Taking Stock of the Cross-Linguistic Data: Spatial Frames of Reference and Their Effect on Thought

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Spatial frames of reference (FoR) have been one of the most promising yet controversial areas to test for linguistic relativity. A primary distinction is between languages like English that primarily use an egocentric frame (e.g., left/right), and like Tseltal Mayan that use a geocentric frame (e.g., uphill/downhill). In studies across more than 20 languages, researchers from the Cognitive Anthropology Research Group (CARG) at the Max Planck Institute for Psycholinguistics found a striking correlation between the predominant FoR used by a language and speakers’ preferences for encoding small-scale spatial arrays in memory on certain tasks. For example, in the “animals” task, participants view an array of toy animals at one table and then turn to face a second table where they are asked to make the “same” array. When turning, your body axes turns with you but the environment does not, creating at least two viable solutions. Speakers of languages like Dutch aligned the animals from the same egocentric perspective, while speakers of languages like Tseltal maintained their same geocentric orientation (Brown & Levinson, 1993). These results led some researchers to conclude that linguistic FoR (re)shape speakers’ non-linguistic spatial representations, making it difficult for them to use their language-incongruent system (Levinson, 2003; Majid et al, 2004; Pederson et al., 1998). Not all researchers, however, agreed with this conclusion, taking issue in particular with the open-ended nature of the tasks which leaves it up to participants to decide what is meant by the “same” (Li & Gleitman, 2002; Li et al., 2011; Newcombe & Huttenlocher, 2000; Pinker, 2007). Two competing accounts have been proposed: a “linguistic relativity” account, where language actually (re)shapes non-linguistic cognition, and a “pragmatic inference” account, where language affects speakers’ interpretation of the task. In this paper, we attempt to reconcile the data collected since the original CARG tasks, which we argue supports the latter account.

Before we describe our own data, it is worth pointing out there are other studies that do not quite support a linguistic relativity account. For example, Mishra et al. (2003) found that Hindi speakers who use an egocentric FoR in their language and Hindi, Nepali and Newari speakers that use a geocentric FoR all preferred the geocentric response on the animals task involving a static array but an egocentric response on a maze task involving a motion path. The same pattern was found among Balinese speakers who use a geocentric FoR in their language (Wassman & Dassen, 1998), suggesting that we encode different types of spatial information using different reference frames. Even some of the original CARG members sometimes struggled to reconcile inconsistencies in their results. In his work with Kilivila, Senft (2001, 2007) noted that many “uncontrolled parameters” could affect the results (2007: 241). Minor differences in procedures
such as whether participants carry the animals to the second table (Cottereau-Reiss, 1999) and the wait time between the two tables (Brown & Levinson, 1993) have been found to affect the results.

In our work with Tseltal and English speakers (Abarbanell, 2010; Li et al., 2011), we adapted some of the original CARG tasks to have two matched conditions, egocentric and geocentric, with clear, correct solutions. By comparing the error rates across these conditions we were able to actually test which system is easier for speakers to use. We found that Tseltal, like English-speakers, could reason equally well using either reference frame and even did better in the egocentric condition on some tasks. Some have argued that we are merely demonstrating speakers’ competence but not their preference (Bohnemeyer & Levinson, 2011; Haun et al., 2011). However, the error pattern on our tasks illustrates that this is not the case. In our “swivel chair” task (Li et al., 2011, Exp. 3), Tseltal-speakers watched as an experimenter hid a coin in one of two boxes to their left/north or right/south side. They were then rotated, eyes closed, to face another direction, and then asked to indicate, eyes open, the location of the coin. Importantly, the number of errors in the geocentric condition varied by the degrees of rotation, with the most errors at 180º, that is, when the view of the environment was the most mismatched from participants’ initial orientation. In contrast, their performance on the egocentric trials was robust regardless of rotation. We did not force them to reason in a way they did not prefer, rather the error pattern confirms that Tseltal speakers take in such spatial information from a body-based perspective, the same as you or I.

