Framing Whorf:
A response to Li et al. (2011)

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Abstract

Many psychologists believe that we talk the way we think, but we do not think the way we talk. In a recent article, Li et al (2011) try to make the case for this view by revisiting one of the sites (spatial thinking in a Mayan group in Mexico) where a case had previously been made for language influencing cognition, and seeing whether they could undermine it by experiments that induce responses in a spatial frame type not used in the particular language. The experiments however miss the target, as we explain, because they did not actually require the participants to use the frame type in question and because of unmatched conditions. We conclude that not only do we talk the way we think, but we think the way we talk. Thinking for speaking in a specific language is bound to influence plain thinking just like any other expertise effect.

1. Why the debate should capture your attention

There is a lively renaissance of debate about the relation between language and non-linguistic cognition which has captured the public interest (see Deutscher 2010 and the associated press coverage on the 'Whorfian debate'). The study by Haun et al. (2011) in the preceding issue of *Cognition* and by Li, Abarbanell, Gleitman, & Papafragou (LAGP) in this issue rekindle the questions in this journal. Even for readers with few interests in language, the discussions should be pertinent. The question is to what extent is the fact that we are a culture-bearing species a crucial element in our psychology? Do we, for example, have different minds by virtue of the different cultures we inhabit? All the recent evidence of expertise effects and of brain plasticity suggest this must be so – differential experience with navigation (McGuire et al. 2000), with dancing, with music, with vision (Bedny et al 2011), with literacy (Petersson et al 2007) shows remarkable differences in brain structure and function. Differential language experience shows the same pattern, warping our psychophysics early in infancy (Kuhl 2004), affecting our perception (Regier & Kay 2009), and showing different patterns of brain activation (Valaki et al. 2004). Numerous studies have now accumulated to show that such experience effects our responses (equally there are numerous studies that have failed to find any correlation between language and cognition – e.g., Malt, Sloman, & Gennari 2003, to name one example that falls outside the domain of present matters, spatial cognition).

Despite this, the idea that language could have any impact on the way we think is anathema to many psychologists (e.g., Pinker 1994). There seem to be a number of reasons for this denial of individual and cross-cultural differences. One is an outmoded idealization associated with the birth of the cognitive sciences in the 1950s, that there is only one uniform human cognitive system, a view dissolved by recent findings from brain imaging and the current boom in research on the genes that might underlie the human performance differences thus revealed (Papassotiropoulos et al. 2006) . A second is sheer ignorance about the scale and depth of linguistic diversity (Evans & Levinson 2009, Dunn et al. in press), which contradicts the idea that "the grammars and lexicons of all languages are broadly similar" (Li & Gleitman 2002:266). A third is perhaps attributable to a libertarian streak in American thought that resists any idea that our options might even be ever so slightly narrowed by the course of development within specific cultural environments, even though it is proven that as far as sound systems go we are thoroughly baked in language-specific shapes by 18 months old (Kuhl 2004).

Thus the exchange between Haun et al. (2011) and LAGP has broad implications. They both concentrate on a specific domain, frames of spatial reference, which are known to differ in their distribution across languages (Levinson 2003). One thing to notice straight away is that there is a certain amount of cross-talk. Haun et al. (2011) and prior studies (as detailed in Levinson 2003) are interested in capturing how individuals code spatial memory in their own ecologies using their non-reflective response strategies – hence the general use of tasks that investigate preferred strategy. LAGP want to show that we are not imprisoned by our language; consequently, they use tasks that by feedback after each trial train participants to behave in a certain way. One class of studies aims at ecological validity, the other at tapping into universal potential. In broad brush terms, both lines of research might be compatible. However, Haun et al. (2011) report a training task conducted in two cultures that spectacularly failed to train participants to perform in the other culture's spatial system. And LAGP advance a pragmatic theory that tries to explain away the findings of preference studies as showing no fundamental effect of language on how people think. Moreover, in addition to the different findings on training capacity, Haun et al. (2011) report that as task complexity increases, reliance on the coding system congruent with the language does not decrease, while LAGP report the exactly contrary finding. In this response, we try to locate how such different findings and conclusions might have arisen.

