationally privileged" element, the expressive locus that will have memorial or categorization effects. After all, it is the lexical encoding preferences of the verb that provide the very name for the Path-Manner typology. Moreover, as we saw (examples in (6)), very often the path-language speaker will omit mention of manner altogether; therefore manner descriptions are not constructed "for speaking" as regularly for these languages as for manner-verb languages. On either or both such grounds, we might expect that path-language speakers must be specially sensitive to the path, manner speakers to the manner. This guess at a cognitive consequence has been the stance adopted by commentators we cited earlier: The fact that path-verb speakers often *omit mention of manner* might be interpreted to suggest they *don't attend to manner properties* of observed motion scenarios (in Spanish, "manner is rarely attended to, at any age", Sebastián and Slobin, op.cit.).

Just as reasonable, however, is the hypothesis that speakers of manner-verb languages will be more sensitive to path. According to such an argument, the path is exhibited independently ("foregrounded") on the surface of the motion verb sentence in manner-verb languages (*into the cave*) rather than being hidden and wrapped up inside the meaning of the verb. Conversely the manner is foregrounded in path-verb languages in gerunds etc. (*xorevontas* – 'dancing') and often gets its own clause (cf. the examples in (6); for discussion of this perspective, see also Talmy, 1985). So long as there is a measureable relation between the language spoken and performance on cognitive tasks, in either direction, this can be interpreted as suggestive of a "Whorflike" effect. Specifically, the experiments and analyses next reported are designed to examine four hypotheses:

Hypothesis 1: **Greek and English speakers express path and manner differently in tasks that require them to describe a depicted motion scene**. This is simply a replication of studies and analyses we have mentioned earlier. It means no more (and no less!) than that Greek speakers speak Greek and English speakers speak English. But this replication is required in order to show that, using our own materials and instructions, the two populations will diverge in their speech forms according to broad linguistic-typological styles. Our analyses will go beyond the main verb to consider also the full system used in each language to describe the motion events (cf. language-specific "patternments", Whorf, 1956). This is important because, as we have seen, while Greek speakers are unlikely to express manner of motion in the main verb, they often do so in modificational phrases or in immediately succeeding clauses.

Hypothesis 2: Memory and/or categorization performance for motion depictions will vary for speakers of the two languages. This is the linguistic-relativistic prediction. On this account, differences between Manner and Path languages in the frequency and salience with which path versus manner is encoded should result in systematic differences in how people in each language group attend to and process path versus manner information in non-linguistic cognitive tasks. In contrast, if we find that Greek and English speakers fall together in their memorial and categorization performance (while differing in their linguistic performance, Hypothesis 1), this is suggestive of the opposed universalist prediction.

Hypothesis 3: Because the language patterns (both the lexical items themselves, and their prototypical contexts of use) are learned, we expect to see manner/path expression to diverge more strongly in adults than in young children, within a

language community. The idea here is that younger speakers may utter only a few, quite general, verbal items with typological differences becoming manifest only as the stock of lexical items increases.

Hypothesis 4: Because the language patterns and their prototypical contexts of use are learned, nonlinguistic consequences (here, memory and categorization performance) will diverge progressively over age. A similar position can be found in the influential studies of John Lucy (1992b; Lucy and Gaskins, 2001) whose Tzeltal-speaking and English-speaking subjects behave similarly in cognitive tasks until about the age of nine, whereupon they diverge in ways that Lucy assigns in large part to growing expertise with the fine structure of the two languages.[6]

Here is a description of how these hypotheses interact so that we can examine the relation between motion verb encoding and motion conceptualization crosslinguistically: Hypotheses 1 and 2 compare and contrast the linguistic and nonlinguistic behavior of monolingual adult speakers of the two languages, while Hypotheses 3 and 4 compare and contrast the learning functions in these regards. Crossing these pairings, Hypotheses 3 and 1 respectively examine the growth of the linguistic property (manner/path) and its steady-state form in the adult languages, while Hypotheses 4 and 2 respectively examine the growth (or nongrowth) of the conceptual property (manner versus path biased similarity spaces) and its steady state in adults in the two language/cultural communities.

3.2.2 Recall and categorization as a function of task upon task (Encoding effects): Each subject in these experiments performs two tasks. One is to verbally describe a motion scene. The other is either to recall that scene (Experiment 1) or to match it to

[6] Lucy's discussion concerns the object/substance distinction.

another scene (i.e. to categorize it; Experiment 2). The order of the tasks varies in the two experiments. But in both cases, performance on the first task may well influence performance on the second. We assess such task-to-task influences in each experiment by means of an item analysis that collapses across language.

4. Experiment 1: Recognition memory

4.1 Participants

Participants were monolingual native speakers of either English or Modern Greek grouped into three age groups. The Young group included 38 English-speaking children between 4;2 and 6;0 years (mean age 5;3) and 38 Greek-speaking children between 4;4 and 7;2 years (mean age 6;2). The Middle group included 39 English-speaking children between 10;4 and 12;8 years (mean age 11;3) and 39 Greek-speaking children between 9;9 and 12;3 years (mean age 10;0). Finally, the Adult group included 20 English-speaking adults between 19;2 and 34;6 years (mean age 24;0) and 21 Greek-speaking adults between 18;1 and 50;8 years (mean age 29;7). Some of the English-speaking adults received course credit for participating.

4.2 Method

4.2.1 Materials

The stimuli for Experiment 1 consisted of a set of 8.5" × 11" black-and-white drawings adapted from Mayer's (1969) well-known frog stories for children. These items were chosen because their vivid illustrations of motion scenes have been used successfully in previous studies to elicit verbal descriptions of movement from both children and adults across a number of languages (Berman and Slobin, 1994). For the purposes of this study, the original pictures were redrawn by an artist to simplify the scenes by removing possible distractors (Figure 1, panel 1.1 and Figure 2 panel 2.1). We also created variations of each scene by systematically altering either the path or the manner of the original movement. For example, to create a path variation, one of the original pictures showing a frog hopping into a room was altered to depict the frog hopping out of the room (Figure 1, panel 1.2). To create a manner variation, a picture showing a boy jumping over a log was changed to show the boy tripping over the log (Figure 2, panel 2.2). Alternative versions of the same drawing varied only in terms of path or manner of motion; all other details such as background or facial expressions were kept constant and neutral.

