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Do iconic gestures pave the way for children's early verbs?

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ABSTRACT
Children produce a deictic gesture for a particular object (point at dog) approximately 3 months before they produce the verbal label for that object ("dog"; Iverson & Goldin-Meadow, 2005). Gesture thus paves the way for children's early nouns. We ask here whether the same pattern of gesture preceding and predicting speech holds for iconic gestures. In other words, do gestures that depict actions precede and predict early verbs? We observed spontaneous speech and gestures produced by 40 children (22 girls, 18 boys) from age 14 to 34 months. Children produced their first iconic gestures 6 months *later* than they produced their first verbs. Thus, unlike the onset of deictic gestures, the onset of iconic gestures conveying action meanings followed, rather than preceded, children's first verbs. However, iconic gestures increased in frequency at the same time as verbs did and, at that time, began to convey meanings not yet expressed in speech. Our findings suggest that children can use gesture to expand their repertoire of action meanings, but only after they have begun to acquire the verb system underlying their language.

Young children use gesture to communicate before they produce their first words (Bates, 1976). The earliest gestures that children use, which typically begin at around 10 months, are *deictics*, which are gestures whose referential meaning is given entirely by the context and not by the form of the gesture (e.g., pointing at a bottle to indicate a BOTTLE). At this early stage, deictic gestures offer children a tool to refer to objects before they have words for those objects, and children take advantage of this offer: they produce deictic gestures for objects approximately 3 months before they produce verbal labels for objects. Moreover, the fact that a child has pointed at a particular object (e.g., a dog) increases the likelihood that

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the child will learn a word for that object ("dog") within the next few months, suggesting that early pointing gestures pave the way for children's first nouns (Iverson & Goldin-Meadow, 2005).

However, children also use a second type of gesture at this early stage known as *iconic* gestures, which are gestures that convey actions or attributes associated with objects (e.g., flapping arms to represent a bird FLYING; Acredolo & Goodwyn, 1985, 1988; see also Iverson, Capirci & Caselli, 1994; Özçalışkan & Goldin-Meadow, 2005a, 2005b). The question we ask here is whether iconic gestures pave the way for children's early verbs in the same way that deictic gestures pave the way for children's early nouns. There is reason to believe that they do, but there is also reason to believe that they do not.

ICONIC GESTURES CONVEYING ACTION MIGHT PAVE THE WAY FOR CHILDREN'S EARLY VERBS

Compared to nouns, verbs present a bigger challenge to children, because they convey relational meanings (Gentner, 1982). Children typically produce their first nouns before producing their first verbs, and nouns predominate over verbs in early production and comprehension of English (Gentner, 1982, 2006; Goldin-Meadow, Seligman, & Gelman, 1976; Huttenlocher & Smiley, 1987; Nelson, 1973) as well as many other spoken languages (e.g., Au, Dapretto, & Song, 1994; Gentner, 1982; Gentner & Boroditsky, 2001). Thus, there is ample opportunity for early iconic gestures to speed the acquisition of verbs.

Mapping a symbol onto a referent constitutes a major milestone in language development; and iconicity, which is the resemblance between a symbol and its referent (Peirce, 1960), could play an important role in this process. A transparent relationship between a symbol and its referent has the potential to render iconic symbols more readily available to young language learners than "true symbols," which have an arbitrary relation to their referents (Piaget, 1962; Werner & Kaplan, 1963). If so, we might expect to find action meanings conveyed first in iconic gestures.

Do early iconic gestures help bootstrap verbs in the same way that deictic gestures bootstrap nouns? There is evidence that young children can learn and produce a range of iconic gestures, which are known as *baby signs*, that indicate actions and attributes associated with an object when those gestures are taught deliberately (rubbing index fingers to convey a spider CRAWLING, raising arms to indicate BIG SIZE; Acredolo & Goodwyn, 1988). These gestures might serve as perceptual symbols (Barsalou, 1999; Goldstone & Barsalou, 1998) that aid in the acquisition of the corresponding concepts. Moreover, the more iconic gestures children have in their communicative repertoires at 1.5 years of age, the larger their verbal vocabularies tend to be at age 2 (Acredolo & Goodwyn, 1988), suggesting a tight link between early iconic gesture use and later verbal vocabulary development (but see Johnston, Durieux-Smith, & Bloom, 2005, for a review of recent work suggesting little association between use of baby signs and later spoken vocabulary). Finally, children who are learning language in the manual modality (e.g., deaf children learning American Sign Language) produce their first signs several months earlier than children who are learning a spoken language produce