2. Classifying reference frames in cognition and language

Reference frames are coordinate systems used to interpret linguistic and nonlinguistic representations of the location, motion, and orientation of entities. They are constituted by an origin and one or more (semi-)axes. In representations of location/motion, the origin is a reference point, most commonly a reference entity or **ground**. The axes are defined with respect to a contextual index, the **anchor**. Psychologists are accustomed to classifying frames on the basis of the identity of the anchor in terms of **egocentric** vs. **allocentric** frames, as illustrated in the left column of Figure 1. As it turns out, however, this classification does not capture the variation in frame use across languages: egocentric and allocentric frames are used in all languages, but certain subtypes are not. These subtypes differ by the operations involved in deriving the axes. Thus, all egocentric frames are anchored to the body of an observer, but only **relative** frames involve projection (geometrically, translation ± rotation) of the observer's body axes onto a distinct ground (as in 'The ball is left of the tree'). In small-scale horizontal space, speakers of Dutch, English, and Japanese use relative frames and to some extent **intrinsic** (object-centered) frames, but not **geocentric** frames derived from the environment. In contrast, speakers of Tenejapan Tseltal and many other languages use intrinsic and geocentric frames, but not relative ones; cf. Figure 2. Figure 1 shows correspondences between the classifications used by much research in psychology and those that language typology has been found sensitive to.

The egocentric-vs.-relative distinction is critically important for the formulation of two hypotheses regarding language-on-thought effects in the cognition of Tseltal speakers, which were successfully tested in previous research and which LAGP set out to contest:

(i)   Tseltal speakers prefer to memorize stimulus arrays in geocentric terms
      (Brown & Levinson 1993)
(ii) Tseltal speakers find reasoning tasks that require relative encoding difficult to master
      (Levinson & Brown 1994).

Below, we argue that the design of LAGP's studies did not permit a test of (ii), since their conditions distinguish between egocentric and geocentric encoding, but not between subtypes. In the egocentric conditions, participants were able to rely on intrinsic egocentric frames (not predicted to vary with language; Danziger 2010) and did not have to use relative frames (predicted to vary with language). We also make the case that LAGP failed to refute (i), since their designs target ability rather than preference. We attribute their participants' apparent strong performance in the egocentric conditions – in some cases, they outperformed the participants in the geocentric conditions – to a bias in the design: the egocentric conditions were easier to solve.

relative (Levinson 1996)
anchor = body of an observer
ground ≠ anchor
axes projected (translated ± rotated)
The ball is right of the chair
(illustrated labeling of the axes is English-style;
cf. Hill 1982)

egocentric intrinsic ('direct' in Danziger 2010)
anchor = body of an observer
ground = anchor
axes extended (no projection or abstraction involved)
The ball is in front of me

object-centered (Carlson-Randvansky & Irwin 1993)
anchor ≠ body of an observer
ground = anchor
axes extended (no projection or abstraction involved)
The ball is in front of the chair

landmark-based ('projected' in Mishra, Dasen,
& Niraula 2003; 'head-anchored' in Bohnemeyer
& O'Meara in press)
anchor = environmental entity/feature
ground ≠ anchor
axes defined as vectors
pointing toward/away from anchor
The ball is mountainward of the chair

geomorphic ('contextual' in Jackendoff 1996: 17)
anchor = environmental entity/feature
ground ≠ anchor
axes projected (in geometric terms, translated)
The ball is downriver of the chair

