

Children's Use of Pointing to Anchor Reference during Story-telling

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Young children are notoriously bad story-tellers. Their stories often lack minimal plot structure, rely on crude temporal sequencing, and make little (if any) use of the rich linguistic devices that allow adults to cohesively bind sentences together in a narrative (Berman and Slobin, 1994). The studies reported here investigate one story-telling dimension that children have trouble with: the maintenance of discourse anaphora.

Within a sentence, nominal reference is governed by the syntax-semantics of the binding conditions (cf. Chomsky 1986, Reinhart & Reuland 1993). Across sentences, however, it depends on extra-grammatical features such as information flow, continuity expectations, and speaker and listener knowledge states (cf. Heim 1982, Grosz, Joshi & Weinstein 1995). Discourse anaphora is rule-governed, but the rules make reference to more than just linguistic structures, and are sometimes probabilistic in application.

It is perhaps not surprising, therefore, that young children have difficulty in making all their nominal elements refer successfully in a discourse. Karmiloff-Smith (1981) documented children's difficulty with discourse anaphora (among other things). She had children tell short stories from sequences of cartoon pictures. Based on a holistic classification of children's stories, she found that 77% of children in her youngest group (aged 4 years) told "Level 1" stories. One of the primary criteria for the Level 1 classification was that children's nominal references were used in a deictic function. That is, children used their linguistic forms (most often pronouns) to point directly to their intended referents, with no consideration of the prior linguistic discourse. An example of part of a Level 1 story from Karmiloff-Smith's study is shown in (1).

(1) She_i wants a vanilla ice-cream. So she_i gives her_i one and she_i walks off licking it.

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The primary discourse failure in this story centers on the underlined pronoun. Based on common sense (and presumably, the content of the pictures), it is clear that this *she* refers to a different person than either the *she* that precedes it or the *her* that follows it. Karmiloff-Smith argues that the underlined *she* should be interpreted as pointing directly to its referent, as a form of deixis. Since these forms are not standardly used deictically, they are often difficult to understand. At the very least, their comprehension depends heavily on the extra-linguistic information provided by context.

More recent studies of children's discourse anaphora during story-telling have painted a slightly more refined picture of children's abilities. Clancy (1992) looked at nominal reference in the narratives Japanese children. She found that even 3-year-old children were significantly more likely to use a full NP (as opposed to ellipsis) when they switched referents than when they maintained the same referent. Thus, these children did tell stories parallel to the one shown in (1), but it was more common for them to replace the equivalent of the underlined *she* with a full NP. Similarly, Hickmann & Hendriks (1999) examined narratives told by children acquiring English, French, German and Chinese. Across languages, they found that more than 80% of 4-5-year-old children's pronouns were co-referential with a linguistic antecedent. Thus, the underlined *she* forms from example (1) above represent only about 20% of children's pronoun uses.

It appears, then, that these deictic pronoun uses may be more of a marginal phenomenon than first supposed. Moreover, they may also be a grammatically sanctioned phenomenon. Avrutin (1999) discusses adult uses of deictic pronouns, such as those shown in (2) and (3).

- (2) She's late (said while pointing to a woman)
- (3) He cut in line (said while elbowing a man)

Like the children's uses, the pronouns in (2) and (3) require extra-linguistic context to determine their referents. For adults, this requirement cashes out in the required use of an explicit deictic gesture such as pointing, or elbowing. For adults, therefore, these so-called deictic pronouns basically borrow their deictic function from a gesture that readily links to the extra-linguistic context.

What is unknown, however, is whether children also support their apparently deictic pronouns with an explicit deictic gesture. Given the nature of the story-telling tasks described above, there is good reason to believe that children might do just that. To aid children's story-telling, the children sat in front of pictures which would have easily allowed children to point to intended referents¹.

¹ Clancy (1992) tried to discourage pointing by having children tell their stories to a blind-folded listener. They do not report on rates of pointing in

The aim of the current studies is to investigate children's story-telling with special attention to their use of pointing as a deictic gesture, and to how pointing might be connected to children's linguistically based referential strategies. We adopt the hypothesis that children's discourse anaphora is adult-like; we expect that when children's nominal forms depend on extra-linguistic context for interpretation, children will augment their linguistic forms with the explicit deictic gesture of pointing.

