ENVIRONMENTAL AND SOCIAL FACTORS IN THE EMERGENCE OF SPATIAL LANGUAGE

Kristian Tylén[*1,2], Zahra Alinam[3], and Cordula Vesper[1,2]

[*]Corresponding Author: kristian@cc.au.dk
[1]Deparment of Linguistics, Cognitive Science and Semiotics,
Aarhus University, Aarhus, Denmark
[2]The Interacting Minds Centre, Aarhus University, Aarhus, Denmark
[3]Architecture & Urbanism Faculty, Tabriz Islamic Art University, Tabriz, Iran

Abstract

Languages across the world vary in how they construe simple spatial relations (Majid et al., 2004). It is, however, far from clear what the source of this variation is. One suggestion is that variation is driven first and foremost by cultural and historical factors such as language contact, transmission, and stochastic drift. As languages are passed down from generation to generation, cognitive biases for structure, compressibility and expressibility shape the emergence of linguistic structure and conventions (Christiansen & Chater, 2008; Kirby et al., 2015). In turn, when a speaker acquires a particular natural language, the structure of that language can influence how she will distribute attention and conceptualize her surrounding giving rise to *linguistic relativity* effects (Bowerman, 1996; Levinson, 2003; Roberson et al., 2005).

Another suggestion is that variation evolves contingent on ecological and environmental factors (Lupyan & Dale, 2016; Winters et al., 2015). The structure of our surrounding environment (affordances) can thus come to bias which conceptual solutions are experientially salient and thus influence which linguistic structures are stabilized (Nölle et al., 2020; Tylén et al., 2013). Here, we present a model that attempts to integrate the two elements (linguistic relativity and the linguistic niche hypothesis) in one dynamical system and provide experimental evidence to test its predictions. The model assumes dynamical circular causality

between environmental affordances and cognitive construal enhanced through cultural transmission (Alinam et al., 2021).

In a preregistered experiment, we used Virtual Reality to study the interactive processes shaping these affordances and their implications focusing on the case of urban environments. Seventy-two participants performed a navigation task first following, and later creating, instructions to find a target object in an urban environment. In each session, a participant would search a virtual urban space for a target, return and make written instructions for the next participant about where to go and look for the target. The same procedure repeated in a transmission chain of 6 generations, where the instructions of the previous participant was passed on to the next. In order to investigate the contingencies between environmental affordances, conceptualization and linguistic interaction, half of the participants did the task in an urban space characterized by windy streets and salient colorful building textures (henceforth the "Barcelona" condition), while the other half did the task in an urban space characterized by straight perpendicular streets and buildings with desaturated color/texture (the "Manhattan" condition). Number of houses, street crossings and their relative position was kept constant between the condition.

In support of our predictions, we find that route descriptions differed between conditions. Descriptions in the Barcelona condition were generally more reliant on local salient vertical landmarks while participants in the Manhattan condition relied more on horizontal and cardinal cues. This suggest that participants are susceptible to the visuo-spatial affordances on their local environment when preparing their instructions supporting the linguistic niche hypothesis. However, more interestingly, these tendencies are enhanced over generations in the transmission chains. Reading the verbal instructions of the previous participant seems to bias the attention of the current participant towards particular cues in the environment. Searching for the target, participants pay more attention to those dimensions of the space profiled in the instructions. And in turn, when later writing their own instructions for the next participant, they seem to not only reproduce description expressing the attentional profile of received instructions, but to even enhance such biases over generations. This is indicative of a linguistic relativity effect (at least according to a weak version of this).

Together, our results point to the mutually enhancing influences of (non-linguistic) environmental affordances and language in guiding attention and conceptualization, and can inform discussions of how linguistic structure emerge contingent on environmental structure.

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