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Starting at the end: the importance of goals in spatial language

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Abstract

We explored the linguistic encoding of Paths in children between the ages of three and seven, in children with Williams syndrome, and in normal adults, focusing specifically on Source and Goal Paths. The results showed an asymmetry, with Goal Paths regularly and systematically encoded, but Source Paths often omitted. This pattern occurred among all groups and across a broad range of domains including Manner of Motion, Change of Possession, Change of State, and Attachment/Detachment events. It also occurred whether participants spontaneously described events or were asked to use a specific verb that biased them towards a Goal or Source Path (e.g. 'give' vs. 'get'). The results are discussed in terms of non-linguistic foundations of spatial language and the linguistic mapping biases that arise when we describe what we see.
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A fundamental aspect of human cognition is our capacity to represent events that capture our spatial, temporal, and causal interactions in the world. This capacity emerges early in development, with children regularly and easily talking about events they observe. Many theories suggest that this occurs in part because our non-linguistic representations of events embody properties that map readily to language, which in turn encode just those

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components of events that are naturally represented by the prelinguistic infant (Bloom, 1973; Bowerman, 1973; Brown, 1973; Mandler, 1992; Slobin, 1973). In short, objects, motions, paths, and spatial–causal relationships could be non-linguistically represented in such a way that they could be mapped rather directly into words and phrases that are acquired early in life. Further, learners might start with biases about how words and phrases map into syntactic units. For example, they might assume that objects map into nouns (Bloom, 1999; Grimshaw, 1981; Waxman, 1998) and that causal agents map into sentential subjects (Fisher, Hall, Rakowitz, & Gleitman, 1994; Grimshaw, 1981; Slobin, 1985). Correspondences between conceptual/semantic entities and syntactic structure form the backbone of current theories about semantic/syntactic mapping (Grimshaw, 1981; Jackendoff, 1983, 1990; Levin & Rappoport Hovav, 1991). They also play a vital role in theories of acquisition: Semantics can serve as a bootstrap into syntax, and vice versa (Fisher, Gleitman, & Gleitman, 1991; Gleitman, 1990; Landau & Gleitman, 1985; Pinker, 1989).

The purpose of this paper is to further explore such biases by examining the encoding of paths by young children learning English. We focus specifically on the contrast between paths that are Goal-oriented—moving towards or culminating in some goal or endpoint—and those that are Source-oriented—moving away from some origin or starting point. Although paths can be encoded in a variety of syntactic forms and positions, we focus on their encoding in prepositional phrases, which are the canonical format for path expression in English.

Our starting point is a finding from Landau and Zukowski (2003), who studied the language of Manner of Motion events in children with Williams syndrome (WS), a rare genetic deficit that gives rise to severe spatial impairment together with spared language. Landau and Zukowski asked whether the children's spatial impairment would result in impaired spatial language, specifically testing the children's ability to represent and talk about the main components of Motion events, as outlined by Talmy (1985). Landau and Zukowski found that WS children and normally developing 5-year-old children regularly encoded the Goal Path and Reference object of Manner of Motion events, but often omitted the Source Path and Reference object. That is, children demonstrated a bias for encoding Goal Paths and their endpoints over Source Paths and their starting points.

The children with WS tended to omit Source Paths and starting points more often than normally developing children, raising the question of whether this fragility was a consequence of abnormal development, possibly even specific to their spatial impairment. If so, then we might expect the pattern of Source omission to be confined to Manner of Motion events, which are clearly spatial, but not to extend to other kinds of events. Alternatively, ancillary evidence (which we review below) suggests that an asymmetry between Source Path and Goal Path could be a pervasive fact about the way we represent events, either linguistically or non-linguistically, or both. If so, then we would expect to see Source Path omission in a variety of different contexts: We should see it with both Manner of Motion and other kinds of events, we should see it in young normally developing children, and we might even see it among normal adults. In this paper, we ask whether this pattern occurs in the language of events across these broad circumstances, and if so, why.

1. The structure of source and goal paths

In an influential paper, Talmy (1985) proposed that Motion events are linguistically expressed in terms of several key components. In English, these include the Figure or object that undergoes motion (usually an NP), the Motion that it undergoes (encoded by the verb), the Path which it traverses (usually a preposition), and the Path's argument, or Reference object (an NP). Further analyses suggest that the complete Path expression (PP) can be categorized as one of the three basic types: FROM Paths, in which the Figure moves *from* a Reference object that is its Source, TO Paths, in which the Figure moves *to* a Reference object that is its Goal, and VIA Paths, in which the Figure moves *past* a Reference object (Jackendoff, 1983). Specific prepositions encode each of these Path types. For example, FROM Paths require prepositions such as 'from', 'out', 'off', etc.; TO Paths require 'to', 'into', 'onto', etc.; and VIA Paths require 'via', 'past', 'through', etc.

Encoding the Path of an event might seem relatively straightforward: The speaker observes a physical path, and then simply encodes it with a suitable Path expression. However, the process of encoding Paths is actually rather complex. First, once speakers observe a physical path, they must form an accurate non-linguistic representation—for example, that the girl is moving *to* a tree and not *away from* a tree, or that a bird flew *into* a bowl and not *out of* a bowl. Given this representation, the Path or Paths can be mapped into language; in English, this is usually a prepositional phrase. Further, the representation of the Path may be modulated by one's focus of attention, which can bias the speaker to attend to some aspects of the event more than others. For example, although an event may depict a girl running *from* the start gate *to* the winner's circle *via* a guidepost, the focus of attention may be directed towards the Goal or endpoint, the Source or starting point, or the midpoint, each of which would lead to preferential encoding of a different Path type (see Regier, 1996).

Furthermore, the verb that is chosen may constrain the syntactic encoding of Path, in line with the assumption that a verb's meaning projects to its syntax (Gleitman, 1990; Gruber, 1965; Jackendoff, 1990; Landau & Gleitman, 1985; Levin & Rappaport Hovav, 1991).[1] Following Jackendoff's analysis, the semantics of Manner of Motion verbs do not include any specific Path as part of their argument structure, and Paths are therefore completely optional in the syntax. For example, the meaning of 'run' says nothing about the Path over which the running is done: Mary can run or she can run *from* the gate and/or *to* the winner's circle, even *past* the loser.

However, for other verbs, such as 'buy', 'sell', 'throw', 'catch', 'give', 'hook', and 'unhook', the Path term is obligatory in the semantics and this licenses its appearance in the syntax. For example, the core meanings of the verbs 'sell' and 'buy' involve a transaction between two actors, one who is the seller, and one who is the buyer, suggesting that the semantic structure of these verbs contains a TO/FROM Path complement (Jackendoff, 1990). However, these Path complements are optional in the syntax; one can

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[1] Note that although the semantic and syntactic argument structure of a verb do not rigidly correspond, certain aspects of the semantics of a verb strongly constrain the expression of a verb's syntactic arguments. For example, the number of a verb's syntactic arguments is usually equal to or fewer than the number of its semantic arguments (Jackendoff, 2002).

say either "Mary sold fruit/ to the man" or "Mary bought fruit/ from the man". In other cases, the Path complement may be obligatory in the syntax (e.g. 'give', 'put') and this may result from purely idiosyncratic facts about specific verbs.[2]

A final important fact to notice is that the use of Path terms ranges beyond the domain of spatial and motion events (Gruber, 1965). Jackendoff (1983) formalized this observation in the Thematic Relations Hypothesis, which states that spatial terms can encode other domains with parallel semantic and syntactic structures. For example, the domain of Possession allows encoding of transfer of possession in a way that is parallel to kinds of changes in location: "Amy gave the doll TO Beth" is parallel to "Amy went TO the store". In this example, the doll changes possession, just as Amy changes location; Beth is the final possessor (Goal) of the doll just as the store is the final location (Goal) for Amy. Such parallel structure is also observed in the domain of Change of State: "Amy went FROM sad TO happy" is parallel to "Amy went FROM the house TO the store". In this example, Amy changes from one emotional state to another in the Change of State domain, just as she changes from one location to another in the Spatial domain (Jackendoff, 1983). The parallels in syntactic structure across verbs in different semantic fields suggest underlying parallels in the way that events are conceived, with spatial events serving as a kind of template to support the expression of change in other fields.

In sum, the linguistic encoding of Path has several levels of complexity. First, the speaker who observes an event must accurately encode it, modulo his attentional biases. Second, these Paths must be mapped into prepositional phrases. The choice of Path expressions may also be modulated by the speaker's choice of verb, which may or may not require a Path complement, and may select for different Path complement types. Finally, these choices can range over domains, and are not restricted to expression of physical paths through space. Because the speaker's perspective will determine her choice of verb as well as Path type, the entire encoding of the Verb–Path complex will be a consequence of several factors, each of which will constrain others.

2. Learning source and goal paths

Given these complexities, how are Path expressions learned? The literature tells us that Path expressions emerge early, even in the one- and two-word speech of children, regardless of whether the Path is expressed as a preposition (as in English) or as a verb (as is more common in Korean) (Bloom, 1973; Choi & Bowerman, 1991). For example, Choi and Bowerman (1991) reported that 14–21 month-olds who are learning English produce 'out', 'up' and 'down' to encode their own Paths and 'on', 'in', and 'off' for those of objects; 14–21 month-olds who are learning Korean produce verbs such as 'anta'

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[2] Note that in the present study, for cases such as 'buy', 'sell', 'throw', 'catch', 'give', 'hook', and 'unhook', we focus only on Goal and Source Paths that are part of the verb's core meaning; i.e. Paths that are likely to be considered semantic arguments rather than semantic adjuncts. For example, in the description "she threw the ball to the boy from the bleachers" we consider only the Goal Path 'to the boy', since the intended possessor (the boy), but not the event location (bleachers), is part of the core meaning of 'throw' (see Koenig, Mauner, & Bienvenue, 2003 for discussion on semantic arguments vs. semantic adjuncts).

and 'ancta' to encode their own Paths and 'kkita' and 'ppayta' for those of objects. The Path expressions of English and Korean speaking children appear to encode both TO and FROM Path types: These include Paths in which one object is removed from another (e.g. 'off' in English; 'ppayta' in Korean) and Paths in which an object is inserted or placed in another (e.g. 'in' for English; 'kkita' for Korean).

In addition to knowing and talking about Paths, children also know and talk about the starting points and endpoints (or initial states and result states) of such Paths. For example, by the age of 2;0, children start talking about resultant states and have knowledge about a broad range of these states, including causal events in which the object affected undergoes some change, as well as change of location events, in which an object moves from one location to another (Clark, 2002). Children also have knowledge of initial states from an early age. Clark, Carpenter, and Deutsch (1995) reported that, in English, children mark reversals (return to a prior reference state) as early as 1;0 year-old, with general verbs such as 'open' being used at first, followed by the use of particles, such as 'out', and then the prefix '-un'. A similar developmental trend was observed for children acquiring German (Clark et al., 1995). By the time children are 2;6 to 3;0 years-old, they have also begun to use a variety of expressions to encode a broader notion of Source, or the starting point, which goes beyond the physical and spatial motions of objects (Clark & Carpenter, 1989, 1994).