The two experiments test different dimensions of children's understanding of how deictic gestures can and should support their linguistic forms during story-telling. Experiment 1 looks at whether children's linguistic forms change when children are unable to make deictic gestures; Experiment 2 investigates children's understanding of the communicative function of deictic pointing in this task.

1. Experiment 1: Hands vs. No Hands

In this experiment, children told stories from sets of cartoon pictures. The main manipulation was whether or not children were allowed to use their hands when they told the stories. If children are indeed using their points to deictically support their nominal reference, then we expect pointing to be systematically linked to how forms are linguistically anchored. More specifically, we predict the following two results: First, when allowed to use their hands, children's rate of pointing should increase when their referential anchoring is more extra-linguistically dependent; Second, when kept from using their hands, children should increase their rate of linguistically dependent anchoring because they can no longer support the extra-linguistic anchoring with an explicit deictic gesture.

1.1 Methods

1.1.1 Subjects

Twelve subjects were tested with a mean age of 3 years, 7 months. Testing took place either at a daycare at Cambridge, MA or at the Laboratory for Developmental Studies at Harvard.

1.1.2 Stimuli and Procedures

The stimuli were eight cartoon stories, each consisting of five pictures (see Figure 1 for an example). All the characters within a story were of the same gender so children could not use gender as a means to disambiguate their pronouns. Half the stories contained three characters and half contained two.

their task, however. And, as will be seen in Experiment 2 here, it is unclear that such a manipulation effectively reduces pointing.

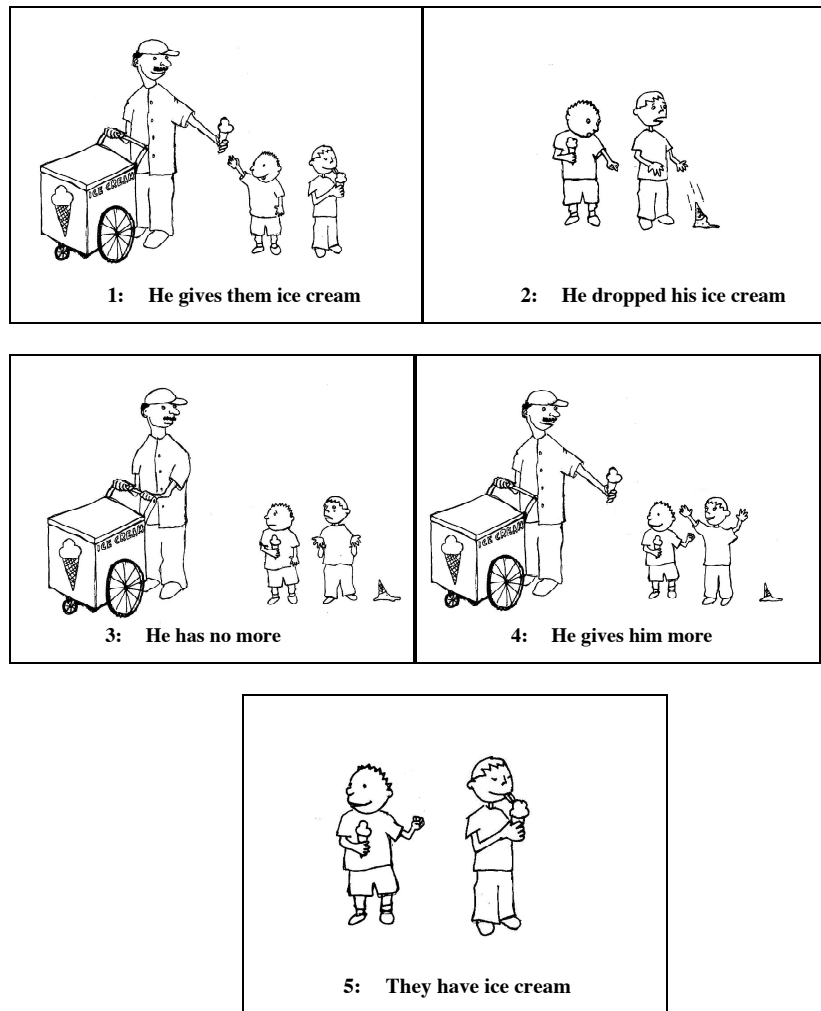


Figure 1: Pictures used in the “Ice Cream” story along with a story told by a child aged 3;8.