absolute (Levinson 1996;
'geographical' in Jackendoff 1996)
anchor = environmental entity/feature
ground ≠ anchor
axes abstracted from geomorphic
or landmark-based system
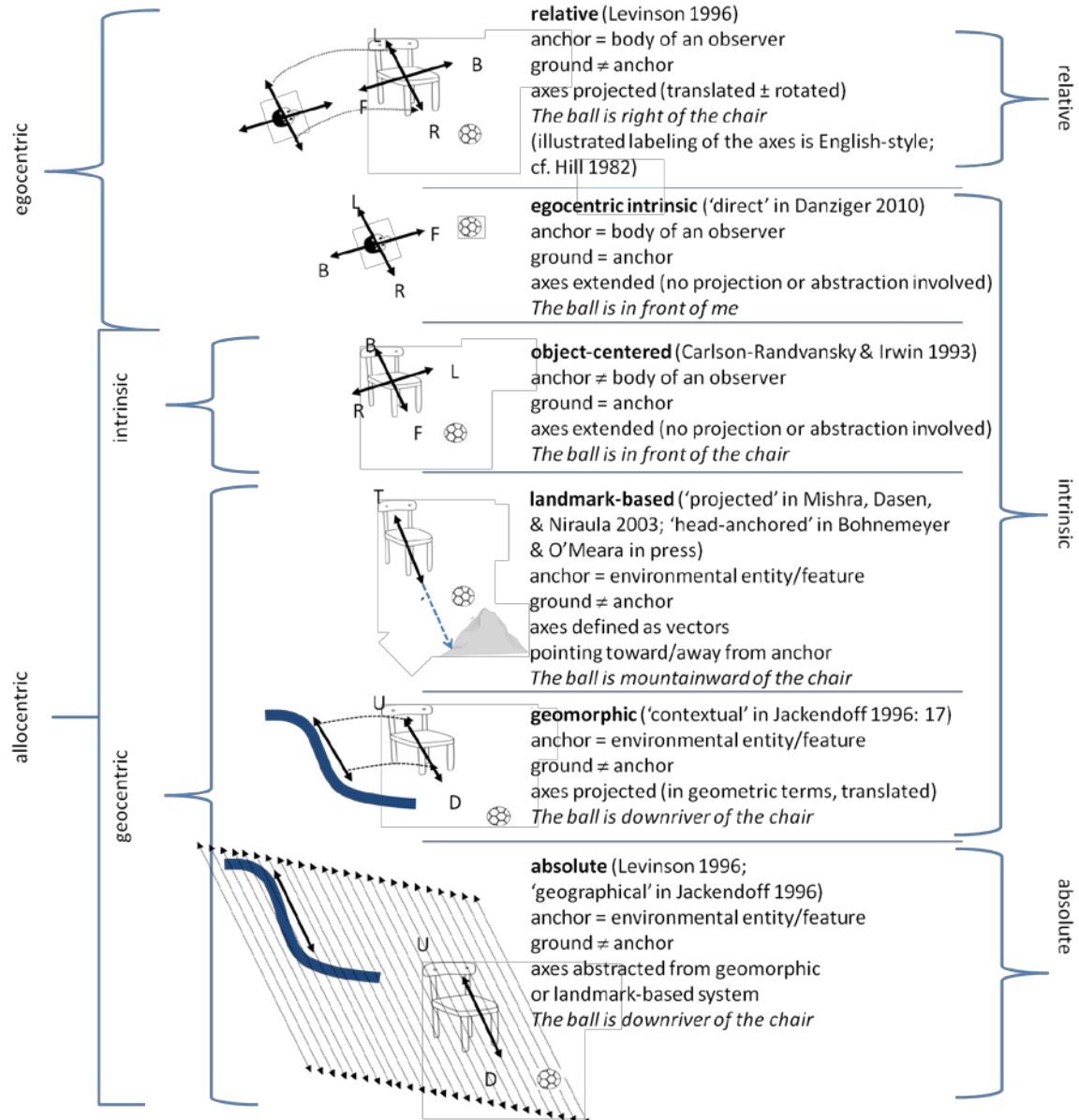*The ball is downriver of the chair*