[INSERT FIGURE 1 HERE]

[INSERT FIGURE 2 HERE]

The original stimulus set included 6 target pictures, each of which had one or both of the possible variations. Two of the targets failed to elicit motion descriptions from nearly all subjects. Moreover, subjects were not able to detect alterations to these two targets at a level that was above chance. Because these items did not yield informative data, we

excluded them from all subsequent analyses. The final set of 4 items with their respective variations is as in Table 1.

[INSERT TABLE 1 HERE]

4.2.2 Procedure

Participants were tested individually by a single experimenter in two sessions two days apart. All sessions were conducted in the participants' native language. Children were interviewed in a quiet room in their regular school or an after-school setting. Adults were interviewed in a number of locations that were convenient for them, including home or school. During Session 1, subjects were presented with the set of target pictures (one at a time) and asked to describe them. In Session 2, subjects were presented with a second set of pictures (again one at a time). The experimenter told the subjects that these pictures could be either the same as the ones they had seen in the previous session or something could have been changed on them; participants were then asked to judge for each picture whether it was the same or different.

Each of the pictures in Session 2 could be identical to the original, or a path/manner variation. Two of the target pictures had only one variation each (manner for Picture 1 and path for Picture 2). For these pictures approximately half of the participants in each language/age subgroup saw the unchanged picture in Session 2, while the other half saw the altered version. The other two target pictures (Pictures 3 and 4) had both variations. In these cases approximately one-third of the participants in each language/age subgroup

saw the unchanged picture; one-third saw the manner variant; and one-third saw the path variant. The total set of possible Session 1-Session 2 pairings yields ten trial types, of which each participant received only four (since they saw only one of the analogues of each of the four target pictures). The ten trial types were systematically distributed across each of the language/age subgroups. The order of presentation of the four items given to each subject was randomized and counterbalanced across subjects for both sessions.

4.2.3 Scoring

Any given trial can be classified as representing No Change from the original picture, a Path Change, or a Manner Change. Because of the way trials were distributed across individual subjects, participants received different numbers of each type of trial. Three separate dependent measures were derived by calculating by participant the proportion of correct judgments made on the recognition task for each of the three trial types.

4.3 Results

4.3.1 Analysis of linguistic descriptions (Main Verb)

To see whether Greek and English speakers do, in fact, differ in their linguistic descriptions of the pictures they viewed during the first session, we coded the main verb in each description as either Manner, Path, or Other. In order to perform an Analysis of Variance we derived a dependent measure that was the total number of items on which a

speaker used a Manner verb as a main verb.[7] A two-way analysis of variance was performed on this measure with Language (Greek vs. English) and Age Group (Young, Middle, Adult) as the independent factors. There was a main effect of Language ($F(1, 193) = 67.234$, $p = .0001$), but no effect of Age Group and no interaction. English speakers used a manner verb as the main verb on a mean of 3.60 out of 4 items, while Greek speakers used manner verbs on a mean of 2.86 items. Correspondingly, Greek speakers were much more likely to use path verbs as the main verb, as is shown in Table 2.

[INSERT TABLE 2 HERE]

4.3.2 Analyses of recognition task scores

Recall that on the recognition task, each trial could involve No Change from the drawing shown in Session 1, a Path Change, or a Manner Change. Because different subjects received different numbers of each kind of trial, we calculated a score summarizing the proportion correct for each subject for each kind of trial. A separate two-way ANOVA with Language (Greek vs. English) and Age Group (Young, Middle, Adult) as independent factors was performed on each of the three dependent scores for the recognition task (i.e., on proportion of correct judgments on Manner Change trials, on Path Change trials, and on No Change trials). There was no main effect of Language on

[7] The decision to count manner rather than path verbs is essentially arbitrary. Since there were relatively few verbs that could not be coded as either Manner or Path verbs (6.25% for the Greek speakers and 3.5% for the English speakers), the pattern for Manner verbs is almost the inverse of the pattern for Path verbs.

any of the three measures; nor did Language enter into a significant interaction with Age Group. Figure 3 illustrates the absence of a Language effect on participants' ability to detect whether or not the path or manner was altered. There was a main effect of Age Group on the proportion of correct judgments on trials in which the Manner was altered ($F(2, 132 = 9.209, p = .0002$), with children in the Young age group scoring significantly lower (mean = .389) than either children in the Middle age group (mean = .710) or the Adult group (mean = .679) ($p < .05$, Games-Howell post hoc test). There was no similar main effect of Age Group for trials involving Path Changes.

[INSERT FIGURE 3 HERE]

4.3.3 Collapsing across language: An item analysis for potential encoding effects

The subject entered into the experimental setting just described by being confronted with a picture, which he or she visually inspected and, presumably, mentally represented. This initial encoding of a picture could have two interrelated effects: First, if the subject encoded the scene under a path representation this might cause him to describe it with a path verb (e.g. *The frog is entering the room).* And second, that very encoding and verbal description might survive over the two-day interval and impact the memory performance. On this hypothesis, encoding performance predicts memory performance but is not a language-specific (that is, "Whorflike") effect: It would occur in both languages, for sometimes an English speaker did utter a path verb and sometimes a Greek speaker

An analysis using Path verbs rather than Manner verbs as the dependent measure yields analogous results with the same significance levels.

uttered a manner verb. Such an effect can be extracted from our data set by an item analysis that collapses across language. The statistical question is this: Suppose we index the subject's initial representation of the scene by his/her verbal description, i.e. if s/he describes a particular item with a path verb we will now assume that this reflects the way s/he mentally encoded what s/he saw. In that case, will s/he be more likely to notice a path-change alteration two days later; and *mutatis mutandis*?