Subjects were first shown all five pictures at once, to encourage them to tell a connected story. They were then shown each picture alone and prompted to tell the story. The experimenter’s prompts contained no references to the characters in the story and consisted primarily of general encouragement (e.g., “What happens in this story?”, “What happened next?”, and “How does the story end?”).

In the Hands-OK condition, children sat in front of the pictures and were allowed to point or not as they desired. In the No-Hands condition, children

were told they could not use their hands while they told the stories. Some subjects were asked to hold their hands behind their backs; other subjects were asked to place their hands inside mittens attached to a rubber ball. Children told half their stories without their hands. The order of the Hands-OK/No-Hands conditions was counterbalanced across stories and subjects.

1.1.3 Coding

Every reference to a human being was coded along several dimensions, including reference form, semantic referent, and syntactic role. In the interests of space, only detailed coding criteria for reference anchoring will be provided here.

Each reference form was coded as being anchored to a prior antecedent in one of the four ways listed below. Note that the anchoring codes consider only the linguistic forms used and how they can be interpreted with respect to the pictures. They do not take into account whether or not pointing acted as an aid in establishing reference. All examples were taken from stories told in this study; the anchoring code refers to the underlined form in the examples.

Proper Linguistic

When a form was bridged to a single previously mentioned antecedent: *That guy_i drops it. Then he_i cries* (cf. picture 3 above).

Uniquely Identifiable Noun Phrase

When a form is not bridged to a linguistic antecedent, but identifies a unique individual on the current picture: *And then the man gave the ice-cream to him* (cf. picture 4 above).

Inferrable from the Whole Sentence + Picture Context

When a form is not bridged to a linguistic antecedent, but only a single individual on the current picture plays the semantic role given to the reference form: *His_i ice-cream falls. He_i gives him_i another one* (cf. picture 4 above).

Bad

When it is unclear from the linguistic form who is being referred to: *She rides on the swing* (said as the first utterance in a story; the picture shows two girls on a swing-set).

These anchoring coding categories can be seen as being on a continuum, with Linguistic anchoring indicating that reference depends on the linguistic discourse, Unique NP and Inferrable anchoring indicating that reference increasingly depends on extra-linguistic factors (such as the picture context), and Bad anchoring indicating that only extra-linguistic factors are relevant, and those are unrecoverable from the linguistic form alone.

All reference forms were coded by two coders working separately. Any disagreements were resolved via discussion among the coders and the first author.

1.2 Results

A total of 569 references were coded. Each child contributed an average number of 47 references; each story contributed an average of 71 references.

The first analysis considered how these references were anchored (ignoring children's pointing). Figure 2 shows the distribution of the 4 anchoring categories for both the Hands-OK and No-Hands condition. As can be seen (and as verified by an ANOVA), the distribution is the same across the conditions, with the plurality of forms being well anchored linguistically.

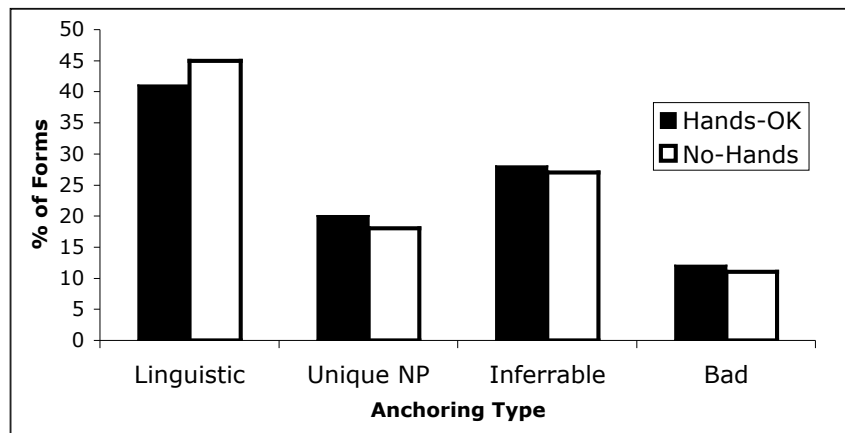


Figure 2: Distribution of Anchoring Types for Hands-OK and No-Hands

The second analysis considered the role that children's pointing might play in this task. The overall rate of pointing in the Hands-OK condition was 29%. Figure 3 shows the rate at which children pointed with reference forms anchored in various ways. An ANOVA on pointing rate with Anchoring type as the independent variable was significant: $F(3,9) = 4.8$, $p < 0.029$. Thus, children's rate of pointing increased as the means of anchoring depended more on extra-linguistic factors.