Figure 1. *Reference frame types and their classification (A - 'away from', B - 'back', D - 'downriver', F - 'front', L - 'left', R - 'right', T - 'toward', U - 'upriver')*
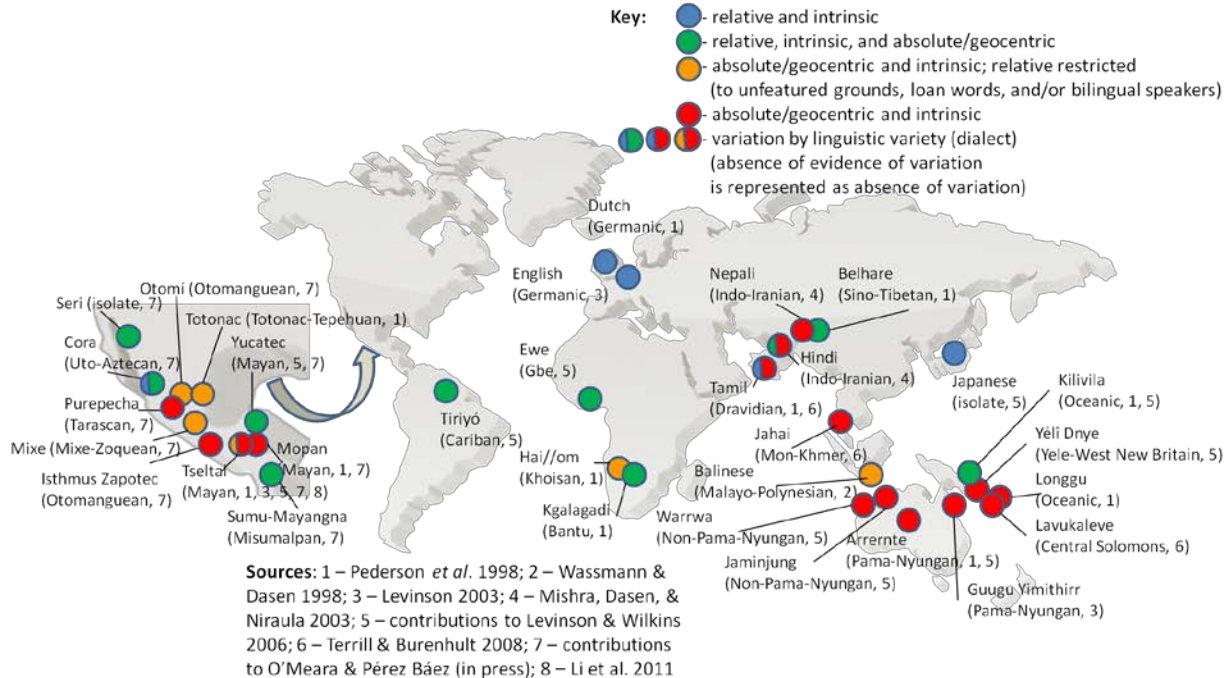
Figure 2. *Reference frame use in small-scale horizontal space across languages*

3. What LAGP did and did not show

The results of LAGP's experiments suggest that Tenejapan Tseltal speakers are capable of solving problems of spatial reasoning whose sole correct solution requires egocentric computation. This finding is perhaps unsurprising – egocentric coding is essential for e.g. the most fundamental interaction between our motor and visual systems – but it nevertheless helpfully clarifies the discussion. However, it does not contradict hypotheses (i)-(ii) above and is not inconsistent with a language-on-thought effect. What LAGP did **not** show was that:

- the cognitive preference data of Brown & Levinson 1993 are unsound
- Tseltal speakers use relative frames in nonlinguistic tasks
- Tseltal speakers perform better egocentrically than geocentrically when conditions are matched
- increased stimulus complexity favors egocentric encoding
- Tseltal speakers' use of frames in cognition is not predicted by their linguistic use of frames
- the cognitive preference data of Brown & Levinson 1993 allow a reanalysis that does not entail a cognitive difference between Tseltal and English speakers.

We now discuss these points in detail.

