The Goal Bias in Language and Memory: Explaining the Asymmetry

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Abstract

In language, speakers are more likely to mention the goals, or endpoints, of motion events than they are to mention sources, or starting points (e.g. Lakusta & Landau, 2005). This phenomenon has been explained in cognitive terms, but may also be affected by discourse-communicative factors: For participants in prior work, sources can be characterized as given, already-known information, while goals are new, relevant information to communicate. We investigate to what extent the goal bias in language (and memory) is affected when the source is or is not in common ground between speaker and hearer, and thus whether it is discourse-given or -new. We find that the goal bias in language is severely diminished when source and goal are discourse-new. We suggest that the goal bias in language can be attributed to discourse-communicative factors in addition to any cognitive goal bias. Discourse factors cannot fully account for the bias in memory.

Keywords: Source-Goal Asymmetry; Language Production; Goal bias; Discourse; Common Ground

Introduction

At their core, motion events involve movement of an object (i.e. the Figure) from a starting location (i.e. the Source) to an endpoint (i.e., the **Goal**; Talmy, 1983; cf. *A butterfly flew from a lamppost* ***to a chair***). Prior work has shown, though, that all these parts may not be "created equal". When talking about motion events, speakers are much more likely to mention the goal, or endpoint, of motion than they are to mention the source, or starting point (Lakusta & Landau, 2005, 2012; Papafragou, 2010; Regier & Zheng, 2007). This goal bias in language holds across ages (Papafragou, 2010; Lakusta & Landau, 2012; Lakusta, Muentener, Petrillo, Mullanaphy, & Muniz, 2016); different types of motion events (Lakusta & Landau, 2005, 2012); typologically different languages (e.g., Regier & Zheng, 2007; Johanson, Semilis, & Papafragou, in press); and even among deaf homesigners who lack exposure to conventional language (Zheng & Goldin-Meadow, 2002).

A similar goal bias has been shown in non-linguistic domains of cognition, such as memory, where goals have been shown to be more accurately encoded in memory than sources (e.g., Papafragou, 2010; Regier & Zheng, 2007; Regier, 1996). As in language, the goal bias in memory has been demonstrated across different types of motion events (Lakusta & Landau, 2012). And, has also been observed in pre-linguistic children (Lakusta, Wagner, O'Hearn, & Landau, 2007; Lakusta & Carey, 2015; Lakusta & DiFabrizio, 2017), suggesting that goals occupy a privileged, more salient status in non-linguistic as well as linguistic event representations.

Thus, in conjunction with a large body of work showing that infants attend to the goals or intentions of an event (e.g., Meltzoff, 1995; Bekkering, Wohlschläger, & Gattis, 2000), the presence of the goal bias in language and memory for *motion* events, also provides some basis to suggest that the linguistic bias has cognitive roots (e.g., Regier, 1996, Regier & Zheng, 2007; Srinavasan & Barner, 2013). Complicating this picture, though, is the fact that the goal bias in memory seems noticeably less robust compared to the goal bias in language. This is especially true when events no longer depict a prototypical *animate* agent moving from one inanimate reference point to another (Lakusta et al., 2007; Lakusta & Landau, 2012; Lakusta & Carey, 2015; Lakusta & DiFabrizio, 2017). In cases like these, some researchers have failed to find evidence of the goal bias in memory – even when the same studies have found a clear goal bias in language and even when the same materials have been used across linguistic and non-linguistic tasks (Lakusta & Landau, 2012).

The discrepancy between the strength of the goal bias in language and memory has been difficult to reconcile with claims that the goal bias is fundamentally rooted in the same (cognitive) mechanism in both domains. In particular, if the mechanism responsible for the goal bias in language is also responsible for the goal bias in memory, why doesn't the bias appear to work in precisely the same way across domains?

The present work proposes a novel explanation for the observation that the strength of the goal bias in linguistic production tasks is more robust than in non-linguistic tasks. We posit that the comparatively more robust goal bias in language may be attributable to an *additional* discourse/communicative asymmetry: When individuals are asked to describe video clips of simple motion events, the initial state of affairs – including the source (i.e., starting point) of the motion – is reasonably assumed to be given. By

contrast, the goal of the motion event (i.e., the endpoint) is considered 'the news' that is relevant to communicate. This makes sources less likely to be mentioned (see Lakusta & Landau, 2012 for a discussion of this possibility). To preview our results, we find evidence in support of this discourse/communicative account: Changing the discourse/communicative status of the source in motion events severely weakens (but does not eliminate) the goal bias in language. We conclude that in language, discourse/communicative factors operate over and above the more general cognitive factors that might drive the goal bias observed in memory.