Surprisingly, ten of the twelve children also pointed in the No-Hands condition. Because pointing had been explicitly discouraged, much of this pointing was anomalous: children pointed with their elbows, their noses, the ball, and even their toes. The overall rate of pointing in the No-Hands condition was 9%. An ANOVA on pointing rate by Anchoring type was not significant, but the data does show the same trend as in the Hands-OK

condition: children's rate of pointing increased as the anchoring depended more on extra-linguistic factors (□ rates of pointing for anchoring types: Linguistic = .02, Unique NP = .08, Inferrable = .14, Bad = .14).

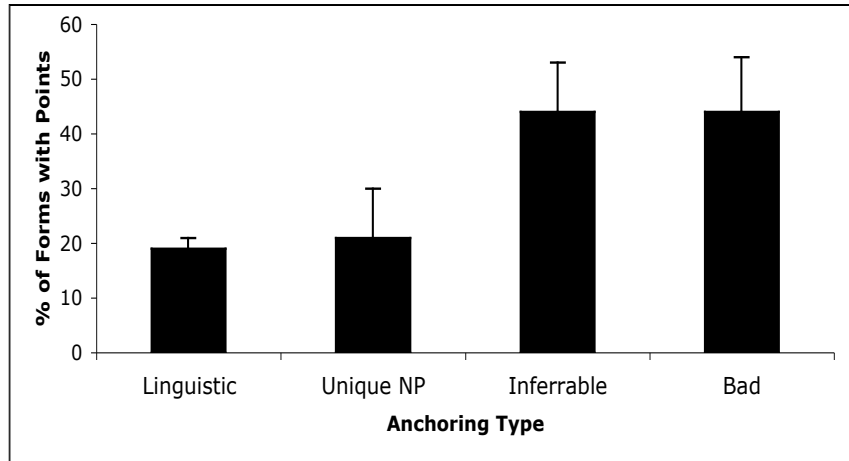


Figure 3: Rate of Pointing in the Hands-OK Condition

1.3 Discussion

There were two main findings from this experiment which provide conflicting support for the initial hypothesis. The first finding is that children do increase their use of pointing when their nominal reference depends more on extra-linguistic context for interpretation. This result supports the hypothesis that children do have an adult-like understanding of the communicative requirements for deixis and nominal reference. However, the second finding is that children do not decrease their reliance on extra-linguistic context when they are prevented from using their hands. This result argues against any strong interpretation of children's adult-like understanding insofar as it suggests that children don't see that pointing is necessary for establishing reference in some cases. Indeed, the fact that the linguistic behavior was unchanged in the No-Hands condition (combined with the rates of anomalous pointing) raises the possibility that children's linguistic references and their pointing may be independent, and perhaps orthogonal, processes.

2. Experiment 2: Blind vs. Full Listener

One of the most striking findings from Experiment 1 was the creative persistence children showed in pointing in the No-Hands condition. Since the pointing was being actively discouraged, children's persistence frequently

didn't translate into a communicatively successful deictic gesture: it is extremely difficult for a child pointing by means of her head (or her elbow, or a ball) to effectively indicate only a single character in a picture. This lack of communicative effectiveness raises the possibility that children didn't intend the pointing to be deictic or to support their nominal reference within the shared discourse. Instead, it may be that the children were pointing to facilitate an internal set of cognitive processes. For example, Goldin-Meadow (2003) reviews a large body of her research showing that children (and adults) use gesture when solving problems, including basic arithmetic or the mechanics of gears. Gestures can reinforce, augment, or even contradict the verbal descriptions subjects offer during problem solving. Goldin-Meadow argues that gestures can reflect cognition, often completely independently of the reflection offered by language.

The pointing in Experiment 1 (both in the Hands-OK and the No-Hands conditions) increased when the nominal reference form depended more on extra-linguistic context for interpretation. From the standpoint of communication, this behavior makes sense since the pointing (at least in the Hands-OK condition) serves to specify that needed extra-linguistic context. The behavior may also make sense, however, from the standpoint of cognitive facilitation: children's pointing may reflect their difficulties in maintaining linguistically anchored discourse anaphora.