3.1. The preference for geocentric cognition is robust. LAGP do not show that Brown & Levinson's (1993) results are unreplicable – in fact, though unreported in their paper, they have themselves precisely replicated the linguistic and cognitive results earlier reported (and meanwhile Gilles Polian has done the same). These earlier findings are thus robust: they show decisively that left to their own resources the Tenejapans will predominantly solve spatial puzzles using a geocentric or absolute strategy.

3.2. No evidence for relative encoding. LAGP's participants did not have to rely on *relative* reference frames to solve the egocentric tasks. Consider Experiment 1. Participants memorize a card showing two colored dots. They then carry the card inside a closed box to a second table, undergoing 180°-rotation in the process, and choose the card that matches in orientation the card in the box. In the egocentric condition, the participants rotate the box with them, whereas in the geocentric condition, they maintain the orientation of the box with respect to the room while they turn. The egocentric coders narrowly outperformed the geocentric coders. However, as Figure 3 shows, all the egocentric coders had to do to solve their task was memorize parts of the stimulus configuration with respect to parts of their body (in Figure 3, their hands) serving as anchors of intrinsic reference frames.
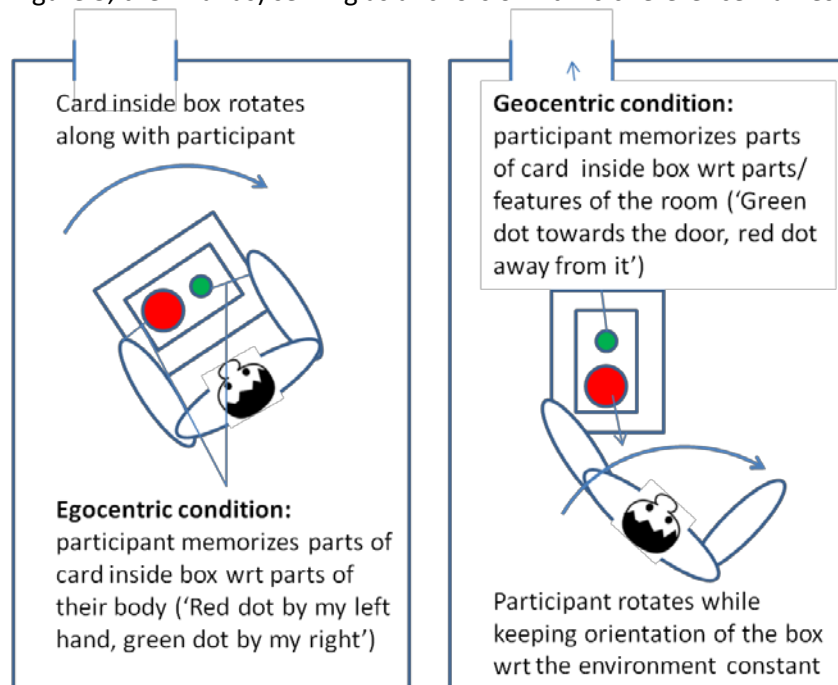

Card inside box rotates along with participant

Egocentric condition: participant memorizes parts of card inside box wrt parts of their body ('Red dot by my left hand, green dot by my right')

Geocentric condition: participant memorizes parts of card inside box wrt parts/ features of the room ('Green dot towards the door, red dot away from it')

Participant rotates while keeping orientation of the box wrt the environment constant

Figure 3. *Anchor points for spatial memory in Experiment 1 of LAGP*

LAGP (footnotes 3, 6) attempt to refute the possibility of egocentric intrinsic encoding, pointing out that it is impossible to represent the relative location of the two dots on the cards of Experiment 1 in intrinsic terms. This is true, but irrelevant – as Figure 3 illustrates, the solution in either condition does not actually require a representation of the relative locations of the dots. Analogous arguments can be advanced for all of the experiments; e.g., in Experiment 4, the egocentric coders could memorize the target cup with respect to one side of their bodies even if they did not carry it themselves.