The Current Study

Prior work on linguistic aspects of the goal bias has typically involved a single participant, who (i) sees a figure located at or near the source (i.e. starting point) of the motion event, (ii) presses a button to watch the event unfold, and then, (iii) describes the event out loud to either no one in particular or a physically co-present, but conversationally unengaged experimenter. Because motion clips in these paradigms typically begin with a scene that sets up the start of the event, the source can be considered already known, 'discourse-old', information, while the goal is considered the 'discourse-new', relevant piece of the event.

Given that speakers have a preference to mention discourse-new over discourse-old (i.e. "given") information in their utterances (Arnold, Wasow, Losongco, & Ginstrom, 2000), a consequence of this single-speaker paradigm may be that it inadvertently creates the conditions for a goal bias both in speakers' descriptions and their representations of motion events in memory. Specifically, participants who do not have to take into account the knowledge state of their interlocutor prioritize mentioning only what is new and relevant to themselves or a 'generic' addressee – in this case, the goal or endpoint of the motion event.

Unlike prior work, the current study asks participants to describe motion events to an attentive, engaged confederate addressee. The presence of an engaged addressee allows us to probe whether the goal bias in language can at least partially be attributed to an asymmetry in the *discourse/communicative status* of sources (typically presented as known, discourse-given entities) versus goals (typically unknown, discourse-new entities) in motion events. This is because the introduction of an addressee allows speakers to consider not only what is discourse-new to themselves, but also what is discourse-new (and presumably relevant to communicate) to their interlocutor.

This discourse/communicative account of the goal bias predicts that changes to the discourse status of the source should affect the magnitude of the goal bias in language. In particular, we expect the goal bias to weaken when sources are also made discourse-new. Alternatively, if the goal bias in language and memory is *purely* driven by a more general cognitive bias towards goals, then changing the communicative setting in which motion events are described should not affect the magnitude of the goal bias in language.

To test the discourse/communicative account, we manipulated the context in which participants described motion events. Participants in our Common Ground condition were asked to describe the motion event to a confederate addressee for whom information about the starting point of the motion was already known – that is, the source constituted discourse-given information. By contrast, participants in our No Common Ground condition were asked to describe the motion event to a confederate addressee that knew nothing about the upcoming motion event – that is, both the source and goal constituted discourse-new, relevant information to communicate about.

Following prior work, we investigated the goal bias in *language* by comparing the proportion of source versus goal mentions as participants describe motion events. We investigated the goal bias in *memory* using an adaptation of the change detection paradigm; we compared how accurately speakers remember sources versus goals *after describing events to an addressee*.

Methods

Participants Fifty-four native speakers of American English (mean age = 20; 28 male, 32 female) participated in the experiment for course credit or $10/hour – 27 in the Common Ground and 27 in the No Common Ground group. The number of participants was determined based on a power analysis of previously reported effects in the literature.

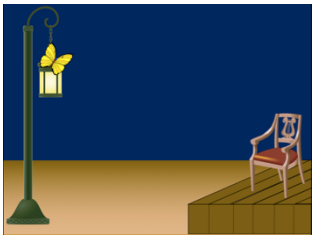
Materials We created 18 test clips, each of which depicted an animate entity moving from an inanimate source landmark (i.e. the starting point of motion) to an inanimate goal landmark (i.e. the end point of motion). (Clipart images were used. See Figure 1a for an example of a butterfly moving from a lamppost (the source) to a chair (the goal)). Each clip was roughly three seconds in length.

Clips were left-right counterbalanced such that half of our clips showed a figure moving from a source on the left to a goal on the right and the other half showed a figure moving from a source on the right to a goal on the left. Source and goal landmarks were also counter-balanced across lists such that objects which were the source of motion in one list were the goals of motion in another. This was done to ensure that our results would not be confounded by the inherent perceptual or conceptual salience (and by extension, salience in linguistic mentions or memory) of one landmark over the other. We also included 18 filler motion events, which did not involve motion between a source and a goal. These filler items were designed such that participants were not able to predict, based on the first frame of the video, whether the clip would eventually involve a source-to-goal motion event.

