Reference Frames as Mechanisms for Mapping Language onto Space

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Reference frames are considered mechanisms for mapping language onto space (Carlson, 1999; Landau & Jackendoff, 1993; Levelt, 1984; Levinson, 1996; Logan, 1995). A typical mapping example involves a spatial description of a perceptual event. For an example from Carlson (2003), imagine a speaker telling a listener who is holding a coffee pot: (1) “The coffee mug is below the coffee pot.” Each of these objects plays a distinct role in this spatial description. The coffee pot serves as a reference object, acting as a landmark from which to describe the location of the coffee mug, also known as the located object. The spatial description thus assists the listener in finding the located object by reducing the area that needs to be searched to the space around the reference object. This space is demarcated through the application of a reference frame, a family of representations (Shelton & McNamara, 2001) that are instantiated through a set of parameters that apply the representation to a particular perceptual event (Logan & Sadler, 1996). A reference frame is typically thought of as consisting of a set of coordinate orthogonal axes whose intersection point is called the origin. The origin is imposed upon the reference object and defines the surrounding space through the orientation and direction parameters. Orientation specifies whether a given axis is horizontal (front/back or left/right) or vertical; direction specifies the endpoint of a given axis (for example, left vs. right). These axes also have a scale that indicates the units of distance applied to the space. Finally, a spatial template further parses the space around the reference object into regions for which the spatial terms offers a god, acceptable or unacceptable characterization of the located object’s placement (Carlson, Regier & Covey, 2003; Carlson-Radvansky & Logan, 1997; Logan & Sadler, 1996).

Most of the research on setting the parameters of a reference frame has been done with English speakers. Below, I discuss the factors that impact these parameters, and address the possibility of cross-linguistic variation.

Origin. Previous research has shown that the identity of the located object, the reference object and the functional interaction between the objects play a role in defining the origin—that is, where the reference frame gets placed within the reference object (Carlson-Radvansky et al., 1999; Carlson & Kenny, 2003). For example, in a neutral context in which the speaker in (1) is drawing the listener’s attention to the mug as a souvenir from a trip, its relationship to the coffee pot is not emphasized, and the located object is assumed to be geometrically below the center of
mass of the coffee pot itself. However, in the context of a speaker making an indirect request of the listener to pour a cup of coffee (Clark, 1996), the ideal location of the coffee mug is not in fact under the pot at all, but under the spout, off to the side. Thus, the role of the objects and their interaction may play a critical function in defining the origin. Coventry, Prat-Sala & Richards (2001) (see also Carlson, 2000) have shown that the strength of this functional influence may vary across types of spatial term (for example, over vs. above). This within language variation suggests the possibility of cross-language variation in the relative strength of geometric and functional information.

**Orientation and Direction.** Orientation and direction together assign directions to space around a reference object. Different sources of information can be used to set these parameters, resulting in different types of reference frames. For example, Levinson (1996) proposes that the features in the environment define the absolute reference frame, the speaker or listener defines the relative reference frame, and the reference object defines the intrinsic reference frame. Often times, these sources of information are in conflict, resulting in different mappings for a given spatial term. Some work from my lab shows that for English speakers initially all reference frame mappings are considered, followed by an inhibition of the non-selected reference frame (Carlson-Radvansky & Jiang, 1998). Looking at the locus of this inhibition, it appears that particular preferred axes are always inhibited, and less-preferred axes inhibited only selectively (Carlson & van Deman, 2008). Because cross-linguistically there are different preferences for using different types of reference frames (Levinson, 2003), this suggests that locus of inhibition and the manner in which a reference frame is selected, and more particularly, the locus of inhibition, may differ cross-linguistically.

In addition, there is evidence that orientation and direction are separate representations. For example, Logan (1995, 1996) observed savings in response time in a spatial cueing task in which participants could respond on the basis of orientation, with additional time needed when direction had to be further specified. Relatedly, Hoffman et al. (2003) observed impairments in patients with Williams Syndrome in a placement task, such that errors were more likely to occur at the wrong endpoint of the correct axis, rather than at a random location, indicating some preservation of axial structure without a further refinement by endpoint. These findings have important cross-linguistic implications, particularly for languages that do not explicitly demarcate left vs. right, but rather use the more general “side”. For these speakers, it may be possible that the endpoints remain unspecified until needed.

**Scale and Spatial Templates.** The scale and spatial extent of the region that is demarcated by a spatial term has been woefully under-studied, both within a given language and across languages. Morrow and Clark (1988) observed that the size of the located and reference objects significantly impacted the distance that was inferred between them for spatial descriptions containing the verb “approach.” Carlson and Covey (2005) built on these findings and demonstrated that English speakers were influenced by the properties of the objects in inferring
their distance for topological (e.g., “near”) and projective (e.g., “left”) spatial terms. Importantly, the spatial term also influenced distance estimates. To the extent that terms are associated with different distances cross-linguistically, one may thus expect to see variation in the spatial extent and scale of these regions (for example, see Regier & Carlson, 2002).

References
Coventry, K., Prat-Sala, M., & Richards, L. (2001). The interplay between geometry and function in the comprehension of *over, under, above* and *below*. *Journal of Memory and Language* 44: 376–398.