From words to memory: Evidence of language guiding motion event reconstruction
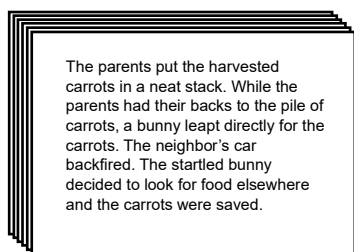
Two primary verb categories exist in human languages: manner and path. Manner verbs describe how a subject moves (e.g., *shoot* and *swim*), whereas path verbs indicate the direction of movement (e.g., *enter* and *rise*) [1]. Languages are categorized as manner or path based on the predominant verb class, resulting in manner languages (e.g., English and German) and path languages (e.g., Turkish and Spanish). These typological variations in language influence non-linguistic perception and memory in different ways [2, 3]. Prior research shows that language usage influences manner and path information prioritization. Linguistic production data supports this idea: individuals demonstrate a preference for verbs in the major verb category of one's language [e.g., 4, 5, 6, 7]. Evidence from gaze data, which shows that individuals first attend to the aspect of motion encoded most frequently in their language when preparing to speak [e.g., 5, 6] also advocates for language effects on aspect saliency. The current study had two main goals. First, it aimed to test whether language continues to affect manner versus path saliency when encoding from language to an internal representation. Past studies investigating motion saliency generally used a paradigm in which participants viewed depictions of events and then linguistically encoded them [e.g., 4, 5, 6, 7]. We designed a new paradigm in which participants read a linguistic event and then recalled the event from memory during an image-selection task, therefore reversing the classic paradigm. If one's language experience affects the saliency of different aspects of motion, the aspect of motion encoded by a language's majority verb class should be recalled by the speakers of that language (e.g., manner language speakers will find manner of motion to be more salient than the path of motion). Because our paradigm requires the target aspect of motion to be held in memory, observing differences in saliency between the language groups would indicate that language influences recall in addition to online processing. The second goal was to explore how the type of sentential element and the order of presenting manner and path information influenced the saliency of the motion aspects. Past studies focused on aspects of motion encoded in verbs, but other sentential elements known as modifiers also encode manner and path (e.g., adjectives, adverbs, prepositions) [1]. Little work has been done on how the location of motion information and sentential element affect cognition. The new linguistic-to-visual paradigm allowed us to test this question.

Procedure & materials. This experiment was conducted as an online survey. English monolinguals (N = 63) and Spanish-English bilinguals (N = 21, data collection is ongoing) participated in a linguistic encoding task followed by a forced-choice memory task. Participants completed four blocks. In each block, participants read six English paragraph vignettes with an embedded target event phrase and then completed six memory questions in which they selected the image that best corresponded to the target phrase events (Table 1; Figure 1).
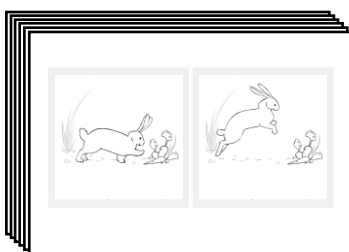
Results & discussion. Memory task responses were analyzed using logistic mixed effects models and revealed significant interaction effects between language group and aspect of motion recalled ($\beta_{interaction}$ = -.94, p < .01). Further significant effects of the target phrase condition on image selection were revealed by the model when comparing the path with path+manner modifier conditions ($\beta_{verb-type}$ = -1.36, p <.001) and the two modifier conditions ($\beta_{verb-type}$ = -1.3, p < .001). English monolinguals selected more manner images after reading both the manner-framed and path-framed phrases, whereas Spanish-English bilinguals selected more manner images after reading manner-framed events but more path images after path-framed events (Figure 2). When presented with extra path or manner information via the modifiers, both monolinguals and bilinguals selected manner images when manner information was present in the phrase. This pattern of results suggests that the manner of motion was overall more salient than the path of motion. Taken together, our results support the idea that typological variance gives rise to differences in memory for motion events [2, 3]. These findings align with prior studies in demonstrating that language type affects aspects of motion saliency

and verb selection [e.g., 4, 5, 6, 7] and further highlight the interplay between language and perception. In addition, greater path information saliency in manner- and path-language bilinguals compared to manner language monolinguals—even when engaged with a manner language—patterned consistently with the hypothesis that L1 and L2 language systems are intertwined rather than independent [7]. Furthermore, regardless of the presentation order, sentential element type, and participant's language experience, manner was more salient than the path of motion. One potential explanation for this could be because the manner of motion is closer to the agent than the path of motion in that the agent performs the manner whereas the path is external to the agent. Finally, the current findings demonstrate the validity of our new paradigm by corroborating the results of past studies. Through this paradigm, researchers can reach more linguistically diverse populations to further the understanding of the interplay between language and perception.