their first words (Anderson & Reilly, 2002; Bonvillian, Orlansky, & Novack, 1983; Meier & Newport, 1990), although there is disagreement over whether these first productions are true signs or gestures (Volterra & Iverson, 1995) and whether the reported sign advantage for American Sign Language holds for other sign languages (e.g., British Sign Language; Woolfe, Herman, Roy, & Woll, 2010). Recent work by Pettenati, Stefanini, and Volterra (2010) shows that the early iconic gestures Italian hearing children produce resemble the earliest signs produced by deaf children learning Italian Sign Language, underscoring the difficulty in teasing apart early signs from gestures. Whether deaf children's earliest productions turn out to be signs, this set of studies raises the possibility that the manual modality has an advantage in the emergence of early symbols, lending credence to the hypothesis that early iconic gestures might pave the way for early verb learning.

ICONIC GESTURE CONVEYING ACTION MIGHT *NOT* PAVE THE WAY FOR CHILDREN'S EARLY VERBS

However, there are reasons to suspect that children's spontaneous iconic gestures conveying action might not help them learn early verbs. The mapping between symbol and referent is more straightforward for nouns and deictic gestures than it is for verbs and iconic gestures. Concrete nouns map onto the perceptual world in a direct way; they refer to objects and entities that naturally stand out as separate, individuated wholes in the world (Gentner, 1982; Gentner & Boroditsky, 2001; Markman, 1989). In contrast, verbs select from a diffuse set of relational concepts for their referents. Verb meanings capture only a subset of the relational information that can potentially be conveyed, and the particular combinations of relations that verbs convey vary across languages (Bowerman & Choi, 2003; Casad & Langacker, 1985; Gentner, 1981, 1982, 2006; Gentner & Boroditsky, 2001; Talmy, 1975, 1983, 2000). Thus, to learn verbs, children must first discover how the language they are learning selects and combines relations (Gentner, 1982, 2006; Gentner & Boroditsky, 2001). According to this hypothesis, for the child to derive verb meanings requires more than just experience with events in the world. It also requires linguistic guidance as to *which* relations in the world map onto the verbs in the language the child is learning. If this hypothesis is correct, iconic gestures, which children presumably derive from experience with the world, ought not to help much, if at all, in their later verb learning.

THE QUESTION: DO ICONIC GESTURES PAVE THE WAY FOR EARLY VERBS?

The existing evidence suggests two equally plausible, but contradictory, possibilities: (a) If gesture is an instrument, or even just a harbinger, of new verb meanings, then we would expect children's first iconic gestures that convey actions to precede the first verbs they produce conveying similar meanings. (b) In contrast, if verb semantics is sufficiently language specific that simple iconic gestures conveying actions are not likely to be helpful in bootstrapping verb meanings, then there would be no reason to expect iconic gestures to precede and/or to facilitate verb learning.

To explore the role that iconic gestures play in the emergence of early verbs, we followed 40 children longitudinally and examined their spontaneous speech and gestures. We asked whether the children used iconic gestures to convey action meanings and, if so, whether those gestures were used prior to the onset of verbal labels for the same kinds of action meanings.

METHODS

Sample and data collection

Forty North American children (22 girls, 18 boys) were videotaped with their parents at home every 4 months from 14 to 34 months. Each videotaped session lasted 90 min, amounting to 540 min of observation across the six sessions for each individual child. Parents were told to interact with their children as they normally would in their everyday routines and to ignore the experimenter. Sessions typically consisted of free play with toys, book reading, and snack time; but they also varied slightly based on the preferences of children and parents. Children's families constituted a heterogeneous mix in terms of income and ethnicity, and were representative of the demographic range of the greater Chicago area, with the exception that all of the children were being raised as monolingual English speakers.

Coding and analysis

We transcribed all of the communicative words and gestures that the children produced. A gesture or word was coded as communicative if the child made an effort to direct the listener's attention. Sounds that were reliably used to refer to entities, properties, or actions ("doggie," "pretty," "eat"), along with onomatopoeic sounds (e.g., "meow," "choo-choo") and conventionalized evