

Representations of Goals & Sources in Causal Motion Events Over Development

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1. Introduction

Infants perceive events and young children readily talk about them. How is this accomplished? Children must first parse an event into its relevant components (e.g., The duck waddled out of the nest into the pond: duck, waddle, out of, nest, etc.). Then, they must categorize the objects, actions, and spatial relations such that they can be mapped into language (duck = figure, waddle = motion, out of nest = source path, into pond = goal path), (Jackendoff, 1983). Finally, they can map these representations into syntactic structures (e.g., noun phrase, verb phrase, prepositional phrase, etc.) so that they can talk about what they see. In this paper we explore how properties of the event, specifically the ability to cause motion in another object (e.g., a cannon shooting a ball), may influence the mapping from non-linguistic representations into language.

The starting point for the current study is the broad and robust asymmetry between goal (into the pond) and source (out of the nest) paths that has been observed in language, where goal paths take a more prominent role than source paths. A goal bias has been observed in the formal study of linguistics in the semantic and syntactic structure of goal and source paths (Nam, 2004, Filip, 2003; Markovskaya, 2006), as well as in the use of language by children and adults. For example, most pertinent to the current study, a goal bias has been observed in how children and adults describe events. Lakusta and Landau (2005) found that when children as young as 3.5 years of age and adults were shown manner of motion events (e.g., a bird flying from a pot into a bowl) and asked to describe them, they were more likely to map the goal path than the source path into the prepositional phrase (PP) (e.g., “the bird flew into the bowl”, rather than, “the bird flew from the pot into the bowl”) (see also Landau & Zukowski, 2003; Papafragou, 2010; Regier & Zheng, 2003). Such a goal bias has also been found to characterize the descriptions of events involving attachment/detachment, transfer, and change of state events – events that differ from manner of motion events in their semantic and syntactic constraints for encoding the source and the goal (Lakusta & Landau, 2005). Further, a goal bias has also been found to extend to *non-linguistic* event representations of animate motion in infants (Lakusta et al., 2007), children, and adults (Lakusta & Landau, 2012), supporting the idea that non-linguistic representations of sources and goals may serve as the basis for the mapping of sources and goal into language (see Lakusta & Landau, 2012 for a further discussion of how goals and sources may be mapped into language).

Although several studies have reported a goal bias in language, few studies have systematically manipulated properties of events to test how a goal bias may be modulated in language. A recent study by Lakusta and Landau (2012) took this approach by manipulating the animacy and intentions of the figure object in the event. In this study, 4-year-old children and adults were asked to view and describe events where an inanimate figure moved from a source to a goal, such as a paper blowing from a container into a candle. Similar to the descriptions of

animate motion events (a person hopping from a table to a ladder; Lakusta & Landau, 2005; 2012), children and adults mapped the goal into the PP more than the source; thus, a goal bias persisted for language. In another experiment (Lakusta & Landau, 2012), children and adults were asked to view and describe motion events where an animate figure moved from the source to the goal while *looking back* at the source (and thus, may have been perceived as intending to move away from the source; e.g., a person hopping from a table to a ladder while looking back at the table). For these events, adults did not show a significant goal bias; rather, encoding of the source increased and they tended to map both the goal and the source into the PP. Children continued to show a goal bias, perhaps because the ‘look back’ manipulation was not a strong enough cue of the actor’s intentions for children. This suggests that, for adults at least, the intentions of the figure modulated the encoding of the goal and source in language.

The current study seeks to explore further how properties of the event can influence the mapping of sources and goals into language. We do so by making the source object *cause* the motion of the figure. Why manipulate causality of the source? First, formal linguistic analyses suggest that events can be understood in terms of two tiers – an action tier which specifies agent-patient information about the event as well as a thematic tier which specifies spatial information about the event, such as goal and source paths (Jackendoff, 1990). Further, the ability to cause motion in another object (e.g., *a cannon* shooting a ball) is one typical semantic property of agents, and agents, in turn, are highly prominent entities in language. For example, compared to patients, they are more likely to be mapped into the subject position (e.g., “John hit Mary” is more canonical than “Mary was hit by John”) (Aissen, 2001; Dowty, 1991; see also Kako, 2006 for evidence of the psychological validity of Dowty’s proposal). Given these findings, the current study asked: will a goal bias persist for causal events where the source may *also* be viewed as an agent? And, if so, will it be as strong for causal events as it is for identical non-causal events?