None of LAGP's tasks establish the employment of the relative frame – the one type of frame missing from the Tseltal language.[1] A type of task that can be solved in a relative frame but not readily in an egocentric intrinsic one, is one in which an observer's perspective is vital for distinguishing two stimuli, e.g., by imagining rotation from a perspective. The identification of enantiomorphs is perhaps the prime example of this, as famously argued by Kant (1991[1768]) (see Levinson 2003: 30-31 for a summary of the recent literature). Levinson & Brown 1994 conducted a part identification experiment (see Figure 4; Danziger in press offers a recent discussion of this type of task), and found that whereas Dutch speakers reliably distinguished enantiomorphs from one another, only one of 16 Tenejapan

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[1] Polian & Bohnemeyer (in press) report a low level of relative use in bilingual speakers in the town of Tenejapa (not the population tested by Brown & Levinson 1993), but near-complete absence in other Tseltal-speaking communities.

Tseltal speakers could be successfully trained to do so - 13 of the Tenejapans falsely accepted enantiomorphs even after having received explicit instruction and training, leading us to say, as quoted by LAGP, that Tenejapans show "a systematic downgrading of left/right asymmetries".
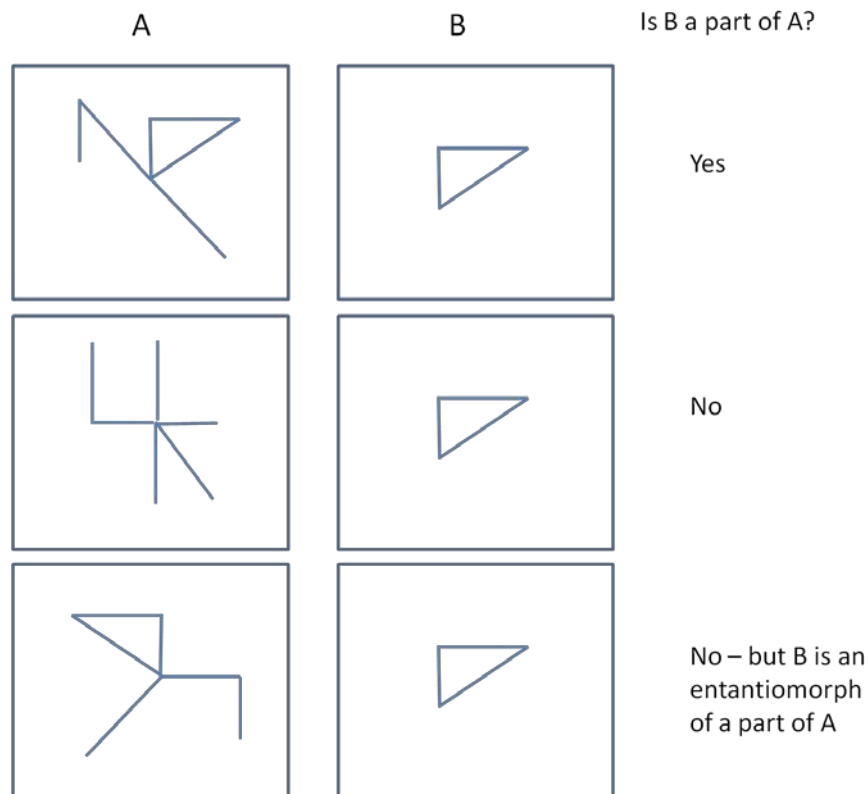

Figure 4. *Enantiomorphs in a part identification task (after Levinson & Brown 1994: 31)*

3.3. No evidence for preferential egocentric encoding. LAGP's data do not address Tseltal speakers' preferred style of spatial cognition, since their studies targeted ability, not preference (cf. also section 3.6 below). LAGP did, however, find that their participants performed in the egocentric conditions equally well or better than in the geocentric ones. But this is readily explained by asymmetries between the egocentric and geocentric conditions of the tasks:

- As mentioned, the egocentric conditions permitted the use of parts of the participants' bodies, or extensions thereof (such as the box in Figure 3), as reference points (or 'grounds'), whereas the geocentric conditions required the selection of objects of the environment as grounds.
- Knowing where one's own body parts are is given by proprioception, but keeping track of the location of the environmental grounds in the geocentric conditions under self-rotation requires systematic updating (note too the loss of visual contact with the stimulus just in the geocentric conditions in the first two experiments).
- In Experiments 3 and 4, although they were not actually holding the stimulus, participants could again readily solve the egocentric task by memorizing the correct part or place with respect to one side of their bodies or clothes (e.g. 'on the side I pocket my money').

