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Pointing and Naming Are Not Redundant: Children Use Gesture to Modify Nouns Before They Modify Nouns in Speech

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Nouns form the first building blocks of children's language but are not consistently modified by other words until around 2.5 years of age. Before then, children often combine their nouns with gestures that indicate the object labeled by the noun, for example, pointing at a bottle while saying "bottle." These gestures are typically assumed to be redundant with speech. Here we present data challenging this assumption, suggesting that these early pointing gestures serve a determiner-like function (i.e., *point at bottle* + "bottle" = that bottle). Using longitudinal data from 18 children (8 girls), we analyzed all utterances containing nouns and focused on (a) utterances containing an unmodified noun combined with a pointing gesture and (b) utterances containing a noun modified by a determiner. We found that the age at which children first produced point + noun combinations predicted the onset age for determiner + noun combinations. Moreover, point + noun combinations decreased following the onset of determiner + noun constructions. Importantly, combinations of pointing gestures with other types of speech (e.g., *point at bottle* + "gimme" = gimme that) did not relate to the onset or offset of determiner + noun constructions. Point + noun combinations thus appear to selectively predict the development of a new construction in speech. When children point to an object and simultaneously label it, they are beginning to develop their understanding of nouns as a modifiable unit of speech.

Keywords: multimodal, language development, noun phrase, determiner, syntax

Children typically begin the process of learning English by producing nouns (Gentner, 1982; Gleitman, Cassidy, Nappa, Papafragou, & Trueswell, 2005). Initially, they produce nouns without dependents, using bare nouns such as "cat" or "bottle." This omission may not be surprising given that specifiers are often unnecessary when the conversation is grounded in the here-and-now, as it is for young children. But by about 2.5 years, children begin to produce specifiers with nouns (e.g., "the cat"; Valian, 1986), thus beginning the process of building nominal constituents (phrases containing a noun accompanied by specifiers, such as determiners, quantifiers, or adjectives). In this study, we examine the onset of nouns combined with one type of specifier—the determiner—and explore the role pointing gestures play in establishing the noun as a building block of a constituent in speech.

Children's gestures provide a unique window onto their early language development and can be used to predict individual variation in the onset and growth of specific linguistic phenomena

(Goldin-Meadow, 2003). Children begin to gesture before they can speak (Bates, 1976), and these prelinguistic gestures predict both the particular words that will soon enter their vocabularies (Iverson & Goldin-Meadow, 2005) and the size of those vocabularies several years later (Rowe & Goldin-Meadow, 2009a). Once children begin producing words, they continue gesturing along with speech. Early in development, children produce two types of gesture + speech combinations: combinations in which the information conveyed in gesture complements the information conveyed in speech (*point at box* + "box") and combinations in which the information conveyed in gesture supplements the information conveyed in speech (*point at box* + "open"; Goldin-Meadow & Morford, 1985; Greenfield & Smith, 1976).

When gesture *supplements* the information conveyed in speech, the two modalities often create a sentence-like meaning ("open box"). These combinations are produced by children who are not yet using two-word combinations (Morford & Goldin-Meadow, 1992) and thus convey meanings that the child is not yet able to convey in speech alone. Interestingly, the age at which a child first produces supplementary combinations (*point at box* + "open") predicts the age at which the child first produces two-word utterances (e.g., "open box"; Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005). The number of supplementary gesture + speech combinations children produce at 18 months also predicts the complexity of their sentences 2 years later (Rowe & Goldin-Meadow 2009b). Moreover, the particular supplementary combinations children produce in gesture + speech systematically precede the onset of corresponding syntactic constructions in speech alone. For example, children produce argument + predicate constructions by combining gesture and speech (e.g., *point at car* + "drive") before producing comparable argument + predi-

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cate constructions entirely in speech (e.g., “ride horsie”: Özçalışkan & Goldin-Meadow, 2005). These findings suggest that it is the specific ways gestures combine with speech, rather than the ability to combine gesture with speech per se, that signal the onset of future linguistic achievements.

Much less is known about the role gesture plays when it complements information conveyed in speech. Pointing at an object while labeling it with a noun has previously been thought to provide information that is redundant with the speech. If, however, children use nouns to classify the objects they label (as recent evidence suggests young infants do when hearing spoken nouns; Parise & Csibra, 2012), then producing a point with a noun could serve to *specify* a particular member of that class. In this sense, pointing gestures could be functioning like determiners. We ask here whether children begin to “modify” spoken nouns with pointing gestures before these modifications emerge in speech as nominal constituents and, if so, whether these point + noun combinations predict the onset of nominal constituents in speech.