To evaluate this question, we had to analyze for encoding effects taking into account the several ways in which the speaker could have expressed the path and manner elements in the depicted scenes. This meant going beyond the main verb to consider the total information provided by the speakers' responses. To do so we summarized the verbal descriptions elicited in this experiment in a coding scheme which included Path-Only, Manner-Only and Combination patterns. The Path-Only class included either bare path verbs or a path verb plus a path modifier; the Manner-Only class contained either bare manner verbs or a manner verb plus a manner modifier. The Combination class included a variety of cases in which the relevant aspects of the semantics of the verb differed from the type of information encoded by the modifier; moreover, it included multi-clausal responses which contained both a manner and a path verb (with or without additional modifiers). We excluded from this analysis descriptions with stacked path or manner verbs (since they may have included modifiers of a different semantic type than the verb) and irrelevant (non-motion) verbs (the combined proportion of these two constructions was relatively low). Table 3 gives a summary of the coding scheme with some examples from both languages.

[INSERT TABLE 3 HERE]

We now asked quantitatively whether the overall kind of motion information in the linguistic descriptions produced by our participants predicts their memory scores by performing separate Chi-squared analyses on each item. Each analysis asked whether there was a systematic relationship between the kind of information a speaker had included in his/her verbal description on that item (Path-Only, Manner-Only, or Combination) and his/her memory performance on the same item, in case that item involved a Path or Manner change in session 2. If linguistic encoding has a systematic effect on non-linguistic cognition, then we should expect that Path-Only verbal descriptions should be associated with more accurate detection of Path changes and Manner-Only verbal descriptions should be associated with more accurate detection of Manner changes. (Verbal descriptions that combine Path and Manner information would not be expected to be predictive of performance.) We used Chi-squared analyses to detect whether there is any kind of systematic relationship between the two variables. There were no significant effects: Whether or not a subject had originally described an event in path or manner terms failed to be predictive of a difference in memory for path or manner.

4.4 Summary

The speakers of Path and Manner languages differed in their likelihood of describing motion scenes with path versus manner verbs (Hypothesis 1 was supported). The

question was whether such differences in verbalization in Session 1 would predict memory performance during Session 2. We assessed this question in two ways, relevant to two interpretations of what such a correlation would mean. First, we asked whether speakers of the Path language would be more likely to utter path verbs and also more likely to remember path alterations; and *mutatis mutandis* for the speakers of the Manner language. Such an effect would be a function of specific language (English versus Greek) and independent of specific item consistency, a potentially Whorflike effect. We found no such effect for either children or adults (Hypotheses 2 and 4 received no support). Second, we asked by means of an item analysis that collapsed across the two language groups whether the subject's original encoding of the scene (as indexed by his or her entire verbal description, i.e. choice of path or manner information, or a combination thereof) would influence memory for that scene two days later (as indexed by that subject's recognition of a path or manner alteration in the new picture). Such an effect would be independent of language, appraising the subject's within-item consistency. Again, no such effects were found.

5. Experiment 2: Categorization

Several factors of design and measurement restrict interpretation of the results just presented. The picture-set was small, and it is possible that the static pictorial format made the recovery of path information somewhat harder than that of manner information.[8] For these and related reasons, differences between languages in the verbal

[8] The fact that it is hard to identify paths from single static depictions of motion was probably the reason two of our initial items caused trouble for our subjects (and ultimately had to be discarded). As we will

description of motion were not as pronounced in this experiment as patterns reported more generally in the literature. Specifically, both groups seemed to focus on manner more than any other dimension of movement, even though English speakers were more likely to express this information in the main verb of their utterance than Greek speakers (see Naigles and Terrazas, 1998, for a similar finding, and discussion). Third, although participants generally scored above chance on the recognition task, the error rate was high. These limitations required further experimentation to resolve.

We therefore carried out a new experiment to investigate whether the path-manner distinction enters into subjects' categorization of motion events. If two motion events are the same in path, are Greek speakers more sensitive to this than English speakers? And if two motion events are the same in manner, does this similarity count for more among the English speakers than among the Greek speakers? This time motion events were represented in the more dynamic format of sequences of pictures and the task was categorization rather than memory.

5.1 Participants

Participants were monolingual native speakers of English and Greek who fell into two age groups. One group comprised 22 Greek-speaking 8-year-olds (range 7;2 -9;2 years; mean 8;4) and 14 English-speaking 8-year-olds between (range 7;5 -10;0 years; mean 8;11). None of the children had participated in Experiment 1. The second group comprised 21 Greek-speaking adults between 18;1 and 50;8 (mean 29;7) years of age

show in Experiment 2, sequences of pictures can solve this problem. For instance, in the present design of Experiment 1, subjects would have been able to infer the direction of motion (whether the boy was

and 20 English-speaking adults between 19;2 and 34;6 years of age (mean 24;0). These were the same subjects who participated in Experiment 1. They completed the categorization experiment immediately after Session 2 of the memory experiment (and before the debriefing session).

5.2 Method

5.2.1 Materials

Materials consisted of a picture-book containing 8 sets of motion scenes. Each set consisted of three motion scenes in a match-to-sample format with one sample and two choices. The sample scene was presented on the left-hand page of the picture-book and the two choice scenes were presented on the opposite page. The choices had the following property: one of them preserved the path given in the sample while changing the manner of motion (the '*same-path* variant'); the other preserved the manner of the sample while changing the path (the '*same-manner* variant'). For instance, one of the sample scenes depicted a man running up the stairs. The same-manner variant for this case showed the same man *running down a hall*, while the same-path variant showed the same man *walking up the stairs* (see Figure 4).