We probed speakers' encoding of these events in memory using a version of the change detection task used by prior work (Regier & Zheng, 2007; Lakusta & Landau, 2012; Papafragou, 2010). For this, we constructed a second set of videos that involved: (i) Changing the Source (ii) Changing the Goal; or (iii) No Changes (i.e., participants saw a video identical to the one they had previously described). Source and goal changes were always replaced with within-category

variants (e.g., the chair was changed to a different example of a chair; Figure 1) to control for the semantic distance between the original and changed object.

(Figure 1a)



(Figure 1b)

Figure 1. (a) Sample first frame of the 'butterfly flying from the lamppost to the chair' clip. In Common Ground conditions, both participant and addressee saw the first frame; in No Common Ground conditions, only participants saw this. Only participants saw events unfold. (b) Sample goal change in the memory task. The original chair was replaced with a slightly different chair.

Procedure Participants were told that they would be performing the experiment with a partner (in reality, a confederate addressee). Participants were told that they would be watching brief video clips and then describing them to their partner. Their partner would see a simple question about the clip on a separate screen and would answer those questions based on the participant's descriptions.

To demonstrate that the addressee was engaged in the experiment, participant and confederate addressee completed a Tower of Hanoi task together. Afterwards, participants performed two practice trials before moving on to the main experiment. Because prior work has shown that the level of engagement of an addressee can affect how much information speakers choose to include in their utterances (Clark & Wilkes-Gibbs, 1986; Bavelas, Coates, & Johnson, 2000) and may also affect speakers' later memory for the event (Pasupathi, Stallworth, & Murdoch, 1998), confederate addressees maintained eye-contact during event descriptions and verbally indicated when they were ready for the next trial (i.e., 'mhmm', 'ok', 'yup', 'I'm ready'). Critically, confederates maintained the same level of engagement in all conditions and used the same verbal indicators regardless of the utterance produced by participants.

Participants were seated in one of two experimental configurations. In the Common Ground condition (Figure 2), both speaker and confederate addressee were seated side-by-side in front of a centrally-located computer screen. Each trial began with the first frame of the video clip shown on this screen. Thus, both speaker and confederate addressee saw the figure's location relative to the source and the goal landmarks; more specifically, they saw where the animate figure started out in each clip. After briefly inspecting the scene, the addressee turned the participants' screen away so that the addressee was not able to watch the clip unfold.

In the No Common Ground condition (Figure 3), speaker and confederate addressee were seated across from each other so that neither could see each other's screens. Speakers were thus led to believe that addressees in this condition were unable to see *any* part of the video clip.

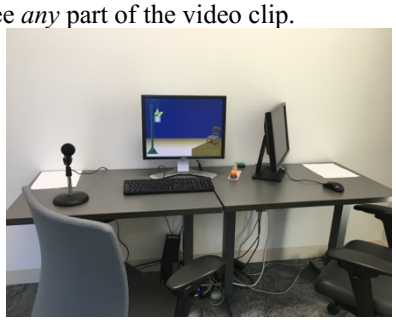


Figure 2. Common Ground configuration. Participants were always seated on the left, confederate addressees on the right. Confederate addressees were shown the first frame of the clip on the participant's screen before turning the screen away.

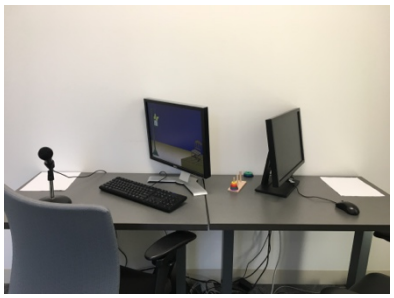


Figure 3. No Common Ground configuration. Participants were always seated on the left, confederate addressees on the right. In the No Common Ground condition, confederate addressees were not permitted to see any part of the participant's computer screen.

In both Common Ground and No Common Ground conditions, participants received the same set of video stimuli and participants performed the same tasks. They were told in all cases that confederate addressees would be answering a simple question about each video clip based on the speakers' description of what happened in each clip.

After finishing the description portion of the experiment, participants were separated from the confederate and participants were given a surprise memory task. During this portion of the experiment, participants were shown the (i) Source Change, (ii) Goal Change, or (iii) No Change variants of the test videos. This was a within-participant manipulation such that six items were randomly assigned the Source Change condition, six to the Goal Change, and six the no Change. Participants were told to circle 'Yes' on their answer sheet if the second video clip was 'exactly the same' as the clip that they had originally described; they were told to mark 'No' otherwise. Thus, correct responses in the Source and Goal Change conditions were always 'No' (i.e., they correctly rejected), but correct responses in No Change condition was always 'Yes' (i.e., they correctly failed to reject). Participants were only tested for memory of target items; clips in the memory portion of the study were presented in the same order as in the scene description portion

of the study.