Nominal constituents contain a noun modified by one or several specifiers that function to disambiguate the noun (Huddleston & Pullum, 2002). In many languages, the obligatory grammatical elements are a noun and a determiner, which includes articles (e.g., *the*, *a*), demonstratives (e.g., *this*, *that*), quantifiers (e.g., *two*, *some*), and possessive pronouns (e.g., *my*, *his*). Nominal constituents appear early in development. Valian (1986) observed six English-learning children beginning at age 2 years and found that, by this age, all six were producing determiners with nouns. In addition, the children did not use determiners with pronouns, suggesting they understood the distinction between the word classes. The best evidence that children are treating determiner + noun combinations as a unit is that they substitute a pronoun for a determiner + noun combination. For example, one child said, “A wagon go boom. It zoom zoom zoom,” replacing “a wagon” with “it.” Using this substitution criterion, Valian found that the six children in her study demonstrated productive use of phrases containing nouns by 2;6 (years; months), around the same time they began producing three- to four-word sentences. All six children produced noun phrases in preverb, postverb, and postpreposition positions, the same positions in which they produced bare nouns, providing further evidence that their noun combinations functioned as a single constituent unit.

We hypothesize that complementary pointing gestures serve as precursors to determiners in young children’s speech. If so, the onset of combinations containing a complementary pointing gesture and a noun (point + noun) should not only *precede* but also *predict* the onset of combinations containing a determiner and noun in speech (determiner + noun). In addition, once children begin to produce determiner + noun combinations in speech, point + noun combinations should decline. To test these predictions, we observed 18 English-learning children who had not begun producing determiner + noun combinations and followed them longitudinally until several months after they began producing these combinations. Our goal was to determine whether children’s so-called complementary pointing gestures function as early specifiers.

Method

Participants

The children in our study were participating in a longitudinal study of language development at the University of Chicago. The larger study contains 60 typically developing children, chosen to represent the diversity of the Chicago area. The families reflect a wide range of socioeconomic status and ethnicity. For our study, we analyzed the utterances and gestures of 10 boys and eight girls chosen on the basis of their average mean length of utterance (MLU) across five observation sessions (at 14, 18, 22, 26, and 30 months). Children in our sample had not missed any observation sessions. Our sample consisted of three boys and three girls with the highest MLUs in the larger sample of 60 children ($M = 2.04 \pm 0.10$), four boys and two girls with the lowest MLUs (mean 1.22 ± 0.06), and three boys and three girls with median MLUs (mean 1.52 ± 0.06). Annual income in the sample for our study ranged from less than \$10,000 to more than \$100,000 per year. Maternal education ranged from 10 years (less than a high school diploma) to more than 18 years (graduate or professional degree).

Data Collection

Children were videotaped with their parents at home for 90 min every 4 months from age 14 through 58 months, resulting in 12 sessions per child. Families were asked to follow their normal routines and ignore the experimenter and camera. The sessions captured a range of interactions and activities, from book reading and play to meals and baths.

Coding

All child speech and gesture were transcribed. We calculated two measures from child speech: (a) nouns without modification (bare nouns) and (b) nouns combined with a determiner (e.g., “the bear,” “a car,” “that shoe”). A noun was considered bare if it had no modifiers: either occurring on its own (e.g., “bear”) or with other non-noun-modifying words (e.g., “bear fall”). A noun was counted as part of a determiner + noun combination if it was modified by “a,” “the,” “this,” or “that.”¹ Unintelligible noises preceding nouns were not counted as modifiers. We attempted to exclude proper nouns from the data set since they are not easily modified by determiners; however, a few (mainly brand names) remained in the sample. When children first begin producing determiner + noun combinations, they do not consistently distinguish between definite (*the*) and indefinite (*a*, *an*) determiners (Karmiloff-Smith, 1979); we therefore included both definite and indefinite determiners, whether the form was contextually appropriate or not.

Gestures were categorized according to their form (e.g., deictic and iconic gestures) and their relation to speech (see Cartmill,

¹ Nouns that were simultaneously modified by a determiner and another word (e.g., an adjective or possessive) were not included in the reported counts of determiner + noun combinations, but including them does not change the age of onset for any children. Simple combinations of single determiners with single nouns were used in order to provide the most direct comparison to the gesture + speech combinations, in which *unmodified* nouns were combined with points.

Demir, & Goldin-Meadow, 2011, for a description of the coding process). Deictic gestures included points to objects and hold-ups (i.e., holding up an object to draw attention to it). For simplicity, we use the term “pointing gesture” to refer to all deictics, including hold-ups. Gestures were glossed according to the object they indicated, which was assumed to be the intended referent. When the object indicated by a pointing gesture was also labeled in speech (e.g., *point at cup* while saying “cup”), the gesture was coded as *complementary* to the meaning in speech. These complementary point + noun combinations are the focus of our study.