[INSERT FIGURE 4 HERE]

To make dynamic information about both path and manner more accessible, we used a sequence of digital color photographs (rather than a single drawing) to depict each

climbing up versus down the tree) had there been a series of pictures depicting the progress of the motion.

motion event. The sample as well as each of the choices consisted of a three-photograph sequence depicting the beginning, middle and end of a unified action. For instance, as shown in Figure 4, the event of a man walking to a bookcase was broken down into three sub-events: starting to move towards the bookcase, moving through the middle of the room, and arriving at the bookcase. All the events within each set involved the same animate protagonist (a man or a dog), or the same moving object (an airplane); an effort was made to keep the surroundings in all scenes as uniform as possible. A full list of stimuli is given in Table 4.

[INSERT TABLE 4 HERE]

The 8 items were arranged in two randomized orders, the second being the inverse of the first. These orders were counterbalanced across subjects within Language and Age groups. The presentation position of same-path vs. same-manner choices (top or bottom of the page) was counterbalanced across items in one fixed order.

A practice item depicted a non-motion event, of a man reading a book on a couch. In one of the choices, the man was shown sitting on the same couch drinking water, while in the other choice he was sitting on the stairs reading the same book. The practice trial was intended to emphasize that the matching decision should not be made on the basis of general similarity to the sample, but on the basis of similarity of action. This was important especially for our younger subjects.

5.2.2 Procedure

Participants were tested individually by a single experimenter. All sessions were conducted in the participants' native language. Children were interviewed in a quiet room in their regular school or after-school setting. Adults were interviewed in a number of locations that were convenient for them, including home or school. Subjects were first presented with the practice trial and were asked to select the choice in which the man was "doing the same thing" as in the sample. If a subject chose incorrectly, the experimenter pointed out the mistake and reminded the subject to pay attention to the details of the actions.

The interview then proceeded with the test trials with the same instruction on each trial (to select the choice in which the agent is doing the same thing as in the sample). Notice that now (as opposed to the practice trial) either choice is "correct". Panel 4.2 of Figure 4 shows the actor "doing the same thing" because he is still running. But panel 4.3 of Figure 4 also shows him doing the same thing because he is still ascending. After all trials were completed, participants were asked to describe each scene verbally. No restrictions were placed as to the appropriateness or length of description. Most subjects gave a one- or two-utterance response. Delaying the verbal description until after the categorization performance was so as to avoid contaminating the latter by any mechanism that would favor consistency (e.g. a recency or priming effect).

5.3 Results

5.3.1 Analysis of linguistic descriptions

5.3.1.1 Main Verb. The main verb in subjects' descriptions of the pictures were coded as Manner, Path, or Other. (If a response included two main verbs from different classes, this response was also coded as "Other"). A dependent variable was created by summing the total number of items (out of 8) for which the main verb was coded as Manner. This variable was then used in a two-way ANOVA with Language Group (Greek vs. English) and Age Group (Children vs. Adults) as the independent variables. The analysis revealed a main effect of Language Group ($F(1, 73) = 217.536$, $p = .0001$), with English speakers using manner verbs on an average of 5.029 items compared to 1.419 items for Greek speakers. There was also a main effect of Age Group ($F(1, 73) = 13.011$, $p = .0006$). Adults used more manner verbs in describing the sample photographs (mean = 3.585) than children did (mean = 2.361). The Language Group by Age Group interaction yielded a significant effect ($F(1, 73) = 17.541$, $p = .0001$). As illustrated in Table 5, the interaction was due to the fact that English adults and children differed from each other, while the English adults used more manner verbs, but Greek adults and children using manner verbs with similar frequency. As the table also shows, English children used fewer manner verbs than English adults but more manner verbs than either Greek children or Greek adults.

[INSERT TABLE 5 HERE]

A corresponding analysis was done using the total number of Path verbs produced by each participant as the dependent variable. Because of the low percentage of responses coded as "Other," the Path data are essentially the complement of the Manner data. The same ANOVA using the Path verb dependent variable yields the same pattern of results with similar probability values (see Table 5 for the mean scores for both Path and Manner verb usage by children and adults in the two Language Groups). The overall pattern of results shows that for the set of items used in this study, speakers' linguistic descriptions parallel the familiar patterns of Manner and Path languages.

An age-related effect was obtained only for the English speakers, with the English children showing a less differentiated pattern, using manner and path verbs[9] about equally. On the basis of this, we might expect, following the Whorfian reasoning, that English adults will be more "infected" by the preferences of their language and will show a stronger bias for manner in the nonlinguistic categorization task than English children. The Path-language pattern already appears to be well-established in the Greek children, but it is still possible that a path bias in nonlinguistic categorization will be stronger for adults due to their extended exposure to the language pattern.

5.3.1.2 Overall motion descriptions. The previous analysis was limited to categorization of the main verbs. Here we consider the range of verbal descriptions when modifiers and second clauses are also taken into account. This analysis gives perhaps a fairer picture of the extent to which the two language groups are more "path-oriented" or "manner-oriented" in their verbal renditions of motion events, when all the descriptive devices (not just the main verb) are considered. Table 6 shows the frequency of these patterns in the total set of utterances (i.e. the descriptions by all subjects of all samples

and variants for all 8 sets - a total of 24 responses for each of 77 subjects = 1848 responses). Following the coding scheme laid out in Experiment 1, the linguistic descriptions are grouped into three major superordinate groups: Path-Only, Manner-Only and Combination. As is clear from Table 6, English and Greek make different use of a range of structural and semantic possibilities, largely as a function of their preference for path/manner main verbs and their tolerance of various conflation patterns. For instance, the table reveals that the single most frequent pattern in English consists of a manner verb plus a path modifier, which accounts for almost 60% of verbal descriptions of motion. Greek speakers are much more likely to use a two-clause response to describe a complex event than English speakers (who can use more compact ways of information packaging). At the other end of the range, Greek speakers are also more likely to use bare verbs of either the path or the manner variety (this tendency is especially strong in the case of younger speakers).