This evidence tells us that both TO and FROM Path types are part of the child's repertoire in the earliest stages of language learning. But it does not tell us whether there is any asymmetry between the Path types—more broadly, those Path types that are Goal-oriented vs. Source-oriented. If there were such an asymmetry, it would have implications for language learning as well as for the structure of language in mature speakers and hearers. Systematic asymmetries in acquisition might suggest a way in which non-linguistic representations of Paths could constrain their linguistic expression. Systematic asymmetries in the structure of language might suggest that Path components conform to some kind of hierarchy, akin to the thematic hierarchy by which agents are most often encoded as sentential subjects.

Several sources of evidence suggest the plausibility of asymmetries in Path type. First, a model recently proposed by Regier (1996, 1997) suggests that perceivers weight the endpoint of an event more strongly than the starting point, a perceptual and attentional asymmetry that is assumed to translate into language. In fact, Regier and Zheng (2003) showed that adults made fewer errors detecting the difference between changes in Goal Paths than changes in Source Paths. They also found that spatial terms marking endpoints (or Goal Paths) were applied to a narrower range of events than those marking starting points (or Source Paths). Native English speakers, for example, used the spatial term 'in' to describe a narrower range of events than the spatial term 'out'.

Additional evidence suggests an asymmetry in children. For example, Freeman, Sinha, and Stedmon (1980) reported that 3- and 4-year-old children found it easier to answer questions about the Path of an object that moved 'to' a landmark than 'from' a landmark. This occurred despite the fact that children were equally good at imitating the motions moving objects made either towards or away from each other. Freeman et al. suggested that there might be a general "allative" bias, i.e. that young children might find it easier to encode motions towards a Goal, rather than away from a Source. Also, Fisher et al. (1994)

found that 3- and 4 year-olds interpreted novel verbs as referring to Goal-directed actions. For example, when a transfer event was shown in which a ball moved from a toy elephant to a toy rabbit, and participants were told this was 'ziking', children and adults overwhelmingly guessed that the verb was 'give' (The elephant is giving the ball to the bunny), although the event was also consistent with 'take' (The bunny is taking the ball from the elephant). Fisher et al. interpreted the findings as support for an 'agency bias', in which children assume that agents—especially animate ones—are encoded as sentential subjects. However, the results are also consistent with the idea that children had an attentional bias in favor of Goal Paths or endpoints, which resulted in their choosing the verb 'give' rather than 'take'.

3. The present experiment

If there is a bias for linguistically encoding Goal Paths over Source Paths, then we might expect several things. First, we would expect to see the bias in children's use of Path components for verbs that are agnostic with respect to their Path components. The clearest case of these is Manner of Motion verbs, which can optionally take Goal, Source, neither, or both. Although Landau and Zukowski (2003) already found a fragility towards Source Paths for these verbs, the events they used showed only a Source or a Goal, but never both. A stronger test of an asymmetry would be to show events including both a Source and a Goal.

Second, we might expect to see the asymmetric pattern across conceptual domains. Recall that our initial impetus for this study stemmed from observations of children with Williams syndrome, who showed more omissions of Source Paths than normally developing children in their descriptions of Manner of Motion events. If the phenomenon is due to impaired spatial capacities, then we might expect it to be limited to Manner of Motion events, but not extend to other event types that are—at least on the face of things— less spatial. In contrast, if the phenomenon is more general, we might expect to see the same pattern across a broader set of domains, consistent with the idea that similar conceptual categories cut across domains and are encoded by the same path terms and structures.

To test these two possibilities, we asked whether the Goal Path bias occurs for Manner of Motion events in which both Source and Goal are simultaneously displayed, as well as for events in three other domains—Change of Possession, Change of State, and Attachment/Detachment. Keeping in mind that the verbs that encode these events will have different constraints on Path selection, we should still see a general tendency to preferentially encode Goal Paths over Source Paths in the prepositional phrase. Finally, we might expect to find substantially the same pattern of bias across children with WS, normally developing children, and possibly even adults.

In sum, to determine how broadly applicable the Goal Path bias is—in terms of both domains and groups—we asked WS children, normally developing children, and adults to describe events depicting Manner of Motion, Change of Possession, Change of State, and Attachment/Detachment. We asked whether their use of Path terms was biased towards Goals, towards Sources, or neither.

4. Experiment 1

4.1. Method

Participants. Ten children with WS between the ages of 9;2 and 17;9 ($M = 13;7$) and 10 mental-age (MA) matched normally developing children between the ages of 4;11 and 7;5 ($M = 5;9$) participated in the study. Twelve undergraduates also participated in order to provide benchmarks for adult performance. All children were tested using a standardized intelligence test, the Kaufman Brief Intelligence Test (KBIT, Kaufman & Kaufman, 1990). This test yields an overall IQ score, as well as scores for two components, Verbal and Matrices. The Verbal subtest requires children to name objects depicted as black and white line drawings and the Matrices subtest—a nonverbal component testing conceptual abilities—requires children to judge which objects 'go together'. The WS children were individually matched to control children on the basis of these subtest scores (M Verbal scores = 36.8, 34.4; SEs = 2.78, 1.89; ranges = 26–52, 26–43, for WS and MA, respectively; M Matrices scores = 19.9, 19.5; SEs = .78, 1.23; ranges 17–25, 15–27, for WS and MA, respectively).

The WS children were recruited through the Williams syndrome Association. All had been diagnosed by a geneticist with the FSH test. The control children were recruited from local mothers' groups.

Materials. Participants were shown 34 videotaped events, each of which was five seconds long and portrayed people and objects undergoing a variety of actions. Event types included 18 Manner of Motion events and 16 non-Manner of Motion events, within which were 6 Change of Possession events, 4 Change of State events, and 6 Attachment/Detachment events (see Table 1).

Table 1
Experiment 1: Event categories and Event types (with glosses for typical verbs in quotes)

Manner of motion ($N=18$)	Non-manner of motion ($N=16$)		
	Change of possession ($N=6$)	Change of state[a] ($N=4$)	Attachment/detachment ($N=6$)
'running' ($N=2$)	'throwing'/'catching' ($N=2$)	color change ($N=2$)	'hooking' ($N=1$)
'hopping' ($N=2$)			'sticking in' ($N=1$)
'spinning' ($N=2$)	'giving'/'getting' ($N=2$)	face expression change ($N=2$)	'gluing on' ($N=1$)
'flying' ($N=2$)			'unhooking' ($N=1$)
'rolling' ($N=2$)	'selling'/'buying' ($N=2$)		'pulling out' ($N=1$)
'walking' ($N=2$)			'ripping off' ($N=1$)
'jumping' ($N=2$)			
'falling'[b] ($N=2$)			
'crawling' ($N=2$)			

[a] Initially, there were also two 'pouring'/'filling' events (e.g. water being poured out of one container into another container) meant to be examples of Change of State events. Participants described these event using 'pour' (e.g. "She poured the water into the bowl"), which in this sense, is not a Change of State verb according to most linguistic analyses (e.g. Levin, 1993 characterizes this sense of 'pour' as a Verb of Putting). Therefore, in this paper, we do not include the analyses of the 'pour' events, although the data showed the same pattern of results as the other event types.

[b] Note that 'falling' is best characterized as a Direction of Motion event. For the present study, since 'fall' was the only Direction of Motion event, we categorized it under Manner of Motion.

The Manner of Motion events included 2 samples each of 9 different types of motion (see Table 1), which roughly replicated the types of motions used in the study by Landau and Zukowski (2003). Each event depicted an object or person (Figure) undergoing a Motion over a Path that started at one object (Source) and ended at another (Goal). For each Manner of Motion event, the Source and Goal objects remained on the screen for the entire five seconds.

The 6 Change of Possession events depicted the transfer of an object from one person to another. Note that this physical description of transfer can be encoded in one of two ways: Either an Agent transferring an object to another person (Theme-Path-Goal), or a Beneficiary accepting the transferred object from another person (Theme-Path-Source). These encodings differ in perspective, and hence would be expected to elicit different verbs and Path components. The 4 Change of State events depicted a human or animal going from some initial state to an end state (Theme/Patient-Source-Goal). Finally, the 6 Attachment/Detachment events each showed a person (Agent) attaching an object to another object or surface (Theme-Path-Goal) or detaching an object from another object or surface (Theme-Path-Source).

The 34 test events were randomized twice to create two orders. Normal adults and WS children were randomly assigned an order. The control children were assigned to the same order as their WS match.

Procedure. Participants were told that they were going to watch short movies and they were to describe 'what happened'. They were then given four practice trials, two that showed Manner of Motion events and two that showed non-Manner of Motion events. All practice events were different from test events. Participants were encouraged throughout the practice trials to produce descriptions that included all components. For example, if a participant said "The girl crawled", the experimenter would reply "Yes. The girl crawled, but do you know *where* she crawled *from* and *where* she crawled *to*?" After such prompting, if the participant still did not describe the practice event completely, the experimenter described the event with all components (e.g. "the girl crawled off the mattress onto a blanket") and asked the participant to repeat this (e.g. "the girl crawled off the mattress onto a blanket"). After the four practice trials, participants proceeded to the 34 test events, with no further prompting. All responses were audiotaped, and all test sessions for the WS and MA matched control children were also videotaped. All of the event descriptions were later transcribed for analysis.

4.2. Results

The descriptions were transcribed and coded in terms of the event's Motion and Path (Goal and/or Source). A second coder scored 20% of all the utterances; in this experiment and all others, reliability was above 90%. The four event types were analyzed for quantitative and qualitative differences among the participant groups. Because the linguistic structure of the verbs for different event types differs somewhat, we report the results separately for each event type.

Table 2
Most frequent specific verbs of motion by manner of motion event type

EVENT TYPE	Experiment 1						Experiment 3a	
	WS		5–7 yr MA		Adults		3–4 yr	
	Verb	Proportion	Verb	Proportion	Verb	Proportion	Verb	Proportion
CRAWL	Crawl	.75	Crawl	.85	Crawl	.79	Crawl	.63
FLY	Fly	.70	Fly	.90	Fly	.83	Fly	.67
HOP	Hop	.80	Hop	.45	Hop	.79	Hop	.42
JUMP	Jump	.80	Jump	1.00	Jump	.83	Jump	.96
ROLL	Roll	.55	Roll	.80	Roll	.96	Roll	.58
RUN	Run	.80	Run	.95	Run	.92	Run	.67
SPIN	Spin	.95	Spin	.40	Spin	.42	Spin	.58
WALK	Walk	.40	Walk	.35	Walk	.42	Walk	.13[a]
FALL	Fall	1.00	Fall	.95	Fall	1.00	Fall	.83

[a] The majority used 'get' as a Manner of Motion verb (e.g. "the man got into his car"; $M = .50$).

4.2.1. Manner of motion events

The Motion was encoded with verbs expressing simple deictic motion (e.g. 'come', 'go'; Ms for WS, MA, and adults $= .26, .20, .19$; SEs $= .04, .04, .04$), or more specific motion (Ms for WS, MA, and adults $= .85, .91, .93$; SEs $= .04, .04, .04$), predominantly Manner of Motion.[3] All groups used a large proportion of specific motion verbs; there were no reliable differences across groups, $F(2, 29) = 1.22$, $P > .10$. Furthermore, people tended to use the same verbs to describe these events (see Table 2).