Predictions

In the Common Ground condition, where the addressee was allowed to see the starting point of the motion event, the source (as in prior work) was discourse-given. However, in the No Common Ground condition, where the addressee was not privy to any information about the motion event, both source and goal were discourse-new.

On a purely cognitive account of the goal bias, the discourse status of entities in a motion event should not affect the frequency of mention of sources and goals. By contrast, on a discourse/communicative account of the goal bias, the goal bias in language should be severely weaker in the No Common Ground condition – where both sources as well as goals were discourse-new – than in the Common Ground condition – where only the goal was discourse-new.

A somewhat independent question is how linguistic descriptions of motion should affect later memory of that motion event. One possibility is that the generation of more informative linguistic representations implies the prior generation of more informative non-linguistic representations. If so, then we expect the patterns in the linguistic description portion of our study to largely correspond to the patterns that emerge in the memory portion of the study. That is, memory for sources should be more accurate in the No Common Ground condition than in the Common Ground condition, where relevant information was not just limited to the goal of motion. It is also possible, though, that there may be no direct relationship between what is mentioned in the motion event and what is subsequently remembered. For instance, even if speakers were more likely to talk about sources in the No Common Ground condition, memory for sources might nevertheless remain relatively impoverished compared to memory for goals.

Results

Language Productions We were primarily interested in how frequently speakers would mention sources relative to goals in their event descriptions. We coded whether each utterance included mention of the source and/or goal of the motion event. Following prior work (e.g. Lakusta and Landau, 2012; Papafragou, 2010), all mentions of sources and goals within (i) a prepositional phrase (e.g. 'from the chair'; 'off the chair'; 'to the chair'; etc.), (ii) within the verb + NP structure (e.g. 'left the cave'), or (iii) within a verb + particle structure (e.g. verb + 'away from the tree') were included.

Statistical analyses of the rate at which sources and goals were mentioned were done using a logistic mixed effect model. Ground Type (Common Ground vs. No Common Ground) and Mention Type (Source vs. Goal) were included as fixed effect factors. Mention Type was included as part of the by-subject and by-item random effects; Ground Type was only included as part of the by-item random effects. We simplified the model only if it failed to converge or if random effects did not significantly improve model fit.

As can be seen in Figure 4, in both the Common Ground and No Common Ground conditions, we replicated the goal bias observed in prior work (Lakusta & Landau, 2005, 2012; Papafragou, 2010). In the No Common Ground condition, though, the goal bias was severely weakened: The preference to mention the goal over the source was greater in the Common Ground condition than in the No Common Ground condition. Consistent with this, we detected significant main effects of Mention Type (ß= 3.26, SE= 0.59, $|z| = 5.51$, $p < .01$) and Ground Type (ß= 1.58, SE= 0.75, $|z| = 2.11$, $p < .05$), but these were modulated by a reliable Ground x Mention interaction (ß= -3.06, SE= 0.99, $|z| = 3.11$, $p < .01$).

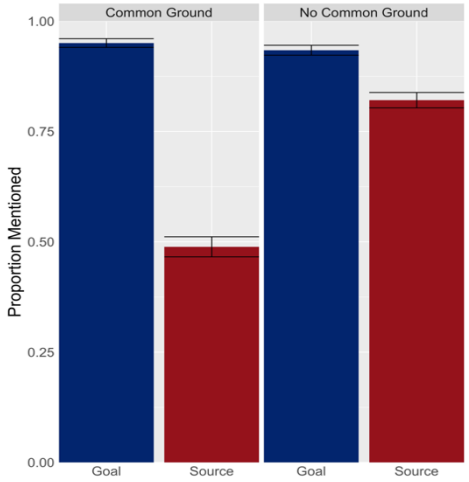


Figure 4. Proportion of Source (Red) and Goal (Blue) mentions in Common Ground and No Common Ground conditions. Error bars represent +/- 1 standard error.