Overall, English speakers produced descriptions that contained both path and manner information on 67.6% of their utterances, compared to 43.2% for the Greek speakers. Path-Only descriptions were predominant among Greek speakers (40.6% of utterances vs. 21.4% for English speakers). Both Greek and English speakers produced relatively few Manner-Only descriptions (6.7% and 4.3% of utterances respectively). We see then that in the present more liberal definition of path expression versus manner expression the results of the earlier analysis (Section 2.1) hold up. Greek speakers are verbally "less mannery" than English speakers.

[INSERT TABLE 6 HERE]

[9] A large majority of the path verbs used by English speaking children are instances of *come* and *go*.

5.3.2 Categorization preferences

5.3.2.1 Effects of language and age on choice in the categorization task. To analyze categorization preferences, we created a dependent variable consisting of the total number of trials on which participants chose the Manner variant as the best match to the sample.[10] A two-way ANOVA with Language and Age Group as the independent factors performed on this dependent variable yield no main effects and no interaction between Language and Age Groups. Both English and Greek speakers, whether children or adults, chose same-manner variants on approximately half of the trials and same-path variants on the other half. As Figure 6 illustrates, while English and Greek speakers show a pronounced difference in the types of verbs they use to encode motion events, this bears no relation to how they categorize the same events: Greek and English speakers are indistinguishable in their categorization preferences.

5.3.2.2 Effects of categorization choice on linguistic choice. Recall that in Experiment 1 we asked (by collapsing by verbal description, across language) whether the subject's original verbal description, no matter her native language, was related to subsequent memorial performance. That is, would having uttered, say, a Path-Only description to describe the event, increase the likelihood that this subject, for this item, would show enhanced sensitivity to alteration in its path? Such task-on-task effects would by no means have been implausible to find, but there were no such item effects in Experiment 1. Here, where the categorization task precedes the verbal description, we can again ask the question whether there are task-on-task effects: Did the way the subject categorized the Sample item (as indexed by his choice of variant) predict subsequent

verbal description? We performed such an analysis using the overall verbal description (Path-Only, Manner-Only) of the Sample item, by item, and collapsing across language, performing separate Chi-squared analyses on each of the 8 items. Rather to our surprise, these analyses yielded no reliable support for the hypothesis that the subject's initial encoding of an individual scene (indexed by the categorization performance) influenced the later verbal description.[11]

5.3.3 Can we torture the data?

So far, our analyses have indicated that classification choices were correlated neither with stable typological patterns, nor with item-by-item preferences in linguistic encoding. We now turn to a final, even more specific analysis. Suppose that a speaker produced the *identical* verb in her description of both the Sample and the same-path variant, but not for the same-manner variant. Would that speaker turn out, on average, to have also – for this item – chosen the same-path variant in the categorization task?

To find out, we tested whether manner verb matches (identical verb uttered by the subject to describe the Sample and its manner-matched variant) were more closely associated with manner categorization preferences and path verb matches were more closely associated with path categorization preferences.[12] This was done in a series of

[10] Because the task was a forced choice between two alternatives, one could equally well use the number of trials on which the Path variant was chosen as the dependent variable without affecting the pattern of the results.

[11] For 6 of the 8 items there was no significant relationship of any kind. For the two items where there was such a significant relationship, one was consistent with the hypothesis and the other contradicted it.

[12] In verb matches (a) the sample and only one of the variants shared the same verb; (b) neither the sample nor the variant contained any other verbs; (c) other clausal components (modifiers, etc.) of the sample and the variant were ignored. We performed a separate analysis for modifier matches. It turns out that, even

item-by-item Chi-squared analyses relating type of verb match (Path Verb Match, Manner Verb Match, or No Match) to participants' categorization preferences on each item. These analyses were performed separately for Greek and English speakers. In neither language group did verb matches correlate consistently with categorization performance. [13]

5.4 Summary

We assessed the relation between categorization of the stimuli and cross-language verbal descriptions of them using several measures of the latter. The first finding was that Greek and English speakers differed in their tendency to express manner information (Hypothesis 1 was again confirmed). Moreover, this language difference grew over age (Hypothesis 3 was confirmed). However, categorization of the visual stimuli did not differ across language or across age groups (Hypotheses 2 and 4 received no support). Item analyses that collapsed across language also showed no relation between categorization performance and subsequent verbal description. This nonrelation between the two tasks held true even where the subjects' verb label was identical for both the Sample and one variant.

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when a speaker used the exact same modifier to encode the sample and only one of the variants, they were not, in general, more likely to match the sample to that variant in the categorization task.

[13] For the Greek speakers, there were no significant relationships between match types and categorization preferences on any of the items. For English speakers, verb matches were related to categorization preferences on 2 of the 8 items (X^2 = 12.424, df = 2, p = .0020 and X^2 = 6.170, df = 2, p - .0457). (For one of these items, matches on manner verbs were associated with manner categorizations. For the other item, both path and manner matches predicted their respective categorization choices.)

6. General discussion

The experiments just reported examined language-thought interactions in a particular domain of language difference: the Path/Manner distinction, famously analyzed by Talmy (1985). In two important ways, this distinction is of the kind that held particular interest for Whorf, and that he tried to relate to significant cultural patternings: First, the linguistic distinction is not (or not solely) some isolated lexical choice or single constructional type. Rather, as we saw, the path/manner distinction is played out in a nexus of linguistic selections (a "cryptotype") that are sometimes lexical, sometimes syntactic, and sometimes cross-clausal in their manifestations; and which map onto complex aspects of events. As one example of the latter, the requirement to choose a path verb in Greek (and somewhat differently, in Spanish and French) is partly conditioned on such variables as whether a boundary, either a physical or metaphorical boundary, has been crossed. Second, and closely related, Whorf had in mind not the idea that some language can express a thought where some other language actually has a gap in expressive resources. Rather linguistic communities manifest probabilistic differences in "fashions of speaking" that he suggested would foster and reflect deep distinctions in the discourse of a culture. In Whorf's own words (1956, p. 147):

> The [distinctions] now to be made between the habitual thought worlds of SAE [Standard Average European] and Hopi speakers … appear to stem from the linguistic differences …By "habitual world" and "thought world" I mean more than simply language, i.e., than the linguistic patterns themselves. I include all the

analogical and suggestive value of the patterns…and all the give-and-take between language and the culture as a whole, wherein is a vast amount that is not linguistic but yet shows the shaping influence of language.