In order to explore this question, the current study showed 3.5- to 4-year-old children and adults causal and non-causal motion events and asked them to describe “what happened”. Critically, in order to directly compare the causal and non-causal events, the events were identical except for the causal status of the source object. In motion events with a non-causal source (the beanbag flew from the tube into the bowl), the source is canonically mapped into the PP. In contrast, in events with a causal source where the source may also be viewed as an agent, the source may be mapped into the syntactic subject position (e.g., “the cannon shot the beanbag into the bowl”). Thus, we hypothesized that by making the source causal and agentive, we may increase the likelihood that the source would be mapped into language.

2. Method

Participants. Thirty children between the ages of 3;6 and 4;0 ($M = 3;9$) participated in the current study. Participants were recruited from the surrounding area through mailings and flyers posted at parents’ groups and daycares. Additionally, sixteen undergraduate adults participated in order to measure adult performance. The adults were recruited from the Montclair State University Psychology Department’s subject pool; all were given course credit for their participation in the study.

Materials. Participants were seated in front of a laptop computer and presented with twenty-four videotaped events portraying a figure object moving from a starting point object (source) to an endpoint object (goal). In half of the events ($n = 12$; henceforth ‘causal events’) the source caused the motion of the figure; for the other half of the events (henceforth, ‘non-causal’ events) the figure object appeared to move on its own from the source to the goal. The figure object in the event was either a ball (silver or blue) or a toy vehicle (car or truck). The goal objects were either a green bowl or a red block, and the source objects were either a tube, blue block or red box. For the causal events, the source objects had a causal mechanism that launched the figure from the source to the goal (e.g., the tube had a spring that propelled the ball, the blue box had a flap that opened on top and a spring flipped the ball, and the red box had a side that moved out and pushed the toy vehicle across the stage). The causal and noncausal events were presented in blocks, and the order of presentation was counterbalanced across subjects; half of the participants viewed the causal events first and half viewed the noncausal events first. Further, within each block the events were randomized to create two orders.

Procedure. The study consisted of three phases: object identification and practice (for children only) and test. In the object identification phase, the children viewed the pictures of the objects they were going to view in the test phase. As they viewed each picture, the children were asked to name each object in the picture. This was done in order to familiarize the children with the objects that they would view in the test events. Following the object identification phase, the children viewed two practice events (a woman with a neutral expression waving and of a woman with a neutral expression clapping). After each video ended, the child was prompted to describe “what happened” and was encouraged to provide a complete description of the event (e.g., if the child responded “clapped”, the experimenter asked, “who clapped”).

Following the practice phase, participants viewed the 24 test events. After each video ended, the screen went blank and the participant was asked to describe “what happened” in the event. The participants’ answers were recorded using a tape recorder and were later transcribed for analysis.

3. Results

Participants’ descriptions were coded for inclusion of a source and a goal for the causal and noncausal events.

In order to test whether a goal bias characterized participants’ descriptions of the causal and noncausal events, planned comparisons (two tailed, paired t-tests) comparing proportion of goal and source included were conducted. The results showed that children and adults included goals more than sources for both causal and noncausal events (see Figures 1 and 2); children causal: $t(25) = 4.05, p < .05$, children noncausal: $t(26) = 7.90, p < .05$, adults causal: $t(15) = 4.56, p < .05$, adult noncausal: $t(15) = 8.01, p < .05$. Thus, a goal bias showed up for the descriptions of causal and noncausal events.

Next, in order to test the critical question of whether the causal manipulation influenced a goal bias, a 2 path type (goal, source), x 2 event type (causal, noncausal) within subjects ANOVA was conducted. This yielded a significant interaction for the children and the adults,

respectively, $F(1,24) = 4.57, p < .05$ and $F(1,15) = 4.48, p < .05$. Thus, although a goal bias persisted for the causal events, it was weaker for the causal events compared to the noncausal events, suggesting that making the source causal modulated goal/source encoding (see Figures 1 and 2). Further planned comparisons showed that the encoding of the source increased from the noncausal to the causal events (source in causal events vs. source in noncausal events for children and adults, respectively: $t(24) = 3.02, p < .05, t(15) = 2.21, p < .05$), whereas the encoding of the goal stayed the same ($ps > .10$).