Memory for Sources and Goal Accuracy in the memory task was analyzed using logistic mixed effects regressions. We included Ground Type and Change Type (Source Change or Goal Change) as fixed effects. Random effects were structured as before. The No Change condition was omitted from this analysis because it served only as an indicator of baseline performance and indeed, was similar in both Common Ground and No Common Ground Conditions (Figure 5; yellow).

Overall, participants were more accurate in the No Common Ground than in the Common Ground conditions, resulting in a significant main effect of Ground Type (Figure 5; ß = 1.07, SE = 0.38, $|z| = 2.82$, $p < 0.01$). Participants were significantly better at detecting changes to the Goal (Blue) than to the Source (Red) in both the Common Ground and No Common Ground conditions (ß = 0.90, SE = 0.22, $|z| = 4.19$, $p < .001$). However, the failure to detect a significant Ground x Change interaction (ß = -0.17, SE = 0.42, $|z| = 0.39$, $p = 0.69$) suggests that the strength of the goal bias in the Common Ground vs. No Common Ground conditions did not differ statistically. In other words, speaking to an addressee in the No Common Ground condition only had the effect of boosting speakers' memory for the event *more generally*. Unlike in the description task, it does not appear to weaken any goal bias that exists in memory encoding processes.

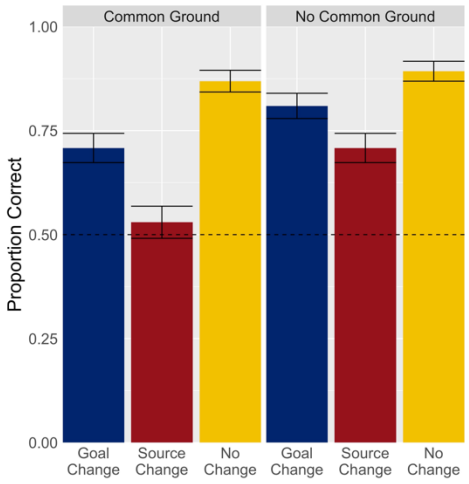


Figure 5. Proportion of Correct Responses in Memory Task. Error bars indicate +/- 1 standard error. Dashed horizontal line indicates chance performance in each condition.

The 'Source Mention Benefit' We used a logistic mixed effect regression to determine whether the rate at which speakers mentioned sources in the language task would predict how accurately they detected source changes in the later memory task. Ground Type and Source Mention (yes, no) were included as fixed effects. Source Mention was included in both by-subject and by-item random effects; Ground Type was only included by-items. Models were reduced and selected as before.

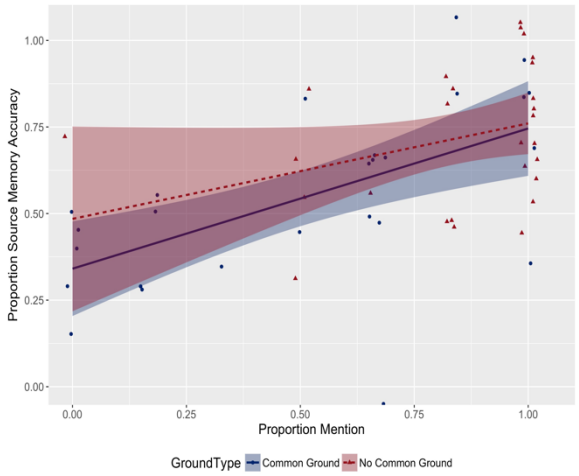
We found that speakers were more likely to accurately encode sources in memory if they had previously mentioned the source in their descriptions (Figure 6). This was indexed by a significant main effect of Source Mention (ß = 1.17, SE = 0.43, |z| = 2.73, p < .01). There was a marginally significant main effect of Ground Type (ß = 1.08, SE = 0.56, |z| = 1.94, p = .053), suggesting that speakers' memory for sources trended towards being more accurate in the No Common Ground than in the Common Ground condition. There was no significant Ground x Source Mention interaction (ß = 0.16, SE = 0.83, |z| = 0.20, p = 0.84). This latter finding suggests that mentioning the source provided the same benefit to source accuracy in the memory task, regardless of Common Ground or No Common Ground condition.

Recall that in the memory task participants were also better at detecting changes to the goal in the No Common Ground as compared to the Common Ground Condition (the two blue bars in Figure 5). This is surprising given that participants mentioned the goal to the same extent in the Common Ground and No Common Ground conditions. One possibility is that goals were remembered more accurately in the No Common Ground condition because mentioning the source (which happened more in this condition) helped to create a more coherent representation of the event as a whole.