Paths were analyzed for inclusion of Goal and Source Paths. In this and all subsequent analyses, these were defined as prepositional phrase (PP) complements of the verb, including prepositions used intransitively (e.g. the boy walked *out*) and prepositions with a noun phrase (e.g. the boy walked *out of the store*). The data shown in Fig. 1 show that participants included the Goal Path (e.g. "into the pitcher") more frequently than the Source Path (e.g. "out of the bucket"), even though both Goal and Source were on the screen during the entire event. This pattern was confirmed by a 3 (Group) $\times 2$ (Goal/ Source Path type) mixed analysis of variance which showed reliable effects of Path type, $F(1, 29) = 57.59$, $P < .01$ and Group, $F(2, 29) = 11.48$, $P < .01$, subsumed by a reliable interaction between the two factors, $F(2, 29) = 8.60$, $P < .01$. Post hoc comparisons showed that the Goal/Source Path asymmetry held for each of the two groups of children (Tukey's *HSD* for WS and MA children, $P < .01$), but not for the adults (Tukey's *HSD*, $P > .05$), with the latter possibly due to ceiling effects.

4.2.2. Change of possession events

The transfer in our Change of Possession events can be encoded with verbs such as 'give', 'throw', and 'sell', which often take Goal Paths (but not Source Paths) to indicate the TO Path part of the event (e.g. "He <u>gave</u> the flowers *to the woman*", but not "He <u>gave</u>

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[3] Since participants sometimes used multiple clauses to describe the events (e.g. "She spun around from the lady and went to the man"), the sums of the means for the simple deictic verbs and the specific motion verbs were greater than 1.0.
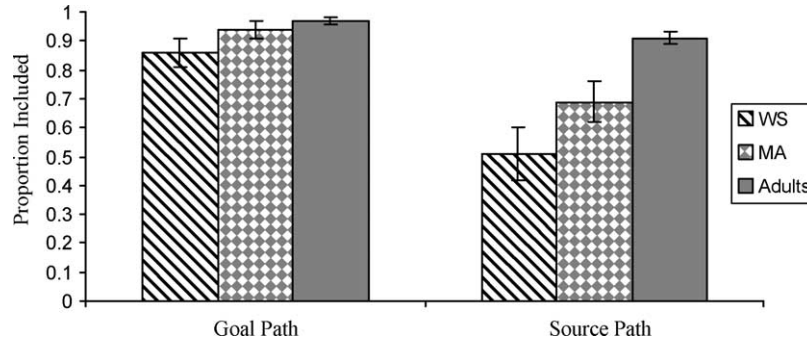
Fig. 1. Proportions (and *SE*s) of Goal and Source Paths included across the Manner of Motion Events.

the flowers *from the woman*"). These same events can also be encoded with verbs such as 'receive', 'catch', and 'buy', which often take Source Paths (but not Goal Paths) to indicate the FROM Path part of the event (e.g. "He received the flowers *from the man*", but not "He received the flowers *to the man*"). For purposes of this analysis, we will call these verbs Goal Path and Source Path verbs, respectively. Our Change of Possession events could also be encoded with verbs that can take either a Goal or a Source Path (e.g. "He took the muffin *to the lady*" or "He took the muffin *from the man*"), or neither (e.g. "They were playing catch").

All groups used predominantly Goal Path verbs, such as 'give' and 'throw' (*M*s for WS, MA, and adults = .80, .77, .69; *SE*s = .05, .04, .03, respectively) rather than Source Path verbs, such as 'get' and 'catch' (*M*s for WS, MA, adults = .10, .17, .22; *SE*s = .04, .05, .04, respectively). This Goal/Source Path verb asymmetry was confirmed by a 3 (Group) × 2 (Goal/Source verb) mixed analysis of variance which showed a reliable Goal/Source Path verb effect, $F(1, 29) = 200.82$, $P < .01$. There was no reliable Group effect, $F(2, 29) = .18$,

Table 3
Frequent verbs used for change of possession events by change of possession event type

EVENT TYPE	Experiment 1						Experiment 3a	
	WS		5–7 yr MA		Adults		3–4 yr	
	Verb	Mean Pro-portion	Verb	Mean Pro-portion	Verb	Mean Pro-portion	Verb	Mean Pro-portion
THROW/CATCH	Throw	.75	Throw	.80	Throw	.83	Throw	.75
			Toss	.20	Toss	.17	Catch	.13
GIVE/RECEIVE	Give	.80	Give	.60	Give	.58	Give	.79
			Handed	.20	Handed	.25		
			Passed	.15	Passed	.13		
SELL/BUY	Give	.55	Buy	.45	Buy	.42	Give	.33
	Get	.20	Give	.25	Purchase	.21	Get	.17
					Pay	.13	Buy	.13
							Pay	.13

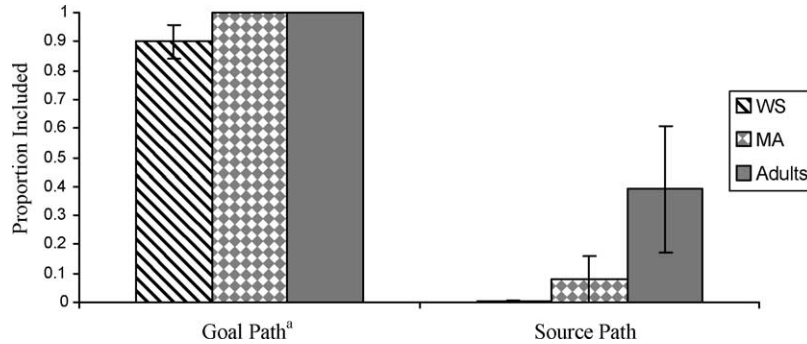*Note:* The verbs shown are those that were used greater than 10% of the time by each group.

Fig. 2. Proportions (and *SEs*) of Goal and Source Paths included across the Change of Possession Events.
[a] Goal paths were PP complements (P+NP) or double object dative constructions (NP+NP). Mean PP complements for WS, MA, and adults were .67, .96, .78, respectively; Mean double object complements for WS, MA, and adults were .33, .04, .22, respectively.

$P > .10$, and no reliable interaction, $F(2, 29) = 2.60$, $P > .05$. As shown in Table 3, all groups described the transfer in the Change of Possession events using similar verbs.[4]

When Goal Path verbs were used, the Path was usually included, whereas when Source Path verbs were used, participants rarely included the Path (see Fig. 2).[5] A 3 (Group) × 2 (Goal/Source Path) mixed analysis of variance showed a reliable Goal/Source Path effect, $F(1, 17) = 96.55$, $P < .01$, with no reliable effect of Group, $F(2, 17) = 3.29$, $P > .05$, or interaction, $F(2, 17) = 1.72$, $P > .10$.[6]

In sum, participants (especially children) most often used Goal Path verbs and included Goal PPs. In contrast, they rarely used Source Path verbs to describe Change of Possession events, and when they did so, they rarely included the actual Source Path.

4.2.3. Change of state events

Our Change of State events could be encoded with verbs such as 'turn', 'change', and 'go', that can take both a Goal and a Source Path (e.g. "The bear's nose turned/

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[4] Although all groups used similar verbs, there was one exception, and this was for the Sell/Buy events (see Table 3). Whereas adults predominantly used 'buy' or 'purchase', WS children predominantly used the Goal Path verb 'give' to describe the sell/buy transfer; MA children used both 'give' and 'buy'. This difference was probably caused by failure of the WS children and some MA matched children to appreciate that more than a simple transfer had occurred.

[5] To conduct a conservative test, only those participants who used both Goal and Source verbs were included in the Path analysis for the Change of Possession events (*n*s for WS, MA, and adults = 5, 6, and 9, respectively). This was also true for the Attach/Detach events in Experiment 1 (*n*s for WS, MA, and adults = 10, 9, and 12, respectively), and for the Change of Possession (*n* for 3–4 year-olds = 9) and Attach/Detach (*n* for 3–4 year olds = 11) events in Experiment 3a.

[6] Two of the Goal Path verbs that were often used ('give' and 'hand') take an obligatory Goal PP. Taking this into consideration, we also conducted the Path analysis with these cases removed. The results continued to show a reliable Goal/Source Path asymmetry, $F(1, 17) = 63.82$, $P < .01$, with Goal Paths included more often than Source Paths (*M* Goal Paths = .73, 1.0, 1.0, *SEs* = .21, .00, .00; *M* Source Paths = .00, .08, .39, *SEs* = .00, .09, .22, for WS, MA, and adults, respectively). There was also a reliable effect of Group, $F(2, 17) = 4.17$, $P < .05$, but no reliable interaction, $F(2, 17) = 1.00$, $P > .10$.

Table 4
Frequent verbs used for change of state events by change of state event type

EVENT TYPE	Experiment 1						Experiment 3a	
	WS		5–7 yr MA		Adults		3–4 yr	
	Verb	Mean proportion	Verb	Mean proportion	Verb	Mean proportion	Verb	Mean proportion
EX-PRESSION CHANGE	Be	.85	Be	.85	Be	.29	Be	.58
	Get	.30	Turn	.20	Go	.29	Open	.21
	Turn	.15			Become	.25	Do	.17
	Look	.15			Look	.17	Turn	.13
					Change	.13		
COLOR CHANGE	Turn	.65	Turn	.70	Turn	.42	Turn	.67
	Be	.65	Have	.25	Change	.38	Be	.25
					Go	.13		

Note: The verbs shown are those that were used greater than 10% of the time by each group. The totals may be equal to or greater than 100% because multiple clauses were often used (see text for details).

changed/went <u>from blue</u> <u>to yellow</u>"), and all groups did use such verbs in their descriptions (*M*s for WS, MA, and adults=.35, .50, .73; *SE*s=.09, .10, .05, respectively). When participants did not use these types of verbs, they used other verbs (e.g. 'be', 'open', 'have', 'look'), which do not take Goal or Source Paths, but rather can simply encode either the initial or final state of the event (e.g. "The bear's nose was yellow" or "she looked mad"). All groups also used these verbs to describe both the initial and final state by using multiple clauses (e.g. "The bear's nose was blue and then it was yellow"; *M*s for WS, MA, and adults=.52, .32, .15, respectively). Furthermore, all groups used similar verbs in their descriptions (see Table 4).