Our experimental review was designed to further document the path/manner distinction, using Greek and English as the test languages; and then to ask whether the obtained language differences were related to performance in nonlinguistic cognitive domains. Hence we tested language usage against categorization and memory performance. Here we first review the findings and the generalizations they suggest about the relative immunity of these cognitive functions to influence by language-specific semantic design features. Thereafter we briefly take up the recent literature that, taken as a whole, documents clear performance differences as a function of particular language. We will try to say why the findings from these experiments and those reported herein are not really in conflict, despite sometime interpretations to the contrary.

6.1 Dissociations of linguistic and conceptual performance on the path/manner dimension

6.1.1 Do English and Greek differ in the required ways?

Experiments 1 and 2 redocumented the path-manner typological distinction between Greek and English. The verbal reports of subjects in both Experiment 1 (Table 2) and especially in Experiment 2 (Table 5) revealed potent language-specific distinctions of the

predicted kinds. These differences grew with the age of the speakers tested. As we showed (Table 5), these age-dependent findings reside primarily in the English-speaking population. The verbal style of the Greek subjects did not change significantly over age in the relevant regards. This difference can be assigned to the necessity for English speakers to acquire a very large and in some ways unlimited vocabulary of verb-manner distinctions, i.e. in English one can *litter-basket one's empties* (put empty beer cans into trash cans), *Seven-forty-seven to China*, and *slash one's way through the line* (said of football halfbacks).[14] It takes a significant time period within early and middle childhood to acquire this large vocabulary and its generative possibilities. Therefore our youngest English-speaking subjects' verbal descriptions tended to stick with a small number of frequent verbs of motion, several of which (*come, go)* are path verbs, and thus look less different from their Greek peers than was the case for the older subjects.

6.1.2 Influences of language on non-linguistic cognitive functions

We next turned to the question of how these clear linguistic distinctions map onto nonlinguistic thought. From Whorf's perspective there are causal links here and, though the influences go both ways, in this partnership "the nature of the language is the factor that limits free plasticity and rigidifies channels of development in the more autocratic way":

[14] True also to Whorf's complex vision, these manner innovations are fed by a cooperating set of language-particular options, including the license to shift between noun and verb without added morphology, and to chain nominals into compounds.

> …language is not merely a reproducing instrument for voicing ideas but rather is itself the shaper of ideas, the program and guide for the individual's mental activity, for his analysis of impressions, for his synthesis of his mental stock in trade. Formulation of ideas is not an independent process…but is part of a particular grammar, and differs, from slightly to greatly, between different grammars (1956, pp. 212-213).

To the extent that this is so, it is reasonable to expect that memorial performance for paths and manner of motion and categorization performance for paths and manner should differ systematically between the Greek and English-speaking populations. Certainly the recent literature has suggested such effects, with Sebastián and Slobin (1994) drawing the conclusion that for Spanish speakers, "Manner is rarely attended to, at any age." Yet neither in the memory task of Experiment 1 nor in the categorization task of Experiment 2 did the English-speaking and Greek-speaking subjects differ as they should have if the latter population was essentially blind to manner properties of events.

One way to dismiss these findings is to treat them as mere null effects: Difference probed for, but not found. The measures might have been too weak, the instructions might have been misleading, and so forth. From this perspective, to say that the experimental manipulations provided no support for a postulated language-driven difference in conceptualization is not to say much. But such an interpretation of the findings ignores the fact that there are stable and strong outcomes in both experiments, along the relevant dimensions: *Greek speakers just like English speakers did attend to manner, and to the same degree, both to remember past depictions of motion and to*

categorize new ones. Thus demonstrably the lexical patterning of the specific languages did not bleed into subjects' performance in tasks that do not call on the linguistic categories specifically.

6.1.3 Language is no faithful mirror of our thoughts

Nothing is less surprising than that spatial organization should be largely immune to language influences. After all, like all navigating creatures from ground wasps to ballet dancers, Greeks and Americans must be attending to manner and path in much the same fashion lest they wander drunkenly off the edge of the earth. In the language and thought literature to which we have here attempted to contribute, language-sensitive effects are expected (by all parties) to be restricted to cognitive performances at a level far removed from the perceptual foundations of spatial acts and inferences. Yet even at these higher-order cognitive levels, we did not see changes in the salience of spatial dimensions as a consequence of how these are semantically encoded by the two languages. What is *really* surprising and potentially informative is that there were no measureable task-on-task effects in the item analyses for either experiment.

The idea motivating the item analyses is this: An observer visually inspecting a scene might represent it to himself either as a path event or as a manner event. This could be true, on occasion, of speakers of both languages though the frequencies might differ across languages and would change even within a speaker from occasion to occasion. But whatever that initial representation, one might expect it to be reflected in memory performance in Experiment 1 or categorization performance in Experiment 2. The item

analyses probed for just such effects, and did not find them. For the memory task, the analysis takes the subject's initial verbal description as indexing his or her initial representation of the scene, either as manner ("He's running out of the room") or path ("He's crossing the room"). If the verbal description actually indexes the subjects' conceptual encoding of the scene, it ought to predict memory performance. But the verbal label did not turn out to predict the subject's memory for path versus manner alterations when this was tested two days later (Figure 3). Similarly in Experiment 2, the analysis takes the subject's categorization choice (manner versus path choice) as indexing his or her initial conceptual representation of the depicted scene. Again, this nonverbal performance failed to predict the subsequent verbal labeling of the scene (Figure 5).