Figure 1

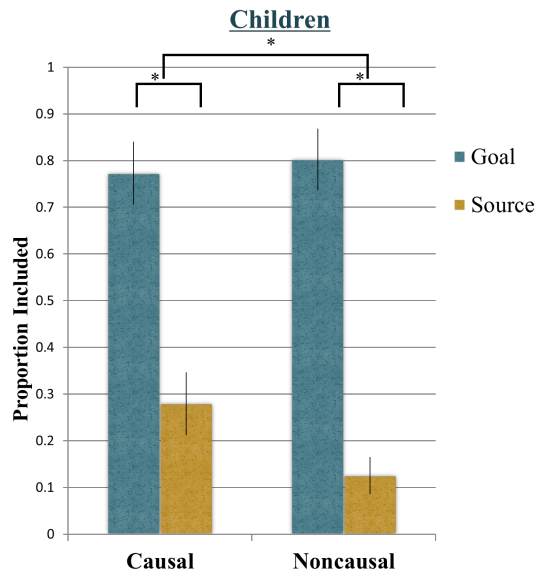
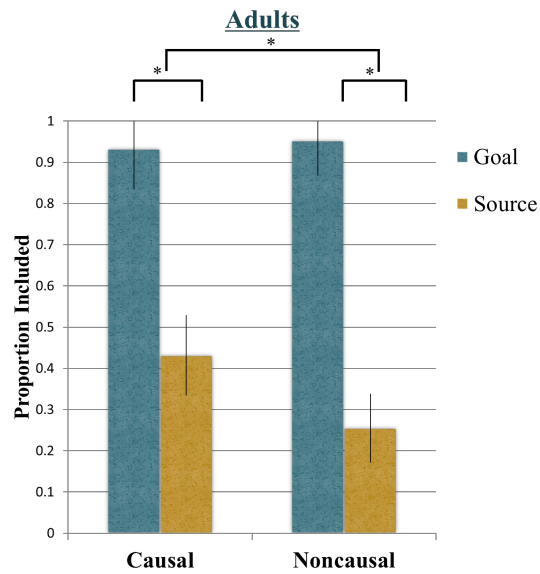


Figure 2



In order to explore how the causal manipulation influenced the mapping of sources into syntactic structure, the next analysis examined how the sources were syntactically encoded in children and adults' descriptions. Note that as discussed in the Introduction, causing motion is one semantic property typical of agents and agents are canonically mapped into the subject position (Dowty, 1991). When children and adults encoded the source in their descriptions, did they map the source into the subject position – perhaps suggesting that they encoded it as an agent? As shown in Tables 1, for the causal events, children encoded the source in the subject position for a large majority of the time (e.g., "The cannon shoot the ball"). When they did not encode it as the subject, they encoded it as the object in a prepositional phrase (e.g., "It goes out of the container") or they mentioned it somewhere other than the subject position or prepositional phrase (e.g., "I saw something on something that pushed the fire engine"). Perhaps surprisingly, for the noncausal events, children also encoded the source in the subject position for the majority of the time. However, it should be noted that out of the seven children who encoded the source as the subject in some of their descriptions, five of these children viewed the causal events before the noncausal events in the experiments. Thus, for these children their perception of the source as causal may have influenced their descriptions of the noncausal events. For the noncausal events, children also encoded the source as the object in a prepositional phrase (e.g., "The ball jumped right off of the thing...").

For the causal events, adults' responses were more mixed; the source was encoded as a subject (e.g., "The box moved the ball..."), as the subject of a by-phrase (e.g., "The little car was pushed by the red box...") or as the object in a PP (e.g., "The ball came off of the box..."). For the noncausal events, adults overwhelmingly encoded the source in a PP (e.g., "It went out of the tube...") (see Table 1).

Table 1
Frequency of Source Encoding in Children and Adults for the Causal and Noncausal Events

	Children		Adults	
	Causal Events	Noncausal Events	Causal Events	Noncausal Events
Source in subject position ¹	94.0%	77.8%	31.7%	4.0%
Source in by-phrase of passive structure ²	0.0%	0.0%	3.7%	2.0%
Source in locative PP ³	3.6%	13.9%	22.0%	76.0%
Source in locative PP in passive structure ⁴	0.0%	0.0%	37.0%	11.0%
Source mentioned ⁵	2.4%	8.3%	6.1%	7.0%

Notes. ¹Source coded as subject: e.g., The cannon moved the ball. ²Source in by-phrase as passive structure: e.g., The ball was moved by the cannon. ³Source in locative PP: e.g., The ball moved out of the cannon. ⁴Source in locative PP in passive structure: e.g., The ball was moved out of the cannon. ⁵Source mentioned somewhere other than in the PP, subject, or subject of a by-phrase: e.g., It was on the box and it moved).