| Condition	Target phrase	Paragraph Vignette
Manner	A bunny **leapt** for the carrots.	The parents put the harvested carrots in a neat stack. While the parents had their backs to the pile of carrots, **[ ]**. The neighbor's car backfiered. The startled bunny decided to look for food elsewhere and the carrots were saved.
Path	A bunny **headed** for the carrots.	
Path + manner modifier	A bunny headed for the carrots **energetically.**	
Manner + path modifier	A bunny leapt **directly** for the carrots.	

The parents put the harvested carrots in a neat stack. While the parents had their backs to the pile of carrots, a bunny leapt directly for the carrots. The neighbor's car backfired. The startled bunny decided to look for food elsewhere and the carrots were saved.

x6 paragraph

x6 image pairs

Table 1 (above)**.** Example the four conditions by each target and the paragraph they were embedded in.
Figure 1 (left)**.** Trial structure of one block.
Figure 2 (below)**.** Average proportion of images selected that match the motion in the target phrase verb (bolded) by the two participant groups.
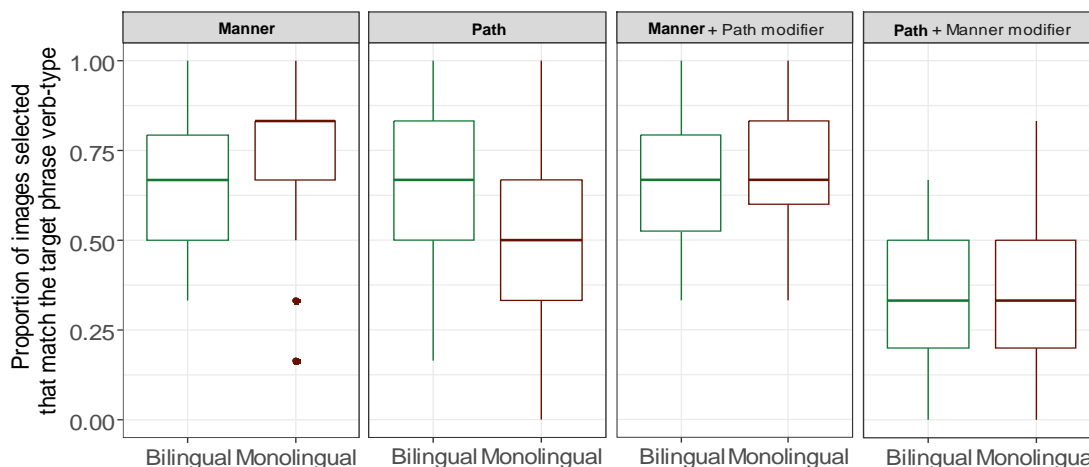
References. [1] Talmy, L. (1985). Lexicalization patterns: Semantic structure in lexical forms. In T. Shopen (Ed.), Language typology and syntactic description (pp. 36-149). Cambridge: Cambridge University Press. **[2]** Slobin, D. I. (1996). From "thought and language" to "thinking for speaking". **[3]**Slobin, D. I. (2003). Language and thought online: Cognitive consequences of linguistic relativity. Language in mind: Advances in the study of language and thought, 157192. **[4]** Naigles, L. R., Eisenberg, A. R., Kako, E. T., Highter, M., & McGraw, N. (1998). Speaking of Motion: Verb Use in English and Spanish. Language and Cognitive Processes, 13(5), 521–549. **[5]** Papafragou, A., Hulbert, J., & Trueswell, J. (2008). Does language guide event perception? Evidence from eye movements. Cognition, 108(1), 155–184. **[6]** Bunger, A., Skordos, D., Trueswell, J. C., & Papafragou, A. (2021). How children attend to events before speaking: Crosslinguistic evidence from the motion domain. Glossa: a journal of general linguistics, 6(1). **[7]** Filipović, L. (2011). Speaking and remembering in one or two languages: Bilingual vs. monolingual lexicalization and memory for motion events. International Journal of Bilingualism, 15(4), 466-485.