The aim of Experiment 2, therefore, is to determine whether children intend their pointing to have a communicative function. Using the same materials as before, children told half their stories to a listener who could see neither the pictures, nor the child's pointing (the Blind Listener condition); the remaining stories were told to a listener with full access to the pictures and child. If children are intending their pointing to deictically communicate information about their nominal reference, then we expect the rate of pointing to drop when they tell the stories to the Blind Listener. However, if children are pointing in order to facilitate their own cognition, then there should be no difference between the two listener conditions.

2.1 Methods

2.1.1 Subjects

Eleven subjects were tested with a mean age of 3 years, 11 months. Testing took place at the Child Study Center at Wellesley College.

2.1.2 Stimuli, Procedures, and Coding

The stimuli and coding were identical to Experiment 1. The procedures were also the same, except as noted. Subjects were introduced to two experimenters. E1 sat with the child throughout and manipulated the pictures. E2 was introduced as the listener of the stories, and children were encouraged in both conditions to direct their stories to E2. E2 provided prompts (e.g.

“And then what happened?”) and encouragement (e.g, “Great story! Can I hear another one?”) for the child. In the Full Listener condition, E2 sat at the same table with E1 and the child; E2 therefore had full access both to the pictures and to the child’s pointing gestures. In the Blind Listener condition, E2 sat at a separate table with her back to the child and E1. She was nominally involved in a task for the child’s teacher which required her visual attention during this part of the experiment. E2 continued to provide prompts and encouragement; moreover E1 periodically checked with the Blind E2 to make sure she could hear the stories and children were encouraged to speak-up so E2 could hear everything. Subjects told half of the stories to a Full access Listener and half to a Blind Listener. The two listener conditions were blocked and counterbalanced across stories and subjects.

2.2 Results

A total of 485 references were coded. Each child contributed an average number of 43 references; each story contributed an average of 60 references.

The first analysis considered how these references were anchored (ignoring children’s pointing). Figure 4 shows the distribution of the 4 anchoring categories for both the Full Listener and Blind Listener conditions. As can be seen (and as verified by an ANOVA), the distribution is the same across the conditions, with the plurality of forms being well anchored linguistically.

The second analysis looked at children’s use of pointing in the two conditions. The overall rate of pointing was statistically identical in the two conditions (11.1% in the Full Listener condition and 12.3% in the Blind Listener condition). However, it was still possible that the pointing was distributed across the different anchoring categories differently in the two conditions. An ANOVA on pointing rate with Anchoring type and Listener status as the independent variables showed no main effects and no interaction. Unlike the previous experiment, these data showed no significant increase in rate of pointing as a function of the anchoring of the nominal form. This lack of result, however, may simply be a function of low overall rates of pointing (8 of 11 subjects pointed on fewer than 6% of all trials) and very high variability in this particular population. As can be seen in Figure 5, the data do conform to the same general pattern found in Experiment 1.