As shown in Fig. 3, when participants used a verb that can take a Goal and a Source PP (e.g. 'turn', 'change' or 'go'), participants included Goal Paths (e.g. "went *to black*") more than Source Paths (e.g. "went *from red*"). A 3 (Group)×2 (Goal/Source Path) mixed analysis of variance showed a reliable effect of Goal/Source Path, $F(1, 25)=26.15$, $P<.01$, confirming a Goal/Source Path asymmetry. There was also a reliable Group effect, $F(2, 25)=13.30$, $P<.01$, with both WS and MA children including fewer Paths overall than adults (Tukey's *HSD* for WS <u>vs.</u> adults and for MA <u>vs.</u> adults, P<.01), but no reliable interaction, $F(2, 25)=3.05$, $P>.05$.
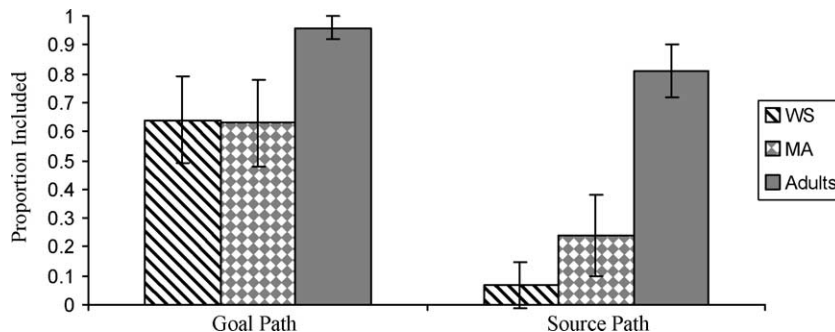

Fig. 3. Mean Proportions (and *SEs*) of Goal and Source Paths included across the Change of State Events.

Table 5
Frequent verbs used for attachment events by attachment event type

EVENT TYPE	Experiment 1						Experiment 3a	
	WS		5–7 yr MA		Adults		3–4 yr	
	Verb	Mean Proportion	Verb	Mean Proportion	Verb	Mean Proportion	Verb	Mean Proportion
HOOK	Put	.80	Put	.70	Put	.42	Put[a]	.50
			Hook	.30	Hook	.25		
					Attach	.25		
STICK	Put	.50	Put	.80	Stick	.67	Put	.58
	Stick	.30			Push	.17	Stick	.25
	Go	.20						
GLUE	Stick	.50	Stick	.70	Glue	.58	Glue	.42
	Put	.40	Put	.20	Stick	.42	Stick	.25
							Put	.25

Note: The verbs shown are those that were used greater than 10% of the time by each group. When the totals were less than or equal to .50, we list the individual verbs used in the footnote below.

[a] 'Leash', 'hook', 'stick', and 'tie' were also used (once each).

4.2.4. Attachment/detachment events

The verbs used to encode the Attachment and Detachment events were similar across all groups (see Tables 5 and 6, respectively). As shown in Table 5, many of the verbs used to encode the Attachment events were verbs such as 'put', 'hook', 'stick', and 'glue'. When referring to events depicting attachment TO a Goal, these verbs often take Goal Paths (e.g. "glue *onto the door*"), but not Source Paths (e.g. glue *off the door) to indicate the TO-path part of the event shown. As shown in Table 6, many of the verbs used to

Table 6
Frequent verbs used for detachment events by detachment event type

EVENT TYPE	Experiment 1						Experiment 3a	
	WS		5–7 yr MA		Adults		3–4 yr	
	Verb	Mean Proportion	Verb	Mean Proportion	Verb	Mean Proportion	Verb	Mean Proportion
UNHOOK	Unhook	.40	Unhook	.40[a]	Unhook	.42[b]	Get	.25
	Take	.50					Tie	.25
							Take	.17
PULL	Take	.60	Put	.60	Pull	.42	Put	.50[c]
	Put	.20	Take	.20	Take	.42		
RIP	Rip	.40	Take	.40	Tear	.33	Take	.67
	Take	.20	Pull	.20	Rip	.25		
					Peel	.17		
					Pull	.17		

Note: The verbs shown are those that were used greater than 10% of the time by each group. When the totals were less than or equal to .50, we list the individual verbs used in footnotes below.

[a] 'Release', 'take', 'hook', 'bring', 'make', and a nonsense word ('unanche') were also used (once each).

[b] 'Untie', 'unlatch', 'unclip', 'unhitch', 'release', 'unhinge', and 'take' were also used (once each).

[c] 'Pull', 'stick', 'take', 'feed', 'dig', 'eat', and 'poke' were also used (once each).

encode the Detachment events were verbs such as 'unhook', 'pull', and 'rip'. When referring to events depicting detachment FROM a Source, these verbs often take Source Paths (e.g. "unhook *from the dock*"), but not Goal Paths (e.g. unhook **onto the dock*) to indicate the FROM-Path part of the event shown. The events were also encoded with other verbs, for example, 'neutral' verbs that can take either Goal or Source Paths (e.g. "the spoon went *into the banana*" OR "the spoon went *out of the banana*") or those that take neither (e.g. "they were eating").

The three Attachment events were described using Goal Path verbs 100% of the time by MA children and adults; WS children did so 90% of the time ($SE = 5.4$). The Detachment events were described using Source Path verbs (Ms for WS, MA, and adults = .84, .60, .97; SEs = .05, .10, .03, respectively), but the use of these verbs was lower than the use of the Goal Path verbs for the Attach event types. We used a mixed analysis of variance to analyze the proportion of Goal Path verbs used for the Attach events compared to the proportion of Source Path verbs used for the Detach events and found a reliable effect of Goal/Source Path verb type, $F(1, 29) = 18.50$, $P < .01$, thus confirming a Goal/Source Path verb asymmetry. There was also a reliable effect of Group, $F(2, 29) = 7.29$, $P < .01$, and a reliable interaction between the two factors, $F(2, 29) = 9.40$, $P < .01$. Post hoc comparisons showed that the Goal/Source Path verb asymmetry held only for the MA children (Tukey's HSD, $P < .01$).

The differences in asymmetry were due to the fact that MA children regularly described two of the Detachment events using Goal Path verbs. One of these events depicted a man pulling a spoon out of a banana and the other depicted a man unhooking a boat from a dock. In both of these, the event starts with the Theme (spoon/boat) attached to the Reference object (i.e. spoon IN the banana; boat HOOKED to the dock). As the event unfolds, the Theme is removed/detached from the Reference object. Still, six of the MA children used 'put in' 'stick on' or 'went into' to describe the first event; and two of the MA children used 'bring' and 'hook' for the second event. Thus, even though the events clearly depicted *detachment*, children described them using Goal Path verbs. This suggests that even for verb selection, there appears to be a Goal bias, and that this is strongest in the youngest children.[7]

Path inclusion is shown in Fig. 4 for both event types. When participants used a Goal Path verb in Attach events, they very often included the Goal Path, whereas when they used a Source Path verb in Detach events, they included the Source Path less often. This asymmetry was confirmed by a 3 (Group)×2 (Goal/Source Path) mixed analysis of variance which showed a reliable effect of Path type, $F(1, 28) = 16.0$, $P < .01$. There was no reliable effect of Group, $F(2, 28) = .89$, $P > .10$, or any reliable interaction, $F(2, 28) = .90$, $P > .10$.[8]

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[7] Four of the WS children also used Goal Path verbs to describe the Detachment event of spoon being put IN a banana. However, the number of these instances was not enough to produce a reliable Goal/Source Path verb asymmetry for the Attach/Detach event types.

[8] Two of the Goal Path verbs that were used ('put' and 'place') require that the Goal PP be included in order for the sentence to be grammatical. Taking this into consideration, we also conducted the Path analysis with these cases removed. The results continued to show a reliable Goal/Source Path type effect, $F(1, 25) = 47.89$, $P < .01$, with Goal Paths included more often than Source Paths (M Goal Paths = .94, .94, 1.0, SEs = .07, .07, .00; M Source Paths = .59, .46, .83, SEs = .11, .12, .07, for WS, MA, and adults, respectively).
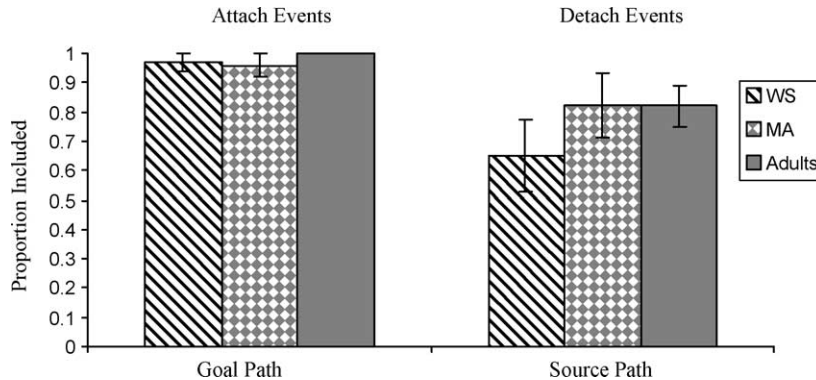
Fig. 4. Proportions (and *SEs*) of Goal and Source Paths included across the Attachment/Detachment Events.

4.2.5. Error patterns across all event types

What happened when participants did not include the Source Path? Across all event types, these cases fell into three categories: (a) Source Path was completely omitted (e.g. "she ran", "it turned to yellow"; $Ms = .24, .32, .15$ for WS, MA, and adults, respectively), (b) the Source object was mentioned somewhere other than the PP (e.g. "He had horns that were *red* and then they turned to brown", "The man caught the shoe and then *the other man* caught it"; $Ms = .42, .15, .10$ for WS, MA, and adults, respectively), or (c) it was encoded with a non-Source preposition (e.g. "The bear's nose turned *to* blue to green", "He walked *to* a towel to another towel"; $Ms = .04, .08, .02$ for WS, MA, and adults, respectively). The cases where the Source was mentioned somewhere other than the PP were largely accounted for by the Change of State events for all groups, and by the Change of Possession events for the WS children. When participants encoded the Path with a non-Source preposition, it was most often encoded with a Goal preposition (*M*s for WS, MA, and adults $= 1.0, .89, .67$, respectively).[9]

4.3. Discussion

Across all event types, participants regularly and systematically included the Goal Path but not the Source Path. For the Change of Possession, Change of State, and Attachment/Detachment events, this asymmetry held for all groups, while for the Manner of Motion events the asymmetry held only for the two groups of children. When the Source Path was not included, it was either completely omitted, encoded with a Goal preposition, or encoded somewhere other than the prepositional phrase.

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[9] To determine whether the Goal/Source asymmetry would remain if we included *any* encoding of Source Paths, we reanalyzed all data in this and all other experiments including error types (b) and (c) as correct, i.e. encoding the Source. In this and all subsequent experiments, all results remained the same except where indicated. In the present experiment, the only difference was for the Change of State events, where we found no reliable Path effect, $F(1, 25) = 2.06, P > .10$. The reason for this difference was that all participants often used multiple clauses to describe the Change of State events and encoded the Source somewhere other than the PP.

In addition, for the Change of Possession and Attachment/Detachment events (i.e. those that can be encoded with either Goal Path or Source Path verbs), participants used Goal Path verbs more often than Source Path verbs. This asymmetry was especially pronounced for the Change of Possession events, where the event itself is inherently neutral with respect to whether a Goal or Source Path verb encodes the transfer.

Overall, these results suggest that children have a bias to linguistically encode Goal Paths rather than Source Paths in the prepositional phrase complement of the verb, and possibly, in the verb itself. How robust is this bias? Would we still see it even if we insisted that participants use a verb biased towards Source Paths (e.g. 'buy')? Given that the task of encoding an event involves several steps (from perceiving the event to choosing a verb and its complements), it is possible that providing participants with a Source Path biased verb would weaken the Goal bias—or strengthen the tendency to encode Sources—by selectively focusing children's attention on the Source Path via the required verb. Alternatively, the Goal Path bias may be so robust in children that it persists even if children are explicitly asked to use a Source Path verb. We test these possibilities in Experiment 2.