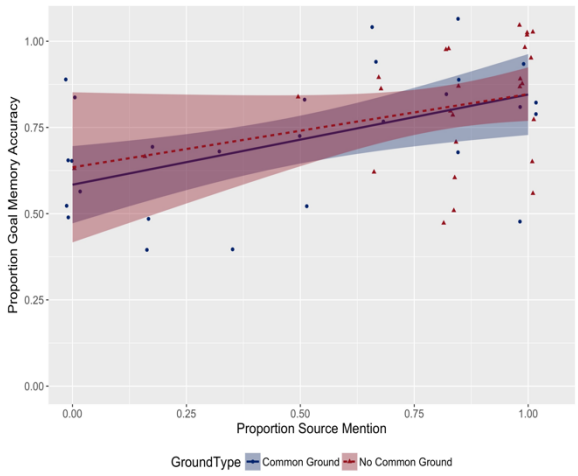
To investigate this, we analyzed whether the rate of source mention would also predict *goal* accuracy in the memory task. We found that participants who mentioned sources more frequently also tended to remember goals more accurately (Figure 6b; ß = 1.09, SE = 0.35, |z| = 3.10, p < .01). No other effects were significant, meaning that the magnitude of the source mention benefit on goal memory did not differ across Common Ground and No Common Ground conditions. Thus, mentioning the source had the secondary benefit of reinforcing memory for other aspects of the motion event – namely, the goal – as well.

Discussion

Prior work has shown a robust goal bias in language: Speakers are much more likely to mention the goal (i.e. endpoint) of a motion event than they are to mention the source (i.e. starting point) of that event. A goal bias has also



(Figure 6a)



(Figure 6b)

Figure 6. Performance in the description and memory task for each subject in the Common Ground (Blue circles) and No Common Ground (Red Triangle) conditions. The x-axis represents proportion of times sources were mentioned during the description task. The y-axis of Figures 6a and 6b show the proportion of accurate responses in the Source Change and Goal Change conditions, respectively. Shaded areas represent +/- 1 standard error.

been observed in non-linguistic cognitive domains, such as memory, suggesting that the goal bias may operate across domains of cognition. An open question and central challenge for such cognitive accounts, though, is how to account for the fact that the goal bias is much more robust across contexts in language than in memory.

We suggest that the discourse/communicative context in which motion descriptions were elicited in prior work exacerbated the goal bias in language: On top of any underlying cognitive goal bias, speakers were additionally more likely to mention the goal than the source because they were describing events in a discourse context that made mentioning the source unnecessary. In our Common Ground condition, where information about the source was discourse-given, we replicated the goal bias in prior work. When we equalized the discourse/communicative status of sources and goals (our No Common Ground condition), this goal bias was drastically weakened. These results are expected if the goal bias – at least in language – is not a reflection of cognitive factors alone.

It is work noting that other work (e.g., Stevenson, Crawley, & Kleinman, 1994) has independently reported a bias for the goal in transfer-of-possession events (i.e., *Leslie handed a book to Ann.*). There, work by Rodhe, Kehler, & Elman (2006) has similarly argued that discourse factors – like different types of coherence relations – can also modulate the goal bias in transfer-of-possession events. We do not manipulate factors like coherence here, but our results also demonstrate the way that discourse factors can interact with event representations in language. Further, our work suggests that (in addition to coherence relations) the goal bias in those cases may also be partially attributed to the givenness of the source in transfer-of-possession events.

Importantly, our results do not rule out the possibility of a cognitive bias towards goals/endpoints: Across tasks and conditions, we found a residual preference to mention goals over sources. Even in the No Common Ground condition, speakers were still more likely to mention goals over sources; and, though participants performed more accurately on the memory task in general, they nevertheless remembered goals more accurately than sources.

By contrast, the discourse status of the source did not *directly* influence the goal bias in memory. However, we did find evidence of an *indirect* 'source mention benefit' that affected how accurately goals, as well as sources, were encoded in memory: Speakers who were more likely to mention the source in their event descriptions were more accurate in remembering *both* goals and sources of motion events. For these participants, mentioning sources improved memory for sources themselves, but also helped to create a more accurate representation of the event more generally.

More broadly, we conclude that discourse/communicative factors should be incorporated into theories about the relationship between language and event cognition. Moreover, our results are consistent with prior work (e.g. Clark & Wilkes-Gibbs, 1986) showing that the extent of the addressee's knowledge has a direct effect on what information speakers choose to include in their utterance.

