Describing Spatial Relations

<table>
<thead>
<tr>
<th>LANGUAGE/COMMUNITY</th>
<th>PROPOSITIONS TRUE OF PHOTOS 2.3, 2.4 &amp; 2.7 AND NO OTHERS</th>
<th>PROPOSITIONS TRUE OF 2.5, 2.6 &amp; 2.8 AND NO OTHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aramaic</td>
<td>&quot;man standing in east&quot; &quot;man standing in west&quot;</td>
<td></td>
</tr>
<tr>
<td>Tzeltal</td>
<td>&quot;tree standing downhill of man&quot; &quot;tree standing uphill of man&quot;</td>
<td></td>
</tr>
<tr>
<td>Hailoë</td>
<td>&quot;man stands in &quot;sac of soft sand&quot;&quot; &quot;man stands in &quot;river land&quot;&quot;</td>
<td></td>
</tr>
<tr>
<td>Longaë</td>
<td>&quot;tree standing on side towards sea&quot; &quot;tree standing on inland side&quot;</td>
<td></td>
</tr>
<tr>
<td>Tamil</td>
<td>&quot;tree on north&quot; &quot;tree on south&quot;</td>
<td></td>
</tr>
<tr>
<td>Totonac</td>
<td>&quot;tree stands east&quot; &quot;tree stands west&quot;</td>
<td></td>
</tr>
<tr>
<td>Yucatec</td>
<td>&quot;man is on my side&quot; &quot;man is on your side&quot;</td>
<td></td>
</tr>
<tr>
<td>Bechaët</td>
<td>&quot;tree right of man&quot; &quot;tree left of man&quot;</td>
<td></td>
</tr>
<tr>
<td>Kgalagadi</td>
<td>&quot;man at left&quot; &quot;man at right&quot;</td>
<td></td>
</tr>
<tr>
<td>Japanese</td>
<td>&quot;man is at left side of tree&quot; &quot;man is at right side of tree&quot;</td>
<td></td>
</tr>
<tr>
<td>Dutch</td>
<td>&quot;man standing to left of tree&quot; &quot;man standing to right of tree&quot;</td>
<td></td>
</tr>
<tr>
<td>Kilivila</td>
<td>(no functional equivalent)</td>
<td>(no functional equivalent)</td>
</tr>
<tr>
<td>Mopunë</td>
<td>(no functional equivalent)</td>
<td>(no functional equivalent)</td>
</tr>
</tbody>
</table>

Table 4. Cross-linguistic functional equivalents.

(Pederson et al. 1998)
Frames of Reference

- **Intrinsic** - features of ground object
- **Relative** - features of speaker
- **Absolute** - features independent of speaker or figure/ground

Table 5. Grouping of languages by information type (transverse axis, men-and-tree set 2).

(Pederson et al. 1998)
• Which sounds more natural?
  – There’s a bee sitting on your left shoulder.
  – There’s a bee sitting on your north shoulder.

(Pederson et al. 1998)

• Arrernte
  – No terms for ‘left’ and ‘right’
  – ‘Left hand’, ‘right hand’ are independent terms

(Pederson et al. 1998)
Recalling Spatial Relations
Turning the tables: language and spatial reasoning

Peggy Li, Lila Gleitman

Abstract
This paper investigates possible influences of the lexical resources of individual languages on the spatial-organization and reasoning styles of their users. That there are such powerful and pervasive influences of language on thought is the theme of the Wexler-Sapir linguistic relativity hypothesis which, after a lengthy period in intellectual limbo, has recently returned to prominence in the anthropological, linguistic, and psycholinguistic literature. Our point of departure is an influential suggestion (Goldin-Meadow) that children's communicative schemes that result in interpretation errors involve what she refers to as "dead reckoning".
(Li & Gleitman, 2002)
Of course the present authors do not know too much about traditional unacquainted cultural groups who live in faraway places. Large disparities between imaginee and imagined make it difficult to interpret either naming practices or experimental responses across these cultural divides. Indeed, PDWLA3 rightly caution us not to add any languages to the sample without being well-acquainted anthropologists on the site. Luckily one does not have to go all the way to Chiapas or Papua-New Guinea to find communities that favor landmark-based spatial terminology: one of us is a native of a highly urbanized culture whose members live and work all crammed together on a skinny little island, about 16 miles long, at the mouth of the Hudson River, namely, Manhattan Island. Culturally diverse (some would say “fertile”) as this community is, its residents share a small, stable, geographically landscaped, rare in mutually known landmarks. Likely this is why their terminology for locations in the community is absolute and - like