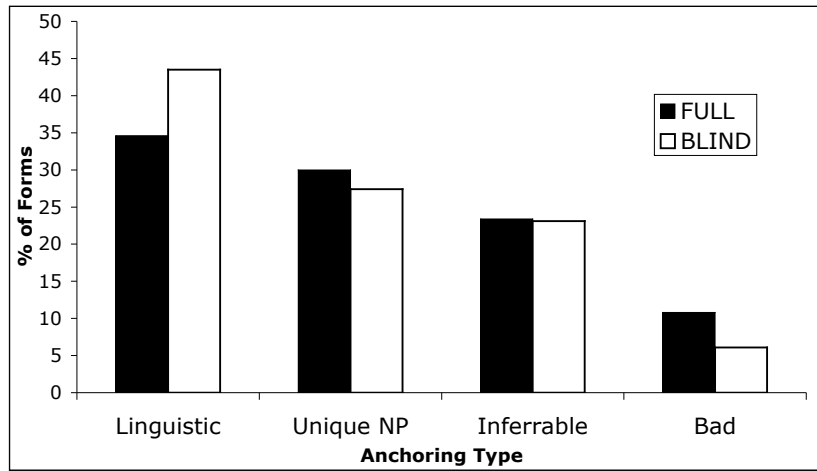


Figure 4: Distribution of Anchoring Types in Full and Blind Listener Conditions

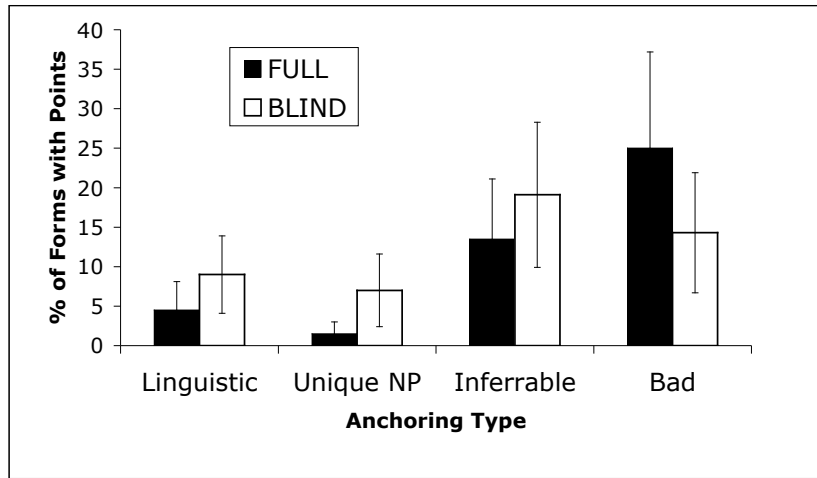


Figure 5: Rate of pointing by Anchoring Type and Listener Condition

2.3 Discussion

The results of this experiment support the hypothesis that children are not pointing to deictically signal their referent to their listener, but instead are

pointing to help themselves cognitively. Children pointed equally often when they told their stories to a listener who had full access to the pictures and pointing as they did to a listener who was blind to both.

3. General Discussion

The aim of these studies was to investigate children's use of deictic pointing gestures in a narrative discourse. Replicating previous work, these studies showed that children regularly produce nominal forms that are not anchored to the previous linguistic discourse and which require extra-linguistic context for their interpretation. The studies showed, moreover, that children are more likely to point when they use such forms.

The initial hypothesis was that children would use their pointing to augment their discourse references because they understood how deictic interpretation works: children were hypothesized to be purposefully using their pointing gestures to communicate their intended referents in situations where their linguistic forms alone were not sufficient to do so. Although the basic behavior was obtained (increased pointing with nominal forms requiring extra-linguistic interpretation), the overall pattern of pointing actually argues against the hypothesis. In particular, the fact that children do not change their linguistic forms even when they are kept from pointing (Exp. 1), the fact that children's pointing increases even when it is non-communicative (Exp. 1), and the fact that children continue to point at the same rates even when their listener cannot see them doing it (Exp. 2), all suggest that children's pointing in this task is not a purposeful, communicative gesture.

Why, then, are children pointing in this task? One strong possibility is that children's pointing reflects their own cognitive processing. Goldin-Meadow (2003) has suggested that gesture in general can serve as an aid to cognition in a variety of ways. For example, it can express alternative approaches to problems (as in gesture-speech mis-matches), and it can externalize information (which may ease on-line processing demands). In these studies, children's pointing increases in just those cases where their nominal forms are least-well anchored into the linguistic discourse. Instead of the pointing compensating communicatively for the linguistic forms, it may simply be that both behaviors independently reflect the local difficulties children are having with the narrative.

Taking this approach raises two important classes questions. First, in what ways is pointing facilitating cognition in this task? Is the pointing helping children keep track of the referents in the story? (And is the presence of pictures necessary to help them do that?) Or, is it an implicit recognition that their linguistic anchoring is breaking down (even if it is not an explicit attempt to correct for that problem)? The second class of questions concerns the stories themselves: what causes children's narrative difficulties? Do these children lack full command of the relevant linguistic forms (as their extraordinarily scant use of indefinite descriptions might suggest)? Or is the

problem based in the schematic nature of the stories (none of the characters were given any names, for example)? Further investigation into these questions is needed.

In conclusion, it is worth considering for a moment the remarkable confluence between cognition and communication found in this task. The best explanation for the entire pattern of data is that children are pointing for themselves, in an effort to facilitate their own cognition in some fashion. That said, it is still the case that children's stories are easier for the listener to understand when they point. This communicative function is, of course, limited: it doesn't apply to the Blind Listener, nor is it very effective in the No-Hands condition. Nevertheless, in the situation that is most like normal story-telling for children (when their listener watches them, and they can use their hands as they like), pointing does help the listener understand the stories, perhaps as much as it helps the child tell them.

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