5. Experiment 2

5.1. Method

Participants and materials. Participants were the same as those in Experiment 1. They were shown 24 new videotaped events, each which was five seconds long and included people and objects undergoing a variety of actions. All 24 event types were non-Manner of Motion, including 12 Change of Possession and 12 Attachment/Detachment (6 Attachment and 6 Detachment), similar to the ones we showed in Experiment 1. Manner of Motion and Change of State events were not used because the verbs that people most often use to describe those events are not themselves inherently biased towards Goal or Source Path complements.

As in Experiment 1, the Change of Possession events depicted the transfer of an object (Theme) between one person (Agent or Beneficiary) and another (Goal or Source) via a Path (to/from). The Attachment/Detachment events showed a person (Agent) attaching/detaching an object (Theme) to/from (Path) another object or surface (Goal/Source). The 24 test events were randomized twice to create two orders. Adults and WS children were randomly assigned to one order. The control children were assigned to the same order as their WS mental-age match.

Procedure. The procedures were identical to those of Experiment 1, except for the following. During training and testing, participants viewed each event, and were then supplied with a target verb (a 'hint') that they were to use when describing it. For example, after viewing an event depicting a girl pulling a pen out of a shoe, the experimenter said, "Your hint is *pulled*". The hint was always the conjugated past tense form of the target verb unless participants had difficulty using this form. For these cases we used the gerund or the present tense form of the verb (e.g. 'pulling' or 'pull').

Participants were supplied with Goal Path and Source Path verbs 12 times each. Goal Path verbs were those that take Goal Paths, but not Source Paths, specifically, 2 'hook',

2 'stick', and 2 'glue' for the 6 Attach events and 2 'throw', 2 'give', and 2'sell' for 6 of the Change of Possession events. Source Path verbs were those that take Source Paths, but not Goal Paths, specifically, 2 'unhook', 2 'pull', and 2 'rip' for the 6 Detach events and 2 'catch', 2 'receive' (or 'get', if 'received' was not understood), and 2 'buy' for 6 of the Change of Possession events.

5.2. Results

5.2.1. Change of possession events

Participants complied when we supplied a Goal Path verb (*M*s for 'give', 'throw', 'sell' = .98 or better across groups). They also did so most of the time when we supplied a Source Path verb (*M*s for 'receive'/'get', 'catch', 'buy' = .92, .97, 1.0 for the WS, MA, and adults, respectively). When children did not use the supplied Source Path verb, they used a Goal Path verb instead (e.g. 'throw' rather than 'catch'; *M*s for WS and MA = .08, .02, respectively).

Fig. 5 shows the proportions of Path types for each group of hint verbs. Participants included the Goal Path (e.g. "sold a muffin *to the girl*") more than the Source Path (e.g. "bought chips *from the man*"). A 3 (Group)×2 (Goal/Source Path) mixed analysis of variance showed a reliable effect of Path type, $F(1, 29) = 133.60$, $P < .01$, confirming this asymmetric pattern. There was also a reliable effect of Group, $F(2, 29) = 12.83$, $P < .01$, and a reliable interaction between the two factors, $F(2, 29) = 3.42$, $P < .05$. Post hoc comparisons showed that the Goal/Source asymmetry held for all groups (Tukey's *HSD* for WS, MA children, and adults, $P < .01$).

5.2.2. Attachment/detachment events

Again, participants used the 'hint' verbs almost all of the time (*M*s for Goal Path verbs 'hook', 'stick', 'glue' = .97, .98, .99 for WS, MA and adults, respectively; *M*s for Source Path verbs 'unhook', 'pull', 'rip' = .98, 1.0, .97, for WS, MA, and adults, respectively).
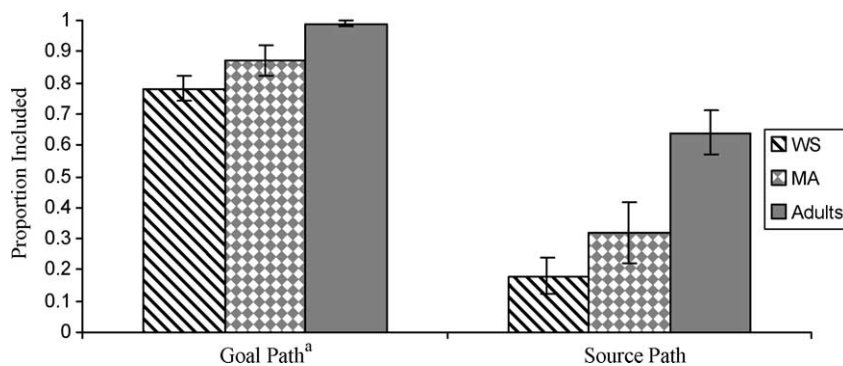

Fig. 5. Proportions (and *SEs*) of Goal and Source Paths included for different 'hint' verb groups across the Change of Possession Events (Based on total number of 'hint' verbs used).

[a]Goal paths were PP complements (P+NP) or douple object dative constructions (NP+NP). Mean PP complements for WS, MA, and adults were .74, .92, .79 respectively; mean double object complements for WS, MA, and adults were .26, .08, .21, respectively.
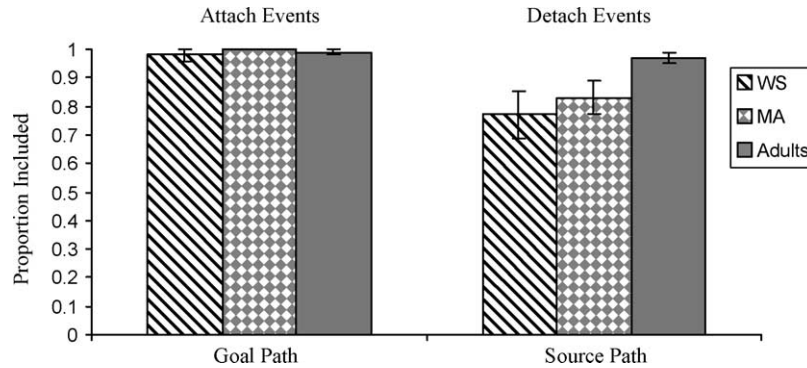
Fig. 6. Proportions (and *SEs*) of Goal and Source Paths included for different 'hint' verb groups across the Attachment/Detachment Events (Based on the total number of 'hint' verbs used).

When they did not use the supplied verb, they used other appropriate verbs (e.g. 'put in' rather than 'stick', 'try to rip' rather than 'rip').

Paths, however, were expressed asymmetrically, as shown in Fig. 6. Participants included the Goal Path (e.g. "onto a basket") more often than the Source Path (e.g. "out of a tomato"). This pattern was confirmed by a 3 (Group)×2 (Goal/Source Path) mixed analysis of variance, which showed reliable effects of Path type, $F(1, 29) = 15.82$, $P < .01$, and Group, $F(2, 29) = 4.16$, $P < .05$, and a reliable interaction between the two factors, $F(2, 29) = 3.53$, $P < .05$. Post hoc comparisons showed that the Goal/Source Path asymmetry held for each of the two groups of children (Tukey's *HSD* for WS and MA children, $P < .01$), but not for the adults.

5.2.3. Error patterns

As in Experiment 1, when participants did not include the Source Path, they either (a) completely omitted it (e.g. "the guy bought a can of soda"; $Ms = .30, .33, .09$ for WS, MA, and adults, respectively), (b) encoded the Source object somewhere other than the PP (e.g. "he unhooked the dog leash because the dog was tied to *the pole*"; $Ms = .13, .06, .11$ for WS, MA, and adults, respectively), or (c) encoded the Source Path with non-Source preposition (e.g. "the girl unhooked the leash *to* the dog"; $Ms = .11, .05, .00$ for WS, MA, and adults, respectively). When WS and MA children encoded the Path with a non-Source preposition, it was always encoded with a Goal preposition (e.g. 'to').

5.3. Discussion

Participants in Experiment 2 almost always used the 'hint' verbs, although there were a few cases where children used a Goal Path verb (e.g. 'give') when supplied with a Source Path verb (e.g. 'get'). Despite these frequent successes, however, when participants used a Source Path verb they rarely included the Source Path itself; in contrast, when they used a Goal Path verb, they almost always included the Goal Path. For the Change of Possession events, the asymmetry held for all groups, while for the Attachment/Detachment events the asymmetry held only for the two groups of children. When children did not include

Source Paths, they usually omitted them, although there were a few cases where they encoded the Source Path with a Goal preposition or included the Source somewhere other than the prepositional phrase.

Overall, these results suggest that the bias to encode Goals is robust: Even when participants were supplied with a biased verb, they continued to encode the Goal Path more frequently than the Source Path. This raises the possibility of a conceptual and linguistic bias whereby learners tend to encode Goal Paths rather than Source Paths in verbs' prepositional phrase complements. If this were the case, one might expect such a 'Goal Path bias' to be present and robust in early language, when children are in the midst of learning verbs. Experiment 3 investigates this possibility by studying normally developing 3–4-year-old children's descriptions of events, without (3a) and with (3b) hint verbs.

6. Experiment 3a

6.1. Method

Participants. Twelve normally developing children between the ages of 3;5 and 4;4 ($M =$ 3;9) participated in the study. The children were recruited through local mothers' groups.

Materials and procedure. The materials and procedure were identical to those in Experiment 1.

6.2. Results

6.2.1. Manner of motion events

Three–four year-olds encoded the Motion with both simple motion verbs (e.g. 'come'; $M = .24$, $SE = .05$) and specific motion verbs (e.g. 'walk' $M = .77$, $SE = .04$), predominantly Manner of Motion verbs. An analysis of variance on proportions of specific motion verbs showed that the 3–4 year-olds produced fewer such verbs than the MA control children of Experiment 1, but were no different from the WS children, $F(2, 29) = 3.49$, $P < .05$ (Tukey's *HSD*, $P < .05$). The most frequent specific verbs used by the 3–4-year-old
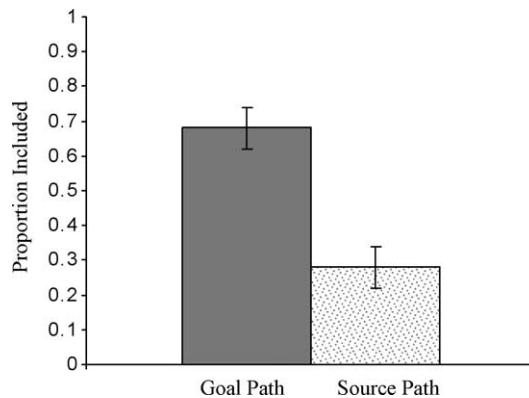

Fig. 7. Proportions (and *SEs*) of Goal and Source Paths included across the Manner of Motion Events for 3–4-year-old children.
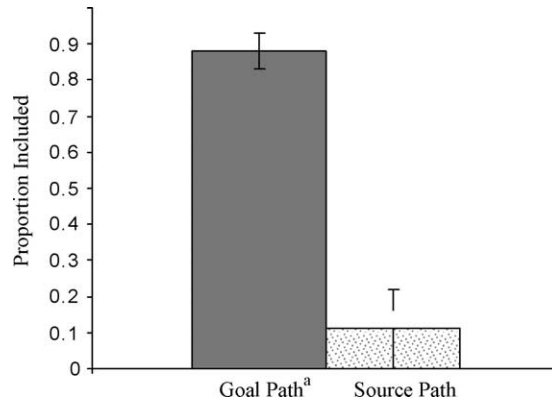
Fig. 8. Proportions (and *SEs*) of Goal and Source Paths included across the Change of Possession Events for 3–4-year-old children.
[a]Goal paths were PP complements (P+NP) or douple object dative constructions (NP+NP). Mean PP and double object complements for 3–4 yr. old children was .84 and .16, respectively.

children tended to be identical to those used by all other groups in Experiment 1 (see Table 2). Furthermore, analysis of Goal and Source Path inclusion showed that the 3–4 year-olds included the Goal Path (e.g. "into the pot") reliably more often than the Source Path (e.g. "from the bowl"), $t(11) = 5.62$, $P < .01$ (see Fig. 7).