(Li & Gleitman, 2002)

COGNITION
Cognition 84 (2002) 165–168
www.elsevier.com/locate/ cogit

Returning the tables:
language affects spatial reasoning

Stephen C. Levinson*, Sotaro Kita1,
Daniel B.M. Haun2, Björn H. Rasch3
*Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands
1Department of Psychology, University of Potsdam, Germany
Received 27 September 2001; received in revised form 2 February 2002; accepted 8 March 2002

Our response must focus on the fundamental conceptual issues involved in the study of spatial frames of reference, but readers should know that the essential phenomenon that provided our investigations in the following. In a nutshell, there are human populations scattered around the world who speak languages which have no conventional way to encode “left”, “right”, “front”, and “back” motions, as in “turn left”, “behind the tree”, and “to the right of the rock”. Instead, these peoples express all directions in terms of cardinal directions, a bit like our “East”, “West”, etc. Careful investigation of their non-linguistic coding for recall, recognition, and inference, together with investigations of their spatial reasoning abilities and their on-line gesture during talk, shows that these people think the way they speak, that is, they code for memory, inference, way-finding, gesture and so on in “absolute” fixed coordinates, not ‘relative’ or ego-centric ones (the full details can be found in Levinson (in press), but the studies are now being replicated across the world by other scholars; see, for example, Wassmann and Eisen (1998). The phenomenon should be of fundamental interest to cognitive science as showing human variability where least expected, and should not be lost in the shuffle of disagreements about its correct interpretation.
Li and Gleitman set out to ask in their Experiment 2h “Can landmark information, if it is salient enough, completely determine the degree to which a single population solves spatial problems?” As “landmarks” they used ‘duck ponds’, big colorful symmetrical objects. They placed one of these on both the stimulus and response tables of the same animals as before; in the ‘relative’ condition they placed the duck ponds always to the participants’ right on both tables; for the ‘absolute’ condition, they placed the ducks always to the south of both tables (and thus with left/right alternation under rotation). The results were that under the ‘absolute’ condition, participants lined up the animals facing the duck ponds, and in the relative condition they did the same, with the animals in the reverse direction. One has to note immediately that these are obviously not ‘landmarks’ in any normal sense, since identical objects are replicated in different locations (you don’t expect to have clones of the local cathedral on neighboring streets!), and the landmark objects are clearly relatively small and moveable. Rather, they will be interpreted by participants as part of the scene to be replicated. What participants clearly did was use the large, bright objects as an orientational cue—they were treating the whole assemblage, both duck ponds and animals, as one array to be reproduced. What kind of coordinate system is involved in maintaining the internal arrangements of an array while its orientation is varied? An orientation-free frame of reference of course—what we call an intrinsic frame of reference (see Levinson, 1996, pp. 147f). So what Li and Gleitman actually tested was whether they could bias

Absolute systems presuppose a conceptual ‘slope’, or series of infinite parallel lines across the environment. You can’t walk around such a conceptual slope, in the way you can walk around a tower. The two systems have long been distinguished in studies of navigation: absolute systems are involved in dead reckoning, landmarks in piloting, and they involve quite different procedures (Gallistel, 1990). Third, Li and Gleitman therefore imagine that the linguistic and conceptual systems under investigation as ‘absolute’ by our project are entirely familiar to English speakers, who, they suggest, could at the drop of a hat say “Give me the spoon that’s northeast of your teacup” (p. 7). They can’t because they can’t routinely compute it, anymore than they can instantly give you their telephone numbers in binary code. But the ‘absolute’ language populations we have been interested in do routinely use such statements, can instantly compute them, and remember everything of whatever scale in terms of the locally relevant conceptual slope, as can be shown not only through memory experiments but also by examining their unconscious gestures during speaking. This is a truly interesting phenomenon, of considerable importance to our understanding of the ‘psychic unity’ of the species, and nothing is gained by shoving it under a terminological rug.

At night, in an alien city, facing a device never seen before (namely a sink with two taps), one Tenzin asked another, “Which is the hot tap, the uphill (southern) or the downhill (northern) one?” They maintain a constant sense of absolute orientation, presumably by running a continuous background computation of egocentric heading with respect to abstract bearings, integrating multiple internal and external cues to achieve this. This is the phenomenon that we are trying to capture.
Fig. 1. Motion-maze task.