In final analysis, what LAGP have demonstrated is not that Tseltal speakers have a bias for egocentric (let alone relative) memory coding, but rather that in these task they were perhaps better at keeping

track of the location of their own body in space than they were at keeping track of objects in the environment.

3.4. No evidence that complexity favors egocentric coding. LAGP found in their Experiment 2 that the complexity of the stimulus to be memorized (a motion path with one, two, or three "legs") impacts performance in the geocentric condition more than in the egocentric condition. This is perhaps unsurprising given that the task was easier to solve in the egocentric condition to begin with as a result of the unmatched conditions, as argued above.

Preference tasks (tasks with alternative solutions, which allow participants to follow their preferred strategies) involving increasing complexity have shown that allocentric performance does not decrease with complexity in the Tenejapan population. For example, genuine inference tasks done with spatial stimuli under rotation were performed as well or better than simple memory tasks (Levinson 2003: 163-167). Meanwhile, working both in Namibia with a population which similarly favors absolute linguistic coding in the Khoisan language Hai//om and in the Netherlands with Dutch participants, Haun et al. (2011) report that the Hai//om speakers' preference for their native geocentric strategy actually *increases* to ceiling level under increased complexity. In the simple task, the spatial relations between three objects had to be remembered, in the complex those between eight objects.

3.5. No evidence of a language-cognition mismatch. LAGP claim that their participants' performance in the egocentric conditions involves a memory coding that is outside the bounds of the language: there is, they say, an "absence of egocentric coding in their linguistic repertoires" (p.17). But in fact Tseltal has rich intrinsic as well as absolute linguistic coding (although almost no relative coding), and this allows many ways to describe locations with respect to ego (like 'near my left hand', 'near my ring finger', etc). (Many languages like Tseltal have terms for left and right body parts which can not be extended spatially, so speakers can talk in terms of their left hand but not in terms of the building to the left of the cathedral.) We argued above that participants relied on egocentric intrinsic representations such as 'near my left hand' to solve the egocentric conditions; these are congruous with the conventional linguistic strategies of Tseltal and thus consonant with a language-on-cognition effect.

LAGP also collected descriptions of some of their stimuli. Following Experiment 1, predominantly geocentric language was elicited, as expected by default. As explained above, this does not conflict with the use of egocentric intrinsic frames in the egocentric nonlinguistic task – both types of representations are native to Tseltal. Following Experiment 4, predominantly deictic and topological (i.e., non-perspectival) descriptions were elicited. Among descriptions encoded in reference frames, again geocentric representations were most frequent.

3.6. No evidence for 'Gricean doubt'. LAGP attribute the discrepancy between their findings and those of Brown & Levinson 1993 to the use of designs with single correct solutions as opposed to multi-solution ("open-ended") designs. The latter, they argue, invite what they call 'Gricean doubt' – an effect of "language on language". Given a semantically general ('ambiguous') instruction like 'Make the same array again', participants wonder what the experimenter wants, and inspect the *probabilities of the use of unmentioned words* to infer the probable interpretation.

We think this suggestion has no substance. First, 'Gricean doubt' has no initial plausibility. It seems very unlikely, for example, that if I asked someone to set up my table, computer and phone the "same way" as it was before moving it to the opposite wall, they would ask me "Do you mean same left-to-right or same north-to-south?". It seems even more unlikely that, in coming to an implicit decision, they would inspect the English language to decide that I probably meant left-to-right, because *left* and *right* are more frequent in English than *north* and *south*. Our reactions to general instructions like 'Make

it the same' rely on practice in the world, not on the probabilities of use of some *other* words that were not used (imagine the search problems involved in any such inference).