6.2.2. Change of possession events

As shown in Table 3, 3–4-year-old children most often used Goal Path verbs to describe the transfer events (e.g. 'throw', 'give'; $M = .71$, $SE = .06$) rather than Source Path verbs (e.g. 'catch', 'get'; $M = .15$, $SE = .03$), $t(11) = 6.70$, $P < .01$. When children did not use Goal Path or Source Path verbs they used other verbs, such as 'pay for'. Analyzing the inclusion of Goal and Source Paths, we found that when 3–4-year-old children used Goal Path verbs they often included Goal Paths, whereas when they used Source Path verbs, they rarely included Source Paths (see Fig. 8), $t(8) = 7.30$, $P < .01$.[10]

6.2.3. Change of state events

Children used many of the same verbs as the groups in Experiment 1 (see Table 4), including verbs that can take a Goal and/or a Source Paths ('turn' and 'change'; $M = .40$, $SE = .08$). The remainder of the time they used other verbs such as 'be'. Unlike both groups of children in Experiment 1, the 3–4 year-olds encoded the Change of State events with multiple clauses only 13% of the time. Most often they described the change with simple clauses such as "she was surprised" or "she did this (child makes a facial expression)", whereas WS and MA children often used multiple clauses, such as "the girl was mad before and then she got surprised". Analysis of Path inclusion showed that when

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[10] As in Experiment 1, we also conducted the analysis with the 'give' and 'hand' cases removed (i.e. cases where it is obligatory to include the Goal PP). The results continued to show a reliable Goal/Source Path type effect, $t(7) = 3.37$, $P < .05$, with Goal Paths included more often than Source paths (M Goal Paths $= .72$, $SE = .16$; M Source Paths $= .13$, $SE = .13$).
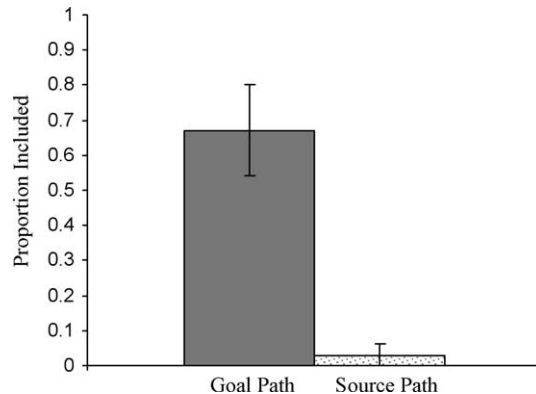
Fig. 9. Mean Proportions (and *SEs*) of Goal and Source Paths included across the Change of State Events for 3–4-year-old children.

children used verbs that can take both a Goal and a Source PP ('turn' and 'change'), Paths were encoded asymmetrically, with Goal Paths (e.g. "turned to pink") included more often than Source Paths (e.g. "turned from green"), $t(9) = 5.12$, $P < .01$ (see Fig. 9).

6.2.4. Attachment/detachment events

Children again used verbs that were similar to those used by the other groups (see Tables 5 and 6). For the Attach events, they used Goal Path verbs ($M = .86$, $SE = .06$), whereas for the Detach events, they used Source Path verbs much less often ($M = .56$, $SE = .07$). This verb asymmetry was confirmed by a *t*-test, $t(11) = 3.98$, $P < .01$. For the Attach events, when children did not use Goal Path verbs, they used a variety of other verbs, e.g. "The lady *was washing* the door". However, for the Detach events, when children did not use Source Path verbs they sometimes used Goal Path verbs instead. Specifically, to describe an event depicting a man unhooking a boat from a dock, two children used Goal Path verbs 'tie on' and 'hang up'. Furthermore, to describe an event depicting a man pulling a spoon out of a banana, six children used Goal Path verbs 'put in', 'stick in', and 'poke in'. Thus, like the MA and WS children in Experiment 1, 3–4-year-old children also showed a Goal Path bias for verb selection.

The Goal/Source asymmetry also held for Path inclusion (see Fig. 10). When participants used a Goal Path verb in Attach events, they very often included the Goal Path, whereas when participants used a Source Path verb in Detach events, they included the Source Path less often, $t(10) = 2.64$, $P < .05$.[11]

6.2.5. Path inclusion across all groups of children

In order to explore the Goal/Source Path asymmetry across all groups of children (3–4 year, WS, and MA), we conducted a 3 (Group) by 2 (Goal/Source Path type)

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[11] As in Experiment 1, we also conducted the analysis with the 'put' cases removed. The results showed a reliable Goal/Source Path type effect, $t(9) = 6.80$, $P < .01$ (*M* Goal Paths = .85, *SE* = .08; *M* Source Paths = .40, *SE* = .07).
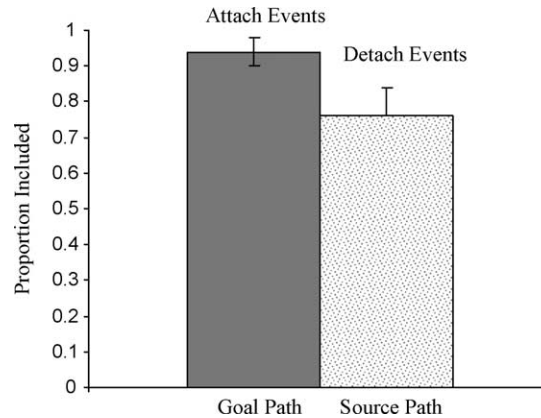
Fig. 10. Proportions (and *SEs*) of Goal and Source Paths included across the Attachment/Detachment Events for 3–4-year-old children.

mixed analysis of variance for each event type. For Manner of Motion, Change of Possession, Change of State, and Attachment/Detachment events, respectively, all omnibus tests showed a reliable effect of Path type, with Goal Paths included more often than Source Paths; $F(1, 29) = 74.46$, $P < .01$, $F(1, 17) = 217.18$, $P < .01$, $F(1, 23) = 41.48$, $P < .01$, and $F(1, 27) = 15.88$, $P < .01$. There were no reliable effects of Group, with the exception of the Manner of Motion events, $F(2, 29) = 12.63$, $P < .01$, for which 3–4-year-old children produced fewer Paths overall than WS or MA children (Tukey's *HSD* for 3–4 year vs. WS and for 3–4 year vs. MA, $P < .05$). Furthermore, none of the analyses showed a reliable Group X Path type interaction, suggesting that the degree of asymmetry between Goal and Source Paths does not reliably differ among 3–4-year-old, WS, and MA children.

6.2.6. Error patterns across all event types

Three and four year-old children's error patterns were virtually identical to the other children's when they did not include a Source Path. They either (a) completely omitted it (e.g. "he catched the ball", "his nose turned to green"; $M = .61$), (b) mentioned the Source object somewhere other than the PP (e.g. "first she was on a *blue mat* and then she went to a pink mat", "he ate *the banana* with a spoon"; $M = .02$), or (c) encoded the Source Path with non-Source preposition (e.g. "the ball went *to* a box to a basket", "he pulled a spoon *into* the banana"; $M = .05$). When children encoded the Source Path with a non-Source preposition, they used a Goal preposition 90% of the time.[12]

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[12] The analysis including error types (b) and (c) as correct showed no reliable Path type effect for the Attachment/Detachment events, $t(10) = 1.75$, $P = .10$, because children often substituted a Goal preposition for a Source preposition.

7. Experiment 3b

7.1. Method

Participants were the same as in Experiment 3a. Materials and procedure were identical to those in Experiment 2.

7.2. Results

7.2.1. Change of possession events

Children used the 'hint' verbs most of the time (M Goal Path verbs, 'throw', 'give', 'sell' = .83, SE = .04; M Source Path verbs, 'catch', 'get'/'receive', 'buy' = .79, SE = .08). When they did not use the target Goal Path verb they often used other Goal Path verbs—mostly 'give' rather than 'sell'. In contrast, when children did not use the target Source Path verb they often used Goal Path verbs: 'throw' rather than 'catch', 'give' rather than 'receive'/'get', and 'give' rather than 'buy'. Goal Paths were included more often than Source Paths, $t(11) = 7.63$, $P < .01$ (see Fig. 11).

7.2.2. Attachment/detachment events

Three-four year-olds used the 'hint' verbs about 95% of the time (M for Goal Path verbs 'hook', 'stick', 'glue' = .94; M for Source Path verbs 'unhook', 'pull', 'rip' = .96). When they did not use the target Goal Path verb, they used other Goal Path verbs (e.g. 'put on' rather than 'hook'). However, when they did not use the target Source Path verb, they used Goal Path verbs instead, i.e. 'hooked' rather than 'unhooked'. Again, Goal Paths were included more often than Source Paths, $t(11) = 3.92$, $P < .01$ (see Fig. 12).
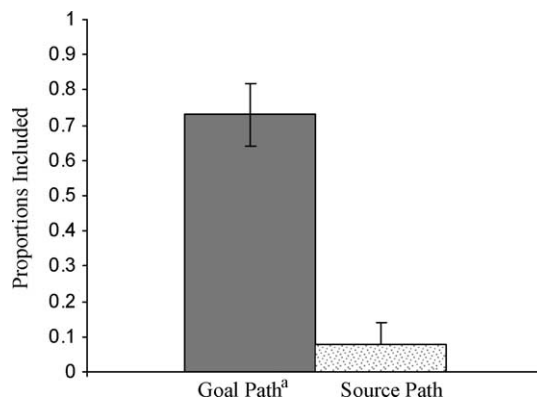

Fig. 11. Proportions (and *SEs*) of Goal and Source Paths included for different 'hint' verb groups across the Change of Possession Events for 3–4-year-old children (Based on total number of 'hint' verbs used).
[a]Goal paths were PP complements (P+NP) or double object dative constructions (NP+NP). Mean PP complements = .95; Mean double object complements = .05.
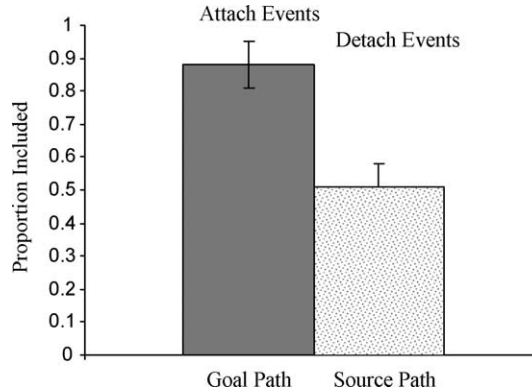
Fig. 12. Proportions (and *SEs*) of Goal and Source Paths included for different 'hint' verb groups across the Attachment/Detachment Events for 3–4-year-old children (Based on total number of 'hint' verbs used).