Within the class of bare nouns, we identified those nouns that were combined with a complementary pointing gesture (point + noun). We then compared the onset and subsequent use of point + noun combinations (e.g., *point at dog* + “dog”) to the onset of determiner + noun combinations (e.g., “a dog,” “the dog”).² Both types of combinations could be produced on their own (as in these examples), or with other speech (e.g., *point at dog* + “dog barks” counted as a point + noun combination; “the dog barks” counted as a determiner + noun combination).

We analyzed pointing gestures combined with all other types of speech as a control. These combinations were defined as any pointing gesture produced with speech that was neither a complementary point + noun combination, nor a complementary point + determiner + noun combination. The speech in these point + other speech combinations sometimes included a noun or pronoun (e.g., *point at refrigerator* + “get it” where “it” does not refer to the refrigerator) but could also contain just a verb (e.g., *point at car* + “drive”), an adjective (e.g., *point at marker* + “all-sticky”), or a noun with multiple modifiers rather than a single determiner (e.g., *point at bear* + “big blue bear”). We charted the onset and trajectory of point + other speech combinations to serve as a backdrop against which to assess the onset and trajectory of point + noun and determiner + noun combinations.

To be certain that we identified the beginning of *productive* use, we established strict criteria for the onset of each type of combination. To meet the onset criteria for complementary point + noun combinations, the child had to (a) produce at least two different point + noun combinations during a single observation session (e.g., *point at cat* + “cat”; *point at baby* + “baby”) and (b) continue producing point + noun combinations at all subsequent sessions until the onset of determiner + noun combinations in speech. We used the same criteria for the onset of point + other speech combinations (e.g., *point at toy* + “red”; *hold up wrapper* + “all gone”). To meet the onset criteria for determiner + noun combinations, the child had to (a) produce two different determiners, each combined with two different nouns (e.g., “a girl”; “a bottle”; “the dog”; “the cookie”), thus requiring a minimum of 4 tokens at onset,³ and (b) continue to produce determiner + noun combinations meeting meet the first criterion at all subsequent sessions.

Results

Onset of Point + Noun Combinations in Relation to Onset of Determiner + Noun Combinations

Children’s productive use of complementary point + noun combinations began when they were between 14 and 34 months

old (mean 19.8 ± 5.7). Their productive use of determiner + noun combinations began later, between 22 and 38 months (mean 26.4 ± 5.1). Their productive use of point + other speech combinations began earlier, between 14 and 30 months (mean 17.77 ± 4.0). Table 1 presents the onset ages for all three types of combinations for the individual children; the number of tokens of each type of combination that the children produced at age of onset follows in parentheses.⁴

For 15 of the 18 children, the onset of point + noun combinations preceded the onset of determiner + noun combinations by at least one observation session (4 months). The remaining three children began producing point + noun combinations and determiner + noun combinations during the same session; the data for these three children are not inconsistent with the predicted pattern, as the children might have produced point + noun combinations first during the 4-month interval between our observations. Eliminating these three children (because ties are inconclusive since they neither support nor refute our hypothesis), we found that significantly more children began producing point + noun combinations *before* determiner + noun combinations than *after* them (15 before, 0 after, 3 ties; Sign Test $Z = -3.475$, $p < .001$). Our criteria for the onset of determiner + nouns were fairly strict in that the child had to produce more than one determiner and more than one noun in these constructions (demonstrating productivity in both the determiner and the noun). Children also had to continue producing the construction at all following observation sessions. If we loosen our criteria and require that the child produce multiple types for only one element (the determiner *or* the noun), we find that two children who had onset determiner + noun and point + noun combinations at the same time under the stricter criteria now produce determiner + noun combinations earlier, and another child began producing the two types of combinations at the same time. However, the statistical pattern holds (14 before, 2 after, 2 ties; Sign Test $Z = -3.153$, $p = .004$). If we further relax our criteria so that continued use at subsequent sessions is not required, we find that one additional child produces determiner + noun combinations before point + noun combinations, but again the statistical pattern holds (13 before, 3 after, 2 ties; Sign Test $Z = -2.876$, $p = .021$). Whatever criteria we use to determine onset of determiner + noun combinations, we find that children reliably produce point + noun combinations earlier than determiner + noun combinations.

We also found that the age at which children first produced point + noun combinations reliably predicted the age at which they first produced determiner + noun combinations (Spearman

² Combinations of determiners and nouns that also contained a pointing gesture (e.g., “the dog” + *point at dog*) were classified as determiner + noun combinations; i.e., the point + noun category contained only bare nouns.

³ We required children to produce two different determiners to increase the likelihood that they had acquired a determiner *category*; if we loosen our criteria and require that children produce only one determiner (either *a* or *the*), the patterns we report are unchanged.