One question raised by our results is whether the discourse/communicative status of *goals* can modulate the mention of goal phrases in language. Is it possible, for instance, to reverse the goal bias (i.e., produce a source bias) strictly by manipulating the givenness vs. newness of goals? We are currently exploring this direction in ongoing work.

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References

Arnold, J., Wasow, T., Losongco, A., & Ginstrom, R. (2000). Heaviness vs. newness: the effects of complexity and information structure on constituent ordering. *Language*, 76, 28-55.

Bavelas, J. B., Coates, L., & Johnson, T. (2000). Listeners as Co-Narrators. *Journal of Personality and Social Psychology*, 79, 941–952.

Bekkering, H., Wohlschläger, A, & Gattis, M. (2000). Imitation of gestures in children is goal-directed. *Quarterly Journal of Experimental Psychology*, 53, 153-164.

Clark, H. H. Clark & Wilkes-Gibbs, D. (1986). Referring as a collaborative process. *Cognition*, 22, 1-39.

Johanson, M., Selimis, S., & Papafragou, A. (in press). The Source-Goal asymmetry in spatial language: Language-general vs. language-specific aspects. *Language, Cognition and Neuroscience.*

Lakusta, L., & Carey, S. (2015). Twelve-month-old infants' encoding of goal and source paths in 'agentive' and 'non-agentive' motion events. *Language Learning and Development*, 11, 152–175.

Lakusta, L., & DiFrabrizio, S. (2017). And, the Winner Is…A Visual Preference for Endpoints over Starting Points in Infants' Motion Event Representations. *Infancy*, 23, 323–343.

Lakusta, L., & Landau, B. (2005). Starting at the end: The importance of goals in spatial language. *Cognition*, 96, 1–33.

Lakusta, L., & Landau, B. (2012). Language and Memory for Motion Events: Origins of the Asymmetry Between Source and Goal Paths. *Cognitive Science*, 36, 517–544.

Lakusta, L., Muentener, P., Petrillo, L., Mullanaphy, N., & Muniz, L. (2016). Does Making Something Move Matter? Representations of Goals and Sources in Motion Events With Causal Sources. *Cognitive Science*, 41, 1–13.

Lakusta, L., Spinelli, D., & Garcia, K. (2017). The relationship between pre-verbal event representations and semantic structures: The case of goal and source paths. *Cognition*, 164, 174-187.

Lakusta, L., Wagner, L., O'Hearn, K., & Landau, B. (2007). Conceptual foundations of spatial language: Evidence for

a goal bias in infants. *Language Learning and Development*, 3, 179–197.

Meltzoff, A. N. (1995). Understanding the intentions of others: Re-enactment of intended acts by 18-month-old children. *Developmental Psychology*, 31, 838–850.

Papafragou, A. (2010). Source-goal asymmetries in motion representation: Implications for language production and comprehension. *Cognitive Science*, 34, 1064–1092.

Pasupathi, M., Stallworth, L. M., & Murdoch, K. (1998). How what we tell becomes what we know: Listener effects on speakers' long-term memory for events. *Discourse Processes*, 26, 1–15.

Regier, T. (1996). *The human semantic potential: Spatial language and constrained connectionism.* Cambridge, MA: MIT Press.

Regier, T., & Zheng, M. (2007). Attention to endpoints: A cross-linguistic constraint on spatial meaning. *Cognitive Science*, 31, 705–719.

Rohde, H., Kehler, A. and Elman, J. (2006). Event Structure and Discourse Coherence Biases in Pronoun Interpretation. Proceedings of the Annual Meeting of the Cognitive Science Society, 28, 697-702.

Srinivasan, M., & Barner, D. (2013). The Amelia Badelia effect: World knowledge and the goal bias in language acquisition. *Cognition*, 128, 431-450.

Stevenson, R., Crawley R., & Kleinman, D. (1994). Thematic roles, focusing and the representation of events. *Language and Cognitive Processes*, 9, 519–548.

Talmy, L. (1983). How language structures space. In H. Pick & L. Acredolo (Eds.), *Spatial orientations: Theory, research, and application* (pp. 225–282). New York: Plenum Press.

Zheng, M. & Goldin-Meadow, S. (2002). Thought before language: how deaf and hearing children express motion events across cultures. *Cognition*, 85, 145-175.