Fig. 2. The paths to be remembered in the Motion-maze task.

Fig. 3. Motion-maze task with Dutch participants: Indoor and Outdoor conditions (a total of five responses by each participant are coded either absolute or relative). Note: the two lines overlap at zero, two, three, and four absolute responses.

Fig. 4. Direction of animals in the Animals-in-a-row task with Dutch participants: Indoor and Outdoor conditions (a total of five responses from each participant are coded either relative or absolute).
Chicken & Egg

- Similar linguistic groups in similar areas use different frames of reference
  - Mopan - intrinsic
  - Tzeltal - absolute & intrinsic
  - Yucatek - relative, absolute, & intrinsic
  - ...so it’s not just culture
- In order to report events, a speaker must encode information using the coordinate space that the language uses
- What would lead members of one linguistic community to use consistent ways of describing space, if not their language?
Ladas and Gleitman (1985) suggest that "natural categories" for lexicalization can be recognized during language acquisition because they should display four crucial properties: (i) they should be learnt early in development (well before, say, age 3); (ii) in the course of learning, one should not be able to detect attempts to construe the relevant terms in other, but related, ways; (iii) they should be universally coded in all languages in the "core vocabulary"; (iv) even under poor input conditions (as where the child has perceptual deficits), they should nevertheless be learnable. By such criteria, there is no evidence that any of the frames of reference are "natural categories" at a conceptual level. (iii) does not hold for a start, and all the acquisition evidence points to relatively late learning. Western children learn the intrinsic frame first, but this is not mastered in production till nearly 4 years of age (Johnston & Slobin, 1979, p. 538) and relative "left"/"right" not till at least as 11 (Piaget, 1928; Weissenborn & Striika, 1984). Interestingly, Tzeltal children learn the absolutes system at least as early as the intrinsic system, but again not before 4 years of age.

This of course is not at all the view that Li and Gleitman are trying to defend. Let us examine their post-Fodorian doctrine in a little more detail. It has two parts: (a) the idea that all our linguistic categories are direct projections from pre-existing biologically-determined concepts (p. 266), and hence "all languages are broadly similar" (p. 266); (b) the idea that linguistic coding can have no cognitive efficacy or cognitive effects. We think the (a) part is, taken literally, clearly untenable – it is the claim really that Japanese hortiifics, Russian aspect, Bantu noun classes and French gender are biologically-determined concepts, and that American Sign Language is really "broadly similar in grammar and lexicon" to American English? We suspect that most such opinions are ill-informed about the range of linguistic diversity – it is, for example, extremely difficult to find even a

Putting all the facts together, the best account seems to be along the lines of the Karmiloff-Smith (1992) "representational redescription", whereby during the course of development innate predispositions are progressively refracted into higher level conceptual representations in response to environmental input, so that they become available for a broader range of comprehension. We argue that language is part of such environmental input driving representational redescription. How does this work?

Notions that are linguistically labeled need to be acquired due to their language specificity. Not all absolute linguistic systems are the same. In Tzeltal, "downhill" means the quadrant centered on N 345° independent of the local slope, whereas in Gaung Yami, "north" means the quadrant centered on N 177° (and in other systems axes may not be orthogonal, nor arcs of 90 degrees, see Levinson, in press). Nor are all relative linguistic systems conceptually identical. In front of in Hassa semantically unifies a part of what English front means (as in "in front of me") and a part of what English behind means (as in "behind the tree") (Levinson, in press).

These notions are acquired from matchings of language to situations, where the analysis of these situations may be given either in earlier acquired notions or in simple universal computational primitives (axes, angles, vectors) which have bases in perceptual motor systems. During this process, a particular type of representation, say a spatial representation based on the absolute frame of reference, is progressively employed in the service of the linguistic system. This leads not only to the eventual acquisition of the lexicalized notion, but also to the general privileged status of the representational system that supports the notion. In other words, the representational system becomes readily available for all conceptual purposes, both linguistic and non-linguistic. In this fashion, representational redescription bootstraps us from simpler notions to complex, culture-specific wholes, and it also makes a particular type of representation readily available for conceptual purposes. Under this view, universals do not lie in the exact character of the higher conceptual systems, but just in the fact that expressions frames of reference in various languages seem to belong to the three main abstract types (absolute, relative and intension), suggesting universal low-level perceptual systems as an ultimate source.

- If memories are encoded linguistically, does this neutralize Whorfian claims?