⁴ The onset age for the production of bare nouns was not calculated because 11 of the 18 children used bare nouns during their first observation session at 14 months. Since we had no way of knowing whether they began to produce bare nouns earlier than 14 months, we could not accurately determine onset age for this category.

Table 1
Ages (in Months) at Which Each Child Began Using the Three Types of Combinations
(Determiner + Noun, Complementary Point + Noun, Point + Other Speech)

Child no.	Sex	Determiner + Noun combinations (2 determiner and 2 noun types)	Point + Noun combinations	Point + Other speech combinations
1	F	26 (16)	18 (13)	14 (4)
2	F	22 (50)	18 (19)	18 (19)
3	M	26 (20)	18 (3)	18 (2)
4	F	26 (18)	14 (2)	14 (6)
5	M	30 (30)	22 (13)	18 (7)
6	M	22 (9)	14 (8)	14 (9)
7	F	22 (28)	18 (3)	18 (3)
8	M	34 (88)	18 (4)	18 (11)
9	M	26 (102)	18 (8)	18 (8)
10	M	26 (24)	18 (4)	18 (3)
11	F	26 (22)	18 (2)	18 (32)
12	F	26 (7)	22 (5)	22 (17)
13	M	38 (11)	34 (3)	30 (14)
14	M	34 (49)	34 (15)	14 (3)
15	M	22 (29)	22 (10)	22 (14)
16	M	18 (10)	18 (8)	18 (25)
17	F	22 (66)	14 (2)	14 (6)
18	F	30 (85)	18 (18)	14 (4)

Note. F = female; M = male. The number of tokens that the child produced during the onset session is given in parentheses.

correlation,⁵ $r = .494$, $p = .037$; Figure 1). In contrast, the onset of point + other speech combinations did not predict the onset of determiner + noun combinations (Spearman correlation, $r = .04$, $p = .88$).⁶ These findings support our first hypothesis—that the onset of point + noun combinations both precedes and predicts the onset of determiner + noun combinations.

Finally, we compared the emergence of other types of noun modification to the emergence of determiners and found that children were likely to begin modifying nouns with other categories of words (e.g., adjectives, possessives, quantifiers) at the same time as they began producing determiner + noun combinations. We found that 11 of the 18 children began producing at least one other type of modifier + noun combination at the same time they

first produced determiner + noun combinations.⁷ Three children began using other modifiers (adjectives or quantifiers) before determiner + nouns but, importantly, still after point + noun combinations. If we use the onset of any modifier + noun combination rather than the onset of determiner + noun combinations, the correlation between onset of point + noun combinations and onset of noun modification in speech remains significant (Spearman correlation, $r = .497$, $p = .036$).

Offset of Point + Noun Combinations in Relation to Onset of Determiner + Noun Combinations

If point + noun combinations act as a stepping-stone to determiner + noun combinations, we would expect them to decline

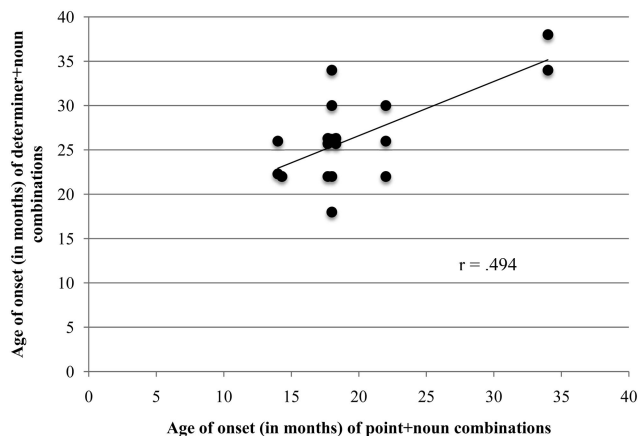


Figure 1. Age of onset (in months) of complementary point + noun combinations (x-axis) and determiner + noun combinations (y-axis). Overlapping dots have been slightly offset to show the number of children with the same onset. All 18 children are included in the graph.

⁵ We used nonparametric correlations because the onsets were not normally distributed.

⁶ Three of the children were already producing point + noun combinations during their first session, and five were already producing point + other speech combinations; we therefore cannot be certain of the actual onset ages for these children. If we eliminate these children from the respective analyses, we find that the overall patterns are unchanged—onset of point + noun combinations correlates (albeit marginally) with onset of determiner + noun combinations ($r = .44$, $p = .10$), but onset of point + other speech combinations does not ($r = .21$, $p = .51$).