The fault clearly lies in the presuppositions of these analyses; namely, that verbal descriptions are tightly tied to (and therefore can serve as indices of) how the subjects have conceptually represented the materials. There is every reason to suppose that language is a far cruder instrument than this. People verbally describe the world to each other (and, sometimes, to themselves) using whatever formal and substantive resources the particular language makes easily available. What the item analyses reflect is that those verbal reports did not come anywhere near exhausting the observers' mental representation of the motion events that they were shown. Language use is in this sense sketchy (for discussion, see also Gleitman and Fisher, in press). A Greek speaker's everyday and easily accessible vocabulary of motion verbs will cause him to call up a path verb to describe events most of the time; including those events that, for English speakers, are most readily nameable with manner verbs ("run" is more frequent than "ascend" or even "go up"). To paraphrase the Mad Hatter in this regard, while people

generally mean what they say, it does not follow that they say what they mean. One tends to say whatever the language forms make it easy to express, leaving it to the listener to fill in the gaps.

Summarizing, the noneffects of the item analyses provide one more suggestive bit of evidence for a view that while any particular language is a partial vehicle for representing thought, its limitations and exactitudes do not impose themselves on the representation of experience. We do not literally "think in English" (or Greek, etc.). This perspective is in direct opposition to Whorf's strongest interpretations of language as "the program and guide" for mental activity. Rather, language seems to be "merely a reproducing instrument for voicing ideas" and not such a very faithful one at that. For most communicative purposes it is enough that speech evoke ideas in listeners, not that it literally render those ideas.

6.2 Influences of the linguistic packaging on task performance

The past decade's investigations have revealed cognitive influences of language on thought of quite another kind than we have been discussing so far. Languages package the same conceptual information in rather different ways that their users come to know in the course of learning (Slobin, 1991; 1996b; Bowerman, 1996). Following traditional usage, let us call this language-specific packaging *the syntax-semantics interface* of languages. Talmy's *conflation patterns* for verb-representation, experimentally studied in the present paper, are a specific instance. As we discussed in the Introduction to this paper, both Greek and English represent motion events as comprised of the same proper

parts - the figure (or the moving object), the path, the manner, the goal. In this sense, the conceptual representation of motion events does not vary across the two languages. However, the parts themselves are distributed differently. English and Greek differ in whether path versus manner information is verb-internal or separately encoded in a prepositional or adverbial phrase. That is, the semantics-to-syntax mappings differ between the two languages.

The implicitly known packaging differences have been shown to affect behavior in important ways. *When subjects are told* (typically, by the implicit means of introducing a nonsense word) *that the task is a linguistic one, semantically conditioned effects are usually observed*. In a beautiful example, Naigles and Terrazas (1998) showed their English- and Spanish-speaking subjects video scenes in which a person is depicted as moving toward some goal in some manner (say, a girl skipping toward a tree) accompanied by audio containing a nonsense verb in a path-biasing structure ("She's kradding the tree," i.e., perhaps, *approaching,* or its Spanish equivalent "Ella está mecando al árbol") or a manner-biasing structure (She's kradding toward the tree", i.e., perhaps, *skipping,* or its Spanish equivalent "Ella está mecando hacia el árbol"). Both groups were guided by the syntactic structure, giving more judgments in favor of the path meaning for intransitive verbs and more in favor of the manner meaning for transitive verbs; that is, their conjectures were sensitive to the semantic implications of the syntactic structure (a procedure known as "syntactic bootstrapping", Gleitman, 1990; Naigles, 1990; Fisher, 1996). However, in addition there was a clear influence of the lexical patternings that differed across the two languages, with Spanish speakers making far more path conjectures overall than English speakers. Clearly, then, speakers have

mastered the statistics of semantics-to-syntax mappings in their languages and (at least in laboratory situations) will bring this knowledge to bear in deciding the meaning of such new verbs as *kradding* or *mecando.* In contrast, in Experiments 1 and 2 of the present paper, when the categorization or memory tasks are divorced (or "more divorced") from language itself, performance by speakers of different languages looks the same.

Effects related to those of Naigles and Terrazas come from the well-known findings of Imai and Gentner (1997). Following a design from Soja, Carey and Spelke (1991) they asked American and Japanese children and adults to categorize novel stimuli – various oddly shaped objects made of novel materials (e.g. toothpaste stuck with sparkles). Responses were expected to differ to the extent that English (at least roughly) marks objects with a special morphology (*a horse*) but not substances (*water* rather than *a water).* Presented with a sample object/substance labeled neutrally ("This is my dax" or "Do you see this dax?"), subjects' extension patterns ("Can you show me another dax?") were investigated. A clear object bias was observed cross-linguistically. But for certain in-between or ambiguous test items, e.g. a lima-bean shaped-lozenge made of semisoft wax) there was a clear language effect: English speakers favored the object over the substance interpretation for these cases while the Japanese speakers did not. Again we see the influence of language-specific packaging *when the task is a linguistic one*: The expression "this dax," though in principle neutral as between mass and count morphology ("this candle", "this wax") is highly likely to be a count noun in English just because count nouns overwhelmingly outnumber mass nouns in English. But Japanese semantics provides no such statistical guidance. Where clear object/substance differences provide no or poor guidance, then, the subjects apparently invoked known language patterns. But

as Mazuka and Friedman (2000) showed, the classifications made by speakers of these two languages fell together when the implicit language instruction was removed from the situation (see also Kay and Kempton, 1984).

Summarizing, several investigators have ingeniously shown that language users, even young children, have mastered the semantic patterns of their languages. They know which kinds of concepts are likely to get bundled together within the word (or phrase). If a task is presented as a labeling one, and especially when the stimulus situation is ambiguous or inconsistent, the speakers are likely to invoke this knowledge, with the outcome that users of different languages will behave differently. But to the extent that language influence is experimentally lessened by the choice of stimulus materials or task instructions, as in the experiments we have presented, these differences among speakers of different languages tend to diminish or disappear too.