Second, although metalinguistic reasoning according to one strand of modern theory plays a known role in Gricean inference (Levinson 2000), it will not yield *this* kind of inference: it will derive instead a negative inference, e.g. from a marked form ('Do not make this unsimilar') or a weak scalar (like 'Make this warm') that the speaker is avoiding saying something, so doesn't intend it ('Don't make this exactly the same' by M-implicature and 'Don't make this hot' by Q-implicature, respectively). The kind of inference that is applicable to 'Make this the same' is, however, *not* metalinguistic, but invokes stereotypical enrichments in accord with the world (by I-implicature or Sperber & Wilson's (1995) Relevance). "Make it the same" will then mean different things in different contexts, and will be interpreted unreflectively in terms of the first thing that comes to mind (Sperber & Wilson 1995). But that is precisely what we are interested in: how do people unconsciously code and reason in situations as close to ecological validity as we can devise.

In short, there is no such pragmatic mechanism as 'Gricean doubt' with which to explain away the robust findings of correlation between linguistic and cognitive coding as matters of experimenter suggestion. Previous studies employing preference paradigms tried to systematically discourage 'double guessing', e.g. by embedding the performance of interest in an apparently different goal (e.g. focusing on the order and identity of objects to defocus on direction), or ratcheting up the task complexity either in memory load (Haun et al. 2011) or by using genuine inference tasks as well as simple memory ones.

4. The big picture

Why hunt for evidence for or against language-on-thought effects? What the two camps have been laboring to discover is the boundary between the domains of biology and culture in cognition (Bohnemeyer 2011). On the view that spatial cognition is uniform across populations, it is a purely biological system and differences in use merely reflect ecological adaptations (Li & Gleitman 2002). In contrast, on the view of spatial cognition as a bio-cultural hybrid, ecological adaptations through culture on a deep time scale become conventionalized in individual communities and must be learned by their members on an ontogenetic timescale through observable behavior such as speech and gesture (Brown & Levinson 2009; Le Guen in press). Contemporary neuroscience shows how behavioral specialization produces specialized brains. On the biological view of spatial cognition, language is an exception to this general principle; on the hybrid view, it is not. The evidence for reference frame systems as bio-cultural hybrids is summarized in Levinson (2003: 315-325). Impressive recent support for this position has come from primate cognition research (Haun et al. 2006). The question of ecological vs. linguistic determinants of reference frame use is currently explored in a large-scale study involving 15 indigenous languages of Mexico and Central America).[2] The contributions to O'Meara & Pérez Báez (in press) present first findings; a follow-up project looking at languages and cultures beyond Mesoamerica is in development.

5. Conclusions

In sum, the data reported by LAGP, given the interpretations we have outlined above, are consistent with the replicable findings from earlier work that recurrently point to an effect of preferred linguistic coding on memory coding. The attempt to explain away those robust findings in terms of an ad hoc theory of language use seems quite unconvincing. Meanwhile, the mismatch between LAGP's findings and their goals are attributable to the fact that their experimental designs were inadequate for testing the cognitive use of the one reference frame (relative) which the language Tseltal lacks, together with

with mismatched experimental conditions making the egocentric tasks easier to solve. What LAGP have successfully demonstrated is the resourcefulness of participants, who are able to use a wide array of linguistic and cognitive codings – languages, and the ways of thinking consonant with them, always offer alternatives and work-arounds. The idea that we are imprisoned in our language – ascribed repeatedly and unwarrantably to Whorf (as pointed out by Lee 1996:153) – is properly buried.

We applaud the authors (and especially Linda Abarbanell, the fieldworker in the team) for taking the trouble to test their ideas in field conditions. The cultures of the world offer psychologists 7000-odd natural laboratories for investigating weird and wonderful expertise effects. Unfortunately, we are losing them at the rate of one a week – we urge our colleagues to make use of the opportunity while it still exists.

Acknowledgments

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