⁷ Our criteria for the onset of adjective + noun, possessive + noun, and quantifier + noun combinations were necessarily different from the criteria for the onset of determiner + noun combinations because the other modifier categories each contained many more possibilities (e.g., many more different adjectives) than our determiner category (*a, the, this, that*). As a result, for other modifier + noun combinations, we required only that children use more than one modifier and more than one noun at a single session (but did not require the each modifier be used with different nouns). The requirement for multiple modifiers was particularly important for the possessive + noun combination, since children often began using a single possessive modifier (“my”) with many nouns before acquiring other possessive forms.

once children gain productive control over determiner + noun combinations. Figure 2 displays the mean number of point + noun combinations and determiner + noun combinations that children produced as a function of the age at which they first demonstrated productive control over determiner + noun combinations: 8 and 4 months prior to onset, at onset, and 4 months following onset. The number of point + noun combinations children produced differed significantly over the four time points, repeated-measures analysis of variance, Greenhouse-Geisser corrected, $F(1.97, 31.56) = 6.20$, $p = .006$. We found that a quadratic model best fit the shape of the point + noun curve, reflecting the rise and fall of point + noun combinations, $F(1, 16) = 18.85$, $p = .001$. There were significant differences between the number of point + noun combinations produced 4 months *before* onset and the number produced 4 months *after* onset ($p < .05$), and between the number of point + noun combinations produced *at* onset and 4 months *after* onset ($p < .05$, all values Bonferroni corrected). There were no significant differences between the number of point + noun combinations produced 8 months *before* onset and 4 months *after* onset ($p = .08$); in other words, by 4 months after the onset of determiner + noun combinations, point + noun combinations had returned to their initial level. Children returned to producing point + noun combinations relatively infrequently presumably because, having mastered the determiner + noun combination in speech, it was no longer necessary to use the pointing gesture to specify a noun.

Importantly, we did not find a significant decline in the number of point + other speech combinations that the children produced at the onset of determiner + noun combinations (mean 57.33 ± 35.07) and at 4 months after the onset (mean 54.67 ± 31.92), $t(18) = 0.43$, $p = .68$. Thus, the decline we found in point + noun combinations did not reflect a general decrease in the number of gesture + speech combinations children produced.

Not surprisingly, after the onset of determiner + noun combinations, the production of bare nouns declined and was signifi-

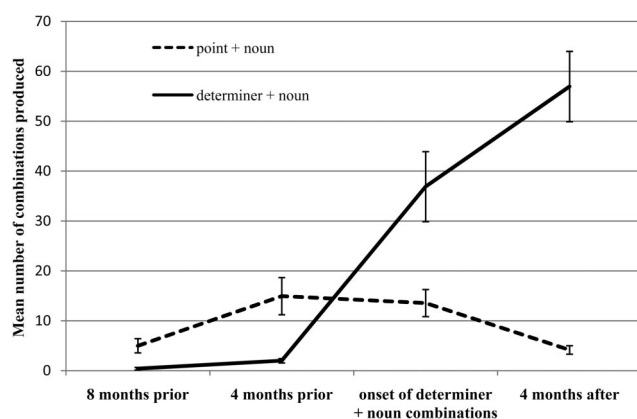


Figure 2. Average number of complementary point + noun combinations and determiner + noun combinations that the children produced prior to, and following, the age identified as the onset of productive use of determiner + noun combinations. All 18 children are represented at the 4 months prior, onset, and 4 months after time points. The 8 months prior time point contains data from only 17 children, since one child began producing determiner + noun combinations at 18 months, and our data began at 14 months. Error bars represent standard error.

cantly lower 4 months after the onset (mean 81.50 ± 45.43) than it was at the onset (mean 120.22 ± 72.68), $t(18) = 2.24$, $p = .03$. Moreover, the *proportion* of bare nouns accompanied by a complementary point (our point + noun measure) also declined significantly (to 6% from 12%) over the same period, $t(18) = 2.53$, $p = .02$. Thus, we find a decrease in point + noun combinations following the onset of determiner + noun combinations even when controlling for the decline in bare nouns. The decrease in point + noun combinations cannot therefore be attributed solely to a decrease in number of bare nouns.