Final thoughts

The experiments presented in this paper attempted to engage the question of linguistic relativity as it has resurfaced in the current psychological and anthropological literature, using motion verb representation and expression as the test bed. The overall findings suggest a good deal of independence between conceptual and linguistic representation. Such findings come as little surprise to recent proponents of the linguistic relativity position for they – as well as Whorf and Sapir themselves, except in their most enthusiastic moments – have no quarrel with the notion that are certain immutable core concepts shared across the species. Rather, these investigators have tried to show that in

addition to these shared concepts, there are different ones too, literally caused and imposed by the language differences themselves. Sometimes this view is called "weak Whorfianism." Based on our findings, we have urged quite a different perspective: Many apparent effects of language on thought are more appropriately interpreted as effects of language on language. In tasks that explicitly or implicitly call for knowledge of language, subjects can in fact draw upon that knowledge. Because the languages differ, speakers of the different languages will differ accordingly. But this proves no more (and no less!) than that English speakers speak English and Greek speakers speak Greek. The linguistic relativity question, interpreted nonvacuously, is whether by having learned these languages speakers differ in the very basis of their inductions, whether they are representing, categorizing, remembering, and reasoning in terms of a (partially) different set of experiential categories. In our view the answer to these questions tends to be no. Here we argued the case by pointing to the following generalization: The more language-like the subjects' task, the more speakers of different languages can be shown to vary in their performance; the more language is removed from the task situation, the more subjects exhibit their human conceptual communalities.

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Table 1

Stimuli for Experiment 1

Session 1	Session 2: Path Variants	Session 2: Manner Variants
1. A boy is jumping over a log.		A boy is stumbling over a log.
2. A frog is jumping into a room.	A frog is jumping out of the room.	
3. A frog is hopping off a turtle.	A frog is hopping on a turtle.	A frog is falling off a turtle.
4. A boy is diving off a cliff.	A boy is diving down a cliff.	A boy is tumbling off a cliff.

Table 2

Verbal descriptions elicited in Experiment 1

	English	Greek
Path V	7.5%	24%
Manner V	89%	69.75%

Table 3

Types of information in elicited descriptions in Experiment 1

Information in Sample	Lexical-Syntactic Conflation Patterns
Path-Only	**Path V (bare):** The frog is entering. O batraxos beni. **Path V+Path Modifier:** The frog is going into the room. O batraxos pigeni sto domatio.
Manner-Only	**Manner V (bare):** The frog is jumping. O batraxos pidai. **Manner V + Manner Modifier:** The frog is jumping briskly. O batraxos pidai apotoma.
Combination	**Path V+Manner Modifier:** The frog is entering jumping. O batraxos beni pidontas. **Path V+Manner Modifier+Path Modifier:** The frog is going into the room jumping. O batraxos pigeni sto domatio pidontas. **Manner V+Path Modifier:** The frog is jumping into the room. O batraxos pidai sto domatio. **Manner V+Manner Modifier+Path Modifier:** The frog is jumping briskly into the room. O batraxos pidai apotoma sto domatio. **Manner V+Path V:** The frog is entering (the room) and jumping. O batraxos beni (sto domatio) ke pidai.

Other	**Path Vs (stacked)** The frog is entering (into the room) and advancing. O batraxos beni (sto domatio) ke proxorai.
	Manner Vs (stacked) He is stumbling and falling (down). Skontafti ke pefti (kato).
	Irrelevant Vs The frog is looking into the room. O batraxos kitai sto domatio.

Table 4

Stimuli for Experiment 2

Sample items	Manner variants	Path variants
1. stumble into a room	walk into a room	stumble down the stairs
2. jump into a room	walk into a room	jump off a chair
3. walk down the stairs	slide down the stairs	walk to the bookcase
4. run up the stairs	walk up the stairs	run down the hall
5. drive through a barn	walk through a barn	drive past a barn
6. sneak out of a room	walk out of a room	sneak into a room
7. jump off the stairs	fall off the stairs	jump on the couch
8. fly over the barn	fly upside down over the barn	fly around the barn

Table 5

Verbal Descriptions for Sample elicited in Experiment 2

Group	Mean Manner Verbs (out of 8 Sample descriptions)	Mean Path Verbs (out of 8 Sample descriptions)
Greek Children	1.500	5.000
Greek Adults	1.333	5.429
English Children	3.714	3.643
English Adults	5.950	1.550

Table 6

Types of information in elicited descriptions in Experiment 2

Linguistic pattern (sample+variants)	**English**	**Greek**
PATH-ONLY	**21.4%**	**40.6%**
Path V (bare) He is entering.	0.7%	9.6%
Path V+Path Modifier He is entering into the room.	20.7%	31%
MANNER-ONLY	**4.3%**	**6.7%**
Manner V (bare) He is walking.	3%	6.1%
Manner V+Manner Modifier He is walking briskly.	1.3%	0.6%
COMBINATION	**67.6%**	**43.2%**
Manner V+Path V He is entering (into the room) and slipping.	2.4%	10.3%
Path V+Manner Modifier He is entering running.	1%	4.9%
Manner V+Path Modifier He is walking down the stairs.	58%	13.4%
Path V+Manner Modifier+Path Modifier He is entering into the room running.	2.5%	13.6%
Manner V+Manner Modifier+Path Modifier He is walking briskly down the stairs.	3.7%	1%
OTHER TYPES	**6%**	**8.9%**
Path Vs (stacked) He is entering (into the room) and advancing.	0.6%	5%
Manner Vs (stacked) He is slipping and falling (down).	3%	1.4%
Irrelevant Vs	2.4%	2.5%

He is searching for the door.		

Table 7

Illustration of a Verb Match

Item 4	**Sample**	**Path Variant**	**Manner Variant**
English Description	**running** up stairs	**running** down hall	walking up stairs
Greek Description	**aneveni** skales **'ascending** stairs'	trexi se diadromo 'running in hall'	**aneveni** skales **'ascending** stairs'