A second critique (see Bohnemeyer & Levinson, 2011) concerns the fact that in some of our tasks (e.g., Li et al., 2011, Exp. 1 & 2) participants carry the stimulus array, covered, from the first to the second table, either rotating it with their bodies in the egocentric condition or holding it stable with the environment in the geocentric condition. They then uncover the array to check their responses. Might this afford an alternative strategy in the egocentric condition? For example, could the Tseltal speakers have simply tracked which item was closest to this thumb or that, which can be easily expressed in Tseltal? We note that this would be difficult to do on the multi-legged motion paths (Exp. 2). Moreover, our results held even when participants no longer carried the array (see the “leave box” and “leave maze” trials in Exp. 1 & 2), when the experimenter moved the array (Exp. 4), and even on tasks that required no carrying at all. Recently, for example, we tested Tseltal-speaking children on the CARG group’s more difficult transitive inference task where the relationship between three objects is revealed two at a time across two tables using the transitive property (e.g., if A is left/north of B, and B is left/north of C, then A is left/north of C). In our version, we used models of fronted buildings rather than symmetrical forms, such that their facing orientation across the two tables indicated which FoR participants were expected to use. We found no difference in performance between the two conditions ($F(1,23) = 1.67, p = .21$). If anything, the children did better in the egocentric than the geocentric condition (66.7% vs. 52.5% correct).

A final challenge to our results came from Haun et al. (2011) who tested Hai//om (Namibia) and German-speaking children on an animals-type task and found that a difference in
performance between the two groups persisted even on instructed trials that, like our tasks, had correct solutions. On closer inspection, however, their instructed trials used left/right terms that are rarely used in Hai//om, and they did not control for a perseveration effect among the German children who always received the egocentric before the geocentric trials. Using a similar task with Tseltal and English-speaking children, we found that once we eliminated left/right language from the instructions, the Tseltal children did as well as the English speakers in the egocentric condition, and curiously, both groups did better on the geocentric trials (Abarbanell, Montana & Li, 2011; Li & Abarbanell, revise & resubmit). How do we reconcile these results with the egocentric advantage found by Li et al. (2011)? The answer involves the distance and degrees of rotation between the two tables. With a 90° rotation and the tables close together so participants can see the same environmental landmarks, the children do better in the geocentric condition, but with 180° rotation this advantage disappears (Li & Abarbanell, revise & resubmit, Exp. 3). This finding concurs with studies in the spatial cognition literature (Rieser, 1989; Presson, & Montello 1994; Farrell & Robertson, 1998; Simons & Wang, 1998). It also explains the findings of Haun et al. (2006) who reported a geocentric preference among three species of great apes and prelinguistic human infants. When Rosati (2015) performed a similar experiment with the tables far apart and a hallway in-between, rather than abutted as in Haun and colleagues’ task, non-human primates favored the egocentric solution. We are sympathetic to the position that the habitual use of a FoR in language might influence speakers’ cognitive preferences by making the underlying concepts more salient or better packaged for use, although this seems to be more plausible for spatial relations that are less readily available, such as the development of non-egocentric left/right (Abarbanell & Li, 2009, 2015). The body of findings as outlined here, however, argue decisively against the strong claims of linguistic relativity that were based on the original CARG tasks (Levinson, 2003). Navigation and spatial reasoning require multiple FoR (see e.g., Burgess, 2005; Gallistel, 2002). Is it really sensible to think that the lack of linguistic expressions to express a FoR means that the underlying representations are not sufficiently exercised, practiced, or used? Given the extant data, we are inclined to believe speakers of different languages encode spatial scenes in much the same way, relying on the same cognitive hardware and processes, with task structure, rather than habitual language use, determining which system is easier to use in any given context.

References


Cottereau-Reiss, P. (1999). L’espace kanak, ou comment ne pas perdre son latin [Kanak space, or how not to lose one’s Latin], Annales Fyssen 14: 34–45.