Similarity of Nouns Used in Point + Noun and Determiner + Noun Combinations

We are hypothesizing that the pointing gesture in point + noun combinations is setting the stage for the acquisition of determiners. If this hypothesis is correct, we might expect that, once acquired, determiners would fit naturally into the slot once filled by points and would therefore be combined with the same types of nouns that were initially combined with points. To explore this prediction, we compared the types of nouns used in point + noun combinations 4 months prior to the onset of determiner + noun combinations to those used in determiner + noun combinations at onset. The spontaneous nature of our observation sessions meant that the children engaged in a variety of activities across sessions (e.g., in one session a child and parent might play with puzzles; in another they might eat lunch or read books). We therefore could not expect great overlap in the specific nouns used with points versus determiners; however, we did find substantial overlap in the *types* of nouns used in combination with points versus determiners. We classified nouns into nine categories (inanimate objects, animals, food, people, vehicles, body parts, clothing, places, and furniture; Feldman, Goldin-Meadow, & Gleitman, 1978). Nouns that did not fit into any of these categories but were too infrequent to form new categories were classified as “other”; this category accounted for 10% of determiner + noun and 3% of point + noun combinations and included sounds (e.g., “buzz”), events (e.g., “birthday”), physical actions (e.g., “hug” or “nap”), and abstract nouns (e.g., “way”). Noun categories occurred in similar distributions in both point + noun and determiner + noun combinations (Figure 3), and the rank orders of the 10 noun categories (including “other”) were strongly correlated (Spearman correlation, $r = .823$, $p = .003$). The substantial overlap in types of objects referred to in determiner + noun and point + noun combinations suggests that the function served initially by pointing gestures was later taken over by determiners.

Discussion

We found that a few months before children produce their first determiner + noun combinations in speech (e.g., “the bottle”), they produce their first complementary point + noun combinations (e.g., *point at bottle* + “bottle”), perhaps setting the stage for the linguistic accomplishment. The age at which this gesture + speech combination is first produced predicts the age at which the construction is first produced entirely in speech. This correlation is noteworthy given that our observation sessions are spaced 4 months apart. Past studies using 4-month sampling intervals have shown that gesture + speech combinations precede spoken con-

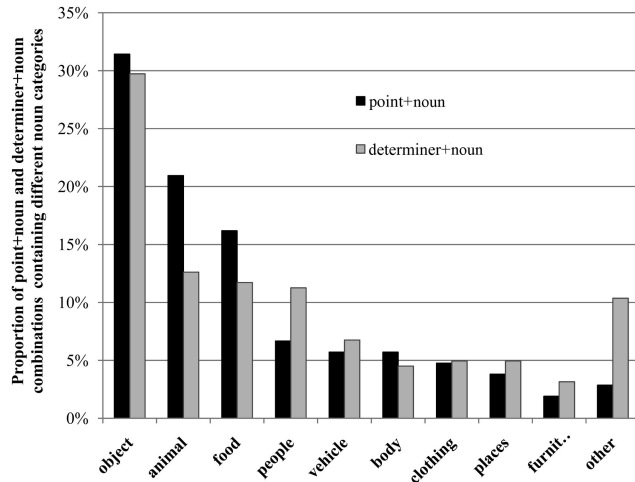


Figure 3. Classification of nouns used in point + noun and determiner + noun combinations ($N = 280$ across both combination types). Nouns in point + noun combinations ($N = 105$) were measured 4 months prior to the onset of determiner + noun combinations. Nouns in determiner + noun combinations ($N = 222$) were measured at onset. Twenty-six nouns (including sounds, events, and abstract nouns) could not be classified using the nine categories and were combined into an “other” category (depicted on the far right of the figure).

structions for some linguistic phenomena (e.g., Özçalışkan & Goldin-Meadow, 2005), but the studies did not correlate the onset of a particular gesture + speech combination with the onset of the parallel speech + speech combination. Studies that have correlated these onset ages all used more frequent sampling of child speech and gesture (e.g., Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005). For example, Iverson and Goldin-Meadow (2005) sampled children an average of eight times over a 14-month period and found that supplementary gesture + speech combinations preceded the emergence of two-word utterances by only 2.3 months. Thus, the fact that we found a relationship between the onset of point + noun combinations and determiner + noun combinations using samples taken every 4 months is striking.

Examining the frequency of point + noun combinations following the onset of determiner + noun combinations is a new type of analysis—previous studies exploring the relation between a gesture + speech combination and the parallel speech + speech combination did not look for a decrease in the gesture + speech combination following the onset of the speech + speech combination. The fact that point + noun combinations did indeed decrease in frequency once determiner + noun combinations emerged in speech provides further support for our hypothesis that using gesture to complement spoken nouns early in development sets the stage for the modification of nouns. Importantly, both the onset and decline patterns were unique to complementary point + noun combinations. Point + other speech combinations did not predict the onset of determiner + noun combinations and did not decrease following this onset.

Our findings suggest that when children point to an object and produce a noun, they are not producing identical information in gesture and speech but are instead combining a noun with a specifier (albeit a nonverbal, gestural one) for the first time. Our results provide evidence that it is the *specific* way in which

children combine speech and gesture (rather than the ability to use a word and gesture together) that predicts the acquisition of new constructions in speech (see also Özçalışkan & Goldin-Meadow, 2005). Our results also provide evidence that gesture can precede and predict the acquisition of a new construction at the level of the phrase (i.e., modifying a noun with a determiner); the findings thus complement previous work showing that gesture can precede and predict the acquisition of new constructions at the level of the sentence (e.g., combining a noun with a verb; Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005).