7.2.3. Path inclusion across all groups of children

As in Experiment 3a, in order to explore the Goal/Source Path asymmetry across all groups of children (3–4 year, WS, and MA), we conducted a 3 (Group) by 2 (Goal/Source Path type) mixed analysis of variance for each event type (Change of Possession and Attachment/Detachment). For the Change of Possession and Attachment/Detachment events respectively, both omnibus tests showed an effect of Path type, with Goal paths included more often than Source paths; $F(1, 29) = 158.89$, $P < .01$ and $F(1, 29) = 27.45$ $P < .01$. There was a reliable Group effect for the Attachment/Detachment events, $F(2, 29) = 9.20$, $P < .01$, with 3–4-year-old children producing fewer Paths overall than WS or MA children (Tukey's *HSD* for 3–4 year <u>vs.</u> WS and for 3–4 year <u>vs.</u> MA, $P < .05$). As in Experiment 3a, neither analysis showed a reliable Group $\times$ Path type interaction, suggesting that the degree of asymmetry between Goal and Source Paths does not reliably differ among 3–4-year-old, WS, and MA children.

7.2.4. Error patterns

When 3–4-year-old children did not include the Source Path, they either (a) omitted the Source Path (e.g. "he caught the glove"; $M = .48$), (b) mentioned the Source object somewhere other than the PP (e.g. "she unhooked the *doggie's* leash"; $M = .07$), or (c) encoded it with a non-Source preposition (e.g. "she unhooked the leash *to* the dog"; $M = .17$). When children encoded the Source Path with a non-Source preposition, they always did so with a Goal preposition (e.g. 'to', 'in').

7.3. Discussion

Like the WS and MA children in Experiments 1 and 2, 3–4-year-old children regularly and accurately included the Goal Path but not the Source Path. The degree of asymmetry was similar across the three groups of children. When the Source Path was not included, it was usually completely omitted or encoded with a Goal preposition. The 3–4 year olds also sometimes included fewer Paths overall than the other groups of children.

Also like the other groups of children, when 3–4-year-old children were free to choose any verb they wanted (Experiment 3a), they used Goal Path verbs more often than Source Path verbs. Even in Experiment 3b, when 3–4-year-old children were supplied with a Source Path verb, they sometimes used a Goal Path verb instead (e.g. 'give' rather than 'receive'/'get').

As a whole, the findings from Experiments 3a and 3b suggest that 3–4-year-old children also have a robust bias to linguistically encode Goal Paths rather than Source Paths. The early and robust characteristics of this bias suggest that it may be conceptual in nature, whereby conceptual endpoints are 'favored' over conceptual starting points—an asymmetry which is reflected in language. We will return to this point in the General Discussion below.

8. General discussion

In three experiments, people linguistically described events by including Goal Paths in prepositional phrases, in preference to Source Paths. Children regularly and accurately described Goal Paths, but less often Source Paths over a variety of events, including those that are clearly spatial—such as Manner of Motion events—as well as other events types including Change of Possession, Change of State, and Attachment/Detachment events. This pattern persisted even when we directed children's attention to a specific kind of Path by supplying them with a verb that takes predominantly a Goal or Source Path (e.g. 'hook' or 'unhook'/'give' or 'get'/'throw' or 'catch'). When children did not encode the Source Path, they completely omitted it or mentioned it in another clause. Strikingly, they sometimes even substituted a Goal Path term ('to') for what was clearly a Source Path, as in "She crawled *to* the blue mat *to* the pink mat".

A bias towards the Goal Path was also reflected in children's choice of verbs. For example, although the Detachment events depicted a Theme being separated from its Source, children sometimes inaccurately encoded these with Goal Path verbs and Goal Paths, saying, e.g. "He *put* the spoon *into* the banana" after viewing an act of a spoon being removed from a banana. For Change of Possession events, which are inherently neutral with respect to what kinds of verbs they take (e.g. 'give'/'get'), children used Goal Path verbs (e.g. 'give') more often than Source Path verbs (e.g. 'get'/'receive'). Children's use of Goal Path verbs to describe such transfer events persisted in Experiment 2, despite our providing them with Source Path verbs (e.g. 'catch', for which they substituted 'throw').

This pattern of accurate and systematic expression of Goal Paths but not Source Paths was observed among normally developing children between 3 and 6 years of age, as well as children with Williams syndrome, who have severe spatial impairments, and who might therefore be expected to show unusual weakness in general encoding of Paths.[13] The fact

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[13] Our current findings revealed few statistically reliable differences between the WS children and their MA matches. This finding is different from that of Landau and Zukowski (2003), who did find reliably fewer Source Paths among WS children than their MA matches. We believe that the reason for this difference is that the present study showed both Source and Goal in every event, whereas Landau and Zukowski's events used only Manner of Motion events in which either a Source or Goal was shown. In fact, the overall Path omissions were greater in the current study for both WS children and MA matches, suggesting that when both Source and Goal appear, there may be competition for which one gets encoded.

that the pattern appeared so clearly among young normally developing children suggests that it probably does not stem from the spatial impairment per se, but rather, is a fact about the cognitive architecture of spatial language, and possibly even that of non-linguistic representation of events. The appearance of the pattern even among normal adults—albeit weaker—also suggests that there is something quite fundamental about the strong tendency to express Goal Paths and the relative fragility of encoding Source Paths. This tendency shows up both in people's perspective on events, and in the structure of language, which appears biased to encode Goal Paths for verbs rather than Source Paths. We discuss these factors below.

8.1. Biases in perspective, biases in language

Perhaps the simplest case can be made for the Manner of Motion events. These events were visually neutral, i.e. they displayed both Source and Goal. Moreover, the verbs that typically describe these events—run, hop, roll, etc.—have no semantic or syntactic constraints on the Path terms they take, and indeed, Paths are completely optional for them (Jackendoff, 1990; Levin, 1993). Still, children linguistically expressed Goal Paths more often than Source Paths. Because this asymmetry has no apparent origins in the linguistic structure of the verbs used, we speculate that it may stem from a Goal biased perspective, which may be non-linguistic—a possibility we discuss later.

A similar case can be made for the Change of Possession and Change of State events. Although these events were also visually neutral, children and adults overwhelmingly showed a bias to encode the Goal Path. For the Change of Possession events, people used Goal Path verbs over Source Path verbs, that is, 'give' rather than 'get' and 'throw' rather than 'catch', and when using these verbs, they more often encoded the specific Goal Path rather than Source Path.[14] For the Change of State events, children used verbs such as 'turn' and 'change', and adults also used the verb 'go'. Yet all groups still mentioned the Goal Path more often than the Source Path. Only the Attach/Detach events were not visually neutral, with the events themselves enforcing a bias towards a Goal Path or Source Path. Yet children and adults still tended to express Goal Paths more often for Attach verbs than they expressed Source Paths for Detach verbs.

Was the phenomenon entirely driven by a biased event perspective? Or was it partly driven by the particular choice of verbs for these events? Certainly, the Manner of Motion events show that, even for the most Path-neutral of all verb types, people still are biased to express Goal Paths rather than Source Paths. But the situation is a bit more complex for the other event types, and it is important to determine whether and to what extent pressures to express the Goal Path might have arisen from the speakers' choice of verbs. We consider each event type in turn.

First, the Change of Possession events elicited verbs such as 'give'/'get', 'throw'/'catch', and 'sell'/buy'. As far as we can tell, with the exception of the verb

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[14] For verbs such as 'give', 'throw', and 'sell', the subject is also the Source, at least on one of the semantic tiers proposed by Jackendoff (1990). The fact that adults and children never leave out the sentential subject suggests that when the Source is a causal agent it must be encoded. Obviously, the cases where the Source and Goal are not Actors or Agents do not have this problem.

'give', the semantic and syntactic structures of these verbs could not by themselves lead to a Goal Path bias. For one thing, the *semantics* of the verbs require both Path types; for example, the verbs 'sell' and 'buy' both have obligatory Path arguments (Jackendoff, 1990). That is, 'selling' involves goods being transferred TO a buyer, and 'buying' involves goods being transferred FROM a seller. Despite this fact, people mentioned the Goal (e.g. "The girl sold a muffin *to the man*") much more frequently than the Source (e.g. "The man bought a muffin *from the girl*"). The same was true for 'throw' and 'catch'. Second, both Path types appear to be optional in the syntax for these verbs. That is, the following sentences are all grammatical: "He sold a muffin (to the girl)/bought a muffin (from the girl)", and "He threw the ball (to the catcher)/caught the ball (from the pitcher)". In sum, the semantics and/or syntax of the verbs used for the Change of Possession events (apart from 'give') do not themselves predict an asymmetry between Goal and Source Paths. Rather, the choice of verb—and whether its Path complement is included—appears again to be the product of a Goal Path biased perspective.

The situation for Change of State events is a bit different. These events elicited path-taking verbs such as 'turn', 'change', and (for adults) 'go'. According to Jackendoff (1990) and Levin (1993), Change of State verbs such as 'turn' and 'change' have three semantic arguments: The entity undergoing the change (Theme), the Source-state, and the Goal-state; but the latter two are not ranked relative to each other in these descriptions. Still, these verbs do seem to show some degree of asymmetry in their syntax. For example, Levin (1993) points out that a verb such as 'turn' can always take a Goal without a Source (e.g. "The frog turned to blue"), but cannot take a Source without a Goal (e.g. *"The frog turned from green"). Rather, in order to express the Source, one must also express the Goal (e.g. "The frog turned from green to blue"). Indeed, children never said "turned from green", but they also rarely said "turned from green to blue". Rather they tended to describe the color change as "turned to blue" with the Source encoded in a separate clause (e.g. "started out green"). These cases make two points. First, children of 3 and older appear to know the syntax of the particular verbs they chose in our study; they rarely violated the "no Source without a Goal" rule for these verbs. But second, even when they have the option to encode the Source as the object of a PP—that is, when they also encode the Goal—they tended not to do so.