4. General Discussion

A goal bias was observed for both causal and noncausal events; adults and children included the goal more than the source whether the source caused the motion of the figure object or whether the figure object appeared to move on its own from the source to the goal. However, although the goal bias persisted for causal events, making the source object cause the motion of the figure significantly weakened a goal bias for children and adults. When the source was causal, children and adults included the source more in their descriptions of the causal events compared to the noncausal events. The encoding of goal remained the same.

The finding that a goal bias persisted in language despite the source causing motion of the figure is further evidence that the goal bias in language is highly robust. As reviewed in the Introduction, past studies have shown that a goal bias characterizes people's descriptions of manner of motion events involving both an animate and inanimate actor (Lakusta & Landau, 2005; 2012), as well as attachment/detachment, transfer, and change of state events. The current findings contribute to this body of research by suggesting that a goal bias also characterizes children and adults' descriptions of causal motion events. Why is a goal bias so robust in

language? One possibility is that there are multiple constraints that lead goals to be more prominent than sources – even sources that cause the motion of other objects and hence may be viewed as agents (Dowty, 1991; Kako, 2006). Some of these constraints may reside in non-linguistic event representations; goals may be attended to more and remembered better than sources (Regier & Zheng, 2003; Lakusta & Landau, 2012) and some of these constraints may reside in language. For example, in semantic structure, locative goals may be true arguments of the verb and sources may be adjuncts (Filip, 2003; Nam, 2004; Markovskaya, 2006; but see Gerhke, 2005). Support for this latter claim comes from linguistic analyses suggesting that the inclusion of a locative goal prepositional phrase can change the telicity of the verb from atelic to telic (e.g., “John swam to the shore”, can be modified by ‘in an hour’ – a phrase that modifies bounded events), whereas the inclusion of a locative source prepositional phrase does not change the telicity of the verb (e.g., “John swam from the shore” can be modified by ‘for an hour’ – a phrase that modifies unbounded events). Considering the causal events in our study (a source moves an object to a goal), goals may have been encoded with such high frequency because they bound the events, and mapping them into the PP changes the telicity of the verb from atelic to telic. Future research specifically exploring the role of telicity in a linguistic goal bias would shed light on this issue.

The finding that a goal bias was weaker for the causal events compared to the noncausal events suggests that ‘cause’ is one property of the event that modulates a goal bias in language. Specifically, we hypothesize that in the current study, when the source object caused motion of the figure, children and adults often interpreted the source, not only as the spatial starting point of the motion, but also as *the agent*, and thus were more likely to map the source into linguistic structure. This idea is consistent with research showing that agents are prominent/salient components of events. For example, in language, agents are more likely to be mapped into the subject position than patients (Dowty, 1991) and infants are more likely to notice a change in the agent than a change in the patient (Cohen & Oakes, 1993). One question for future research is whether sources would ever be encoded as often as goals, or perhaps even in preference to goals. For example, if the source caused the motion of the figure and was volitional and intentional (e.g., a man throws a ball to the girl), would a source bias be observed?

Although in the current study we infer that the causal status of the source weakened the goal bias for causal events, there is another possibility that needs to be ruled out in future studies. It is possible that the causal source was encoded more in the causal events compared to the noncausal events, not because it was interpreted as the agent per se, but rather because it was simply more salient; for example, the source itself physically moved in the events to propel the figure. Thus, perhaps the motion of the source attracted children and adults’ attention to the source object causing it to be mapped into language more often. Given the high frequency with which the children and adults in our study encoded the causal source in the subject position (see Table 1)– a position which agents are often mapped into - we think this explanation is unlikely. However, future research can rule out this possibility by controlling for the physical salience of the source objects while manipulating the causal property of the source.

In conclusion, the present study tested whether manipulating the causal status of the source object in motion events modulates a goal bias in language. Our results suggest that it does. Sources that cause motion of the figure object were encoded more often than noncausal sources

in language. However, despite the weakening of the goal bias, a goal bias remained nonetheless, highlighting the robustness of the goal bias in language. Current work in our laboratory is exploring the implications of these findings for infant cognitive development and early language acquisition.

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