We propose that when children gesture to an object and label it with a spoken noun, they are producing a category-level verbal label (Parise & Csibra, 2012) and using gesture to specify a member of the category. The act of combining a specifier in gesture with a category label in speech (e.g., *point at truck* + “truck”) may lay the foundation for using speech to specify an instance of the category (“the truck”), just as pointing at a chair while saying “mama” appears to lay the foundation for a sentence like “mama chair” (Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005). Whether producing a complementary point + noun combination *reflects* the child’s readiness to acquire determiner + noun combinations, or plays a *causal* role in acquiring the construction remains an open question. Previous research has found that gesturing can play a causal role both in young children learning new vocabulary words (LeBarton, Raudenbush, & Goldin-Meadow, 2013) and in older children learning how to solve a new math problem (Broaders, Wagner Cook, Mitchell, & Goldin-Meadow, 2007; Cook, Mitchell, & Goldin-Meadow, 2008; Goldin-Meadow, Cook, & Mitchell, 2009). To determine whether gesturing plays a causal role in the acquisition of nominal constituents, we need to manipulate the gestures children produce and observe the effect (or noneffect) of that manipulation on the acquisition of determiner + noun constructions.

It is important to note that gesture does not always predict transitions in language learning. Gesture seems to precede and predict linguistic developments when those developments involve *new* constructions, but not when the developments involve fleshing out existing constructions (Özçalışkan & Goldin-Meadow, 2009). For example, children produce predicate + argument combinations in which speech conveys a predicate and gesture an argument several months before producing the predicate + argument combination entirely in speech (e.g., “bite” + *point at toast* [act + object] precedes “pull my diaper” [act + object]; Özçalışkan & Goldin-Meadow, 2009). However, gesture does *not* precede speech in adding additional arguments once the predicate + argument construction has been acquired. Thus, children produce their first predicate + 2 argument combination in speech (e.g., “I am sitting in the pool” [actor + predicate + location]) and in speech + gesture (e.g., “Daddy gone” + *point outside* [actor + predicate + location]) at the same age (Özçalışkan & Goldin-Meadow, 2009). The Özçalışkan and Goldin-Meadow (2009) study demonstrates that gesture precedes *new* constructions at the clausal level, as children begin to combine words to form sentences.

The fact that the onset of the gesture + speech combination discussed here (the complementary point + noun) predicts the onset of a construction in speech (the determiner + noun) suggests that this construction is indeed *new*. In other words, the bare nouns that children produce prior to the onset of determiner + noun combina-

tions should not necessarily be considered a determiner phrase containing a noun and a null determiner but should instead be considered an unmodified noun. Our findings highlight the fact that combining determiners with nouns in speech is a developmental milestone.

Pointing to an object while producing a noun for that object anchors the communication in the immediate environment and narrows the scope of the noun. Spoken determiners provide another way to specify the scope and, together with the noun, constitute a determiner phrase. Determiners are typically obligatory in English, and they begin to appear in children's speech by around 2 years of age (Valian, 1986). However, at this age, children are not yet sensitive to their interlocutor's needs (Karmiloff-Smith, 1979). They know that nouns should be modified before they begin modifying them in ways that make their intended referent transparent to their interlocutor. Children's structural understanding of determiner phrases appears to precede their functional proficiency. This relationship is reminiscent of acquisition patterns seen in other aspects of language learning. For example, children omit arguments more frequently, and in different ways, than adults do (Allen, 2000; Serratrice, 2005; Valian, 1991); it is only as children age that they begin to understand the social cues and discourse contexts that govern when one form should be used, and how to make use of those cues in forming their own speech. Combining nouns with gesture may, in fact, be one way children begin to develop their understanding of nouns as a modifiable unit of speech. It takes children years to master the correct forms that characterize fluent use of nominal constituents, but gesture may start them down that path to proficiency.