Finally, the Attach/Detach events present still a different case. These events were themselves biased, and accordingly, Attach events elicited verbs such as 'hook', 'glue', 'stick', and 'leash', and Detach events elicited verbs such as 'unhook', 'pull', 'rip', 'tear', and 'take'.[15] According to Jackendoff (1990), the semantic structures of both groups of verbs have obligatory Path complements, with the Attach verbs including a Goal Path (e.g. 'glue' *means* that something is attached TO something else) and Detach verbs including a Source Path (e.g. 'rip' *means* that something is detached FROM something else). But what shows up in the syntax may reflect a bias towards expression of Goal Paths. In Levin's

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[15] These verbs also have multiple senses, which can introduce additional complexity in determining what syntactic structure to use. One example, which we have already mentioned, is 'rip'. Although this verb can be used in a non-removal sense (e.g. I ripped my shirt), the event we showed was a case of removal, i.e. removing a label from a bottle by ripping it off the surface. We limit our discussion in this paper to those uses that were the correct ones for the events we showed.

(1993) analysis, Attach verbs require syntactic expression of the (Goal) Path, unless the verb is accompanied by a plural NP. For example, a verb such as 'hook' requires a Goal Path to express asymmetrical attachment of the kind we showed (e.g. *'he hooked the boat/to the dock'). The only time the Path can be omitted is when there is a plural NP, resulting in a reading of symmetrical attachment (e.g. "he hooked the keys", meaning together); however, none of our events showed this kind of attachment, and this intended meaning was therefore unlikely.

Levin does not discuss in detail the situation for Detach verbs, but our own observations suggest that there may be more optionality in Path expression. For example, for some Detach verbs, it is grammatical to omit the Path and still have a directed Detachment reading (e.g. "he unhooked the leash"). This may be caused by the prefix 'un' for certain verbs, although it is not clear whether young children understand that this morpheme itself represents a Source Path. For other verbs, omitting the Path leads to an ambiguous or non-removal reading (e.g. "He ripped the label" has a non-removal reading).

If Attach verbs have obligatory syntactic expression of Path but Detach verbs do not, then we might expect somewhat less frequent expression of Source Paths than Goal Paths for Detach vs. Attach verbs; and this is what we found. As with the Change of State verbs, children's Goal Path bias for these verbs may be partly a function of their knowledge of the syntactic requirements of different verbs. Again, however, we do not think this is the whole story. The fact is, children often used verbs such as 'take', 'rip', 'tear', and 'pull' without Source Paths to describe events of removal. These verbs actually do require Path expressions in order to have an unambiguous Detach reading, and this is something the children have not yet completely learned. So, although children may have learned that Source Paths are more optional for Detach than Attach verbs, they may not have learned that omission in the syntax leads to different (non-correct) semantic readings.

To summarize, it appears that at least two factors are at work in causing the Goal Path bias we observed. First, over all event types, children and adults seem to adopt a Goal biased perspective on events. This causes them to preferentially mention the Goal Path over the Source Path when displayed events are "neutral", and when the verbs they use allow for both options. The second factor reflects the constraints introduced from the semantic and syntactic structure of the verbs themselves. Even when the semantic structures of the verbs call for obligatory inclusion of both Path types, the syntax sometimes (perhaps often) tends to render the Source Path optional.

Are there other factors that cause the frequent omission of Source Paths? Undoubtedly, yes. For instance, there surely are pragmatic features of the situation which could induce more attention to Sources than Goals (see Papafragou, Massey, & Gleitman, 2004 for related observations). For example, if we had shown a rabbit being shot out of a cannon and landing in a ditch, people would likely mention the Source and Source Path. This is similar to the fact that one can easily induce people to use the passive (placing the agent in object position), despite the extremely strong bias— all other things being equal— to place the agent in subject position (Bock, 1986). In our case, we forced all things to be otherwise equal by showing relatively neutral Sources and Goals, and in these cases, people showed a strong bias towards expressing the Goal Path in preference to the Source Path.

What about relative frequencies of Goal and Source Path terms? Could these explain the asymmetry? Frequency counts show that Goal prepositions ('in', 'on', and 'to') are more

frequent than Source prepositions ('out', 'off', and 'from') (Carroll, Davies, & Richman, 1971). However, there are several facts mitigating against this as a complete explanation. First, Source verbs such as 'catch', 'buy', and 'get' are more frequent than Goal verbs such as 'throw', 'sell', and 'give'; yet children overwhelmingly use 'throw' (not 'catch') and 'give' (not 'get'). Second, children use Source prepositions (such as 'off') from an early age (e.g. Choi & Bowerman, 1991; Clark & Carpenter, 1994), so there is no reason to think they cannot encode or express Source Paths. Finally, there are reasons to suspect that pre-linguistic infants show a bias to encode Goals over Sources (see below, and Lakusta, Wagner, O'Hearn Donny, & Landau, 2004). This would suggest that the Goal Path bias is a product of non-linguistic conceptual biases that drive the acquisition of language, rather than sheer frequency of input.

We suspect that the increased optionality of Source Paths may reflect a design feature which requires the more important or central elements of meaning—here, Goals and Goal Paths—to be expressed at the expense of less important ones (cf. Langacker, 1991). This idea may be reflected in formal theories of word meaning which suggest that lexical items possess a qualia or explanatory structure that contains critical aspects of a word's meaning, such as a teleological and an agentive component for verbs (e.g. Moravcsik, 1981, 1990; Prasada, 2000; Pustejovsky, 1995). Even for simple Manner of Motion verbs such as run or hop, there may be a teleological component of meaning that leads to a strong bias to encode the Goal Path and endpoint of motion. In contrast, there may be no clear role for the Source (starting point) in the qualia structure of these verbs. In contrast, there is a clear role for the Source in a verb such as 'give', and as our results show, this Source, which is also the agent, does appear as the syntactic subject of the sentence.

Taking these issues into account, we speculate that a Goal–Source asymmetry may be an aspect of structure that represents an important bias, perhaps akin to the tendency to encode causal agents as subjects (cf. Fisher et al., 1994; Slobin, 1985). If this is true, linguistic theories positing thematic hierarchies and linking rules (e.g. Grimshaw, 1981; Jackendoff, 1990; Pinker, 1989) may want to consider promoting the Goal role above the Source role for verbs whose semantics include these components.

8.2. Broader reflections of a goal path bias

Our results are consistent with a variety of findings that support the idea that children come to language learning with a Goal Path bias, that this bias may be reflected in languages of the world, and that it may have its origins in non-linguistic representations of events in infancy.

First, evidence from language acquisition shows that Goal Path terms may be produced earlier than Source Path terms. Clancy (1985) reported that children acquiring Japanese express the locative Goal case particle ('ni') earlier than the Source particle ('kara'); a similar phenomenon has been reported for children acquiring Hungarian (Pléh, 1998). And Bowerman reported that children tend to broadly overgeneralize spatial terms that describe separation but not those that describe joining (Bowerman, 1996; Bowerman, Lourdes de León, & Choi, 1995). This pattern was found across English, Korean, Dutch, and Tzotzil Mayan, indicating that the spatial terms marking Goal Paths are more finely differentiated than spatial terms marking Source Paths (also see Regier, 1997; Regier & Zheng, 2003).

Finally, Zheng and Goldin-Meadow (2002) reported that American and Chinese congenitally deaf children who were not exposed to any conventional language model produced Figures and Endpoints more often than Agents, Origins, Recipients, and Places when describing various types of motion. Since these children were not exposed to any conventional language model, these results suggest that the bias to express Goals, rather than Sources, may be brought to the task by the language learner.

The idea of a Goal bias is also supported by studies of Japanese aggramatics (Ihara & Fujita, 2000). When these patients described Change of Possession events, they correctly provided the Goal marker ('ni') for GIVE verbs (e.g. 'ageru') more often than the Source marker ('kara') for RECEIVE verbs (e.g. 'uketoru'). And when they did not use the correct Source marker (-kara), they sometimes substituted a Goal marker (-ni)—a pattern reminiscent of the children we studied.

Ihara and Fujita (2000) note that this asymmetry between Source and Goal is reflected in many of the world's languages. For example, in Japanese and Korean, the Goal marker is sometimes substituted for the Source marker, but the opposite pattern never occurs. Also, in Japanese the Goal marker 'ni' can sometimes be omitted, whereas the Source marker 'kara' can never be omitted. These indicate that the expression of the Goal is the unmarked form. We suggest that this asymmetry in markedness is also reflected in English where Change of State verbs, such as 'turn', can take resultatives in which the Goal state directly follows the verb (as in "Danny's hair turned red" meaning he dyed his hair from brown to red). But it is virtually impossible (for us, at least) to find a verb that expresses a Change of State in which the Source only is mentioned directly following the verb, as in *"The frog blurned green" meaning it started out green and turned some other color.

How can we explain the Goal Path bias in children and adults? One possibility is that people have a Goal biased perspective on events that makes them more likely to encode Goal states than Source states. This interpretation would place the burden of proof in our non-linguistic representations of events, and would require explanations at the level of perceptual and attentional systems. Two sources of evidence suggest that this may be at least part of the explanation. One is the literature on infancy, which suggests that even prelinguistic infants tend to be goal-oriented, and tend to focus on causal roles, animates, and especially, intentional states (e.g. Gergely, Nádasdy, Csibra, & Bíró, 1995; Leslie & Keeble, 1987; Meltzoff, 1995; Tomasello & Barton, 1994; Woodward, 1998). For example, Meltzoff (1995) reported that 18-month-old children re-enacted an intended act (e.g. pushing a button with a stick), even when the animate actor failed to accomplish the act (i.e. he missed the button). Gergely et al. (1995) showed that 12-month-old infants looked longer when an agent did not take the most direct path to its intended goal, suggesting the infants were surprised by the failure to directly follow intentions. Finally, Woodward (1998) reported findings suggesting that even 6 month-olds have knowledge about goal-directed actions. In this study, infants looked longer when an animate actor reached for a new goal than when the actor took a new path towards an old goal. Overall this literature suggests that, at minimum, infants know about goal-directed actions and may even have heightened interest in these actions, which could, in turn, lead to heightened attention to goal states. If infants do attend to Goals rather than sources, this might lead to biases in language learning.

A second source of support for this view comes from a recently proposed computational model. Regier (1997) argued that a plausible learning model for spatial terms would embody a learner who attends sequentially to the components of an event, computing its spatial relationship at the end. Over time, components of the event will be lost to memory, leaving end states as the most likely to survive. The asymmetry between starting and end points is the product of this plausible scenario: "The child has more of a chance to absorb the result of the event than its starting configuration. By the time the child's attention has been captured by the motion, the starting configuration is no longer perceptually available—only the motion itself is, followed by the resultant end-state (p. 202)". Regier's case is bolstered by the asymmetries he finds in non-linguistic perception and memory tasks and in the structure of semantic categories of Path terms over languages. And it is fully consistent with the Goal Path bias we have reported.

9. Conclusion

Our research has shown that English speaking children show a bias to linguistically express Goal Paths in preference to Source Paths. We speculate that such a bias may have its origins in non-linguistic representations of events that weight Goals and their Paths more heavily than Sources and their Paths. This non-linguistic bias could serve as a building block for language learning if it is reflected in a linguistic asymmetry—one which considers the expression of Goal Paths to be more often obligatory and/or more highly ranked than Source Paths. Although our findings focus on one language (English) and one syntactic structure (prepositional phrase), it seems likely that this phenomenon may extend to a variety of languages and linguistic structures which encode Paths. If so, then the bias we have described may have broad implications for our understanding of how we represent events, and how children learn to talk about them.

Acknowledgements

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