References

- Allen, S. E. M. (2000). A discourse-pragmatic explanation for argument representation in child Inuktitut. *Linguistics*, 38, 483–521. doi:10.1515/ling.38.3.483
- Bates, E. (1976). *Language and context: The acquisition of pragmatics*. New York, NY: Academic.
- Broaders, S. C., Wagner Cook, S., Mitchell, Z., & Goldin-Meadow, S. (2007). Making children gesture reveals implicit knowledge and leads to learning. *Journal of Experimental Psychology: General*, 136, 539–550. doi:10.1037/0096-3445.136.4.539
- Cartmill, E. A., Demir, O. E., & Goldin-Meadow, S. (2011). Studying gesture. In E. Hoff (Ed.), *The guide to research methods in child language* (pp. 208–225). West Sussex, England: Wiley-Blackwell.
- Cook, S. W., Mitchell, Z., & Goldin-Meadow, S. (2008). Gesturing makes learning last. *Cognition*, 106, 1047–1058. doi:10.1016/j.cognition.2007.04.010
- Feldman, H., Goldin-Meadow, S., & Gleitman, L. (1978). Beyond Herodotus: The creation of language by linguistically deprived deaf children. In A. Lock (Ed.), *Action, symbol, and gesture: The emergence of language* (pp. 351–414). New York, NY: Academic Press.
- Gentner, D. (1982). Why nouns are learned before verbs: Linguistic relativity versus natural partitioning. In S. A. Kuczaj (Ed.), *Language development: Vol. 2. Language, thought and culture* (pp. 301–334). Hillsdale, NJ: Erlbaum.
- Gleitman, L. R., Cassidy, K., Nappa, R., Papafragou, A., & Trueswell, J. C. (2005). Hard words. *Language Learning and Development*, 1, 23–64. doi:10.1207/s15473341l1d0101_4
- Goldin-Meadow, S. (2003). *Hearing gesture: How our hands help us think*. Cambridge, MA: Harvard University Press.
- Goldin-Meadow, S., & Butcher, C. (2003). Pointing toward two-word speech in young children. In S. Kita (Ed.), *Pointing: Where language, culture, and cognition meet* (pp. 85–107). Mahwah, NJ: Erlbaum.
- Goldin-Meadow, S., Cook, S. W., & Mitchell, Z. A. (2009). Gesturing gives children new ideas about math. *Psychological Science*, 20, 267–272. doi:10.1111/j.1467-9280.2009.02297.x
- Goldin-Meadow, S., & Morford, M. (1985). Gesture in early child language: Studies of deaf and hearing children. *Merrill-Palmer Quarterly*, 31, 145–176.
- Greenfield, P., & Smith, J. (1976). *The structure of communication in early language development*. New York, NY: Academic Press.
- Huddleston, R., & Pullum, G. K. (2002). *The Cambridge grammar of the English language*. Cambridge, England: Cambridge University Press.
- Iverson, J. M., & Goldin-Meadow, S. (2005). Gesture paves the way for language development. *Psychological Science*, 16, 367–371. doi:10.1111/j.0956-7976.2005.01542.x
- Karmiloff-Smith, A. 1979. *A functional approach to child language: A study of determiners and reference*. Cambridge, England: Cambridge University Press.
- LeBarton, E. S., Raudenbush, S., & Goldin-Meadow, S. (2013). Experimentally-induced increases in early gesture lead to increases in spoken vocabulary. *Journal of Cognition and Development*. doi:10.1080/15248372.2013.858041
- Morford, M., & Goldin-Meadow, S. (1992). Comprehension and production of gesture in combination with speech in one-word speakers. *Journal of Child Language*, 19, 559–580. doi:10.1017/S0305000900011569
- Özçalışkan, S., & Goldin-Meadow, S. (2005). Gesture is at the cutting edge of early language development. *Cognition*, 96, B101–B113. doi:10.1016/j.cognition.2005.01.001
- Özçalışkan, S., & Goldin-Meadow, S. (2009). When gesture–speech combinations do and do not index linguistic change. *Language and Cognitive Processes*, 24, 190–217. doi:10.1080/01690960801956911
- Parise, E., & Csibra, G. (2012). Electrophysiological evidence for the understanding of maternal speech by 9-month-old infants. *Psychological Science*, 23, 728–733. doi:10.1177/0956797612438734
- Rowe, M. L., & Goldin-Meadow, S. (2009a). Differences in early gesture explain SES disparities in child vocabulary size at school entry. *Science*, 323, 951–953. doi:10.1126/science.1167025
- Rowe, M. L., & Goldin-Meadow, S. (2009b). Early gesture selectively predicts later language learning. *Developmental Science*, 12, 182–187. doi:10.1111/j.1467-7687.2008.00764.x
- Serratrice, L. (2005). The role of discourse pragmatics in the acquisition of subjects in Italian. *Applied Psycholinguistics*, 26, 437–462. doi:10.1017/S0142716405050241
- Valian, V. (1986). Syntactic categories in the speech of young children. *Developmental Psychology*, 22, 562–579. doi:10.1037/0012-1649.22.4.562
- Valian, V. (1991). Syntactic subjects in the early speech of American and Italian children. *Cognition*, 40, 21–81. doi:10.1016/0010-0277(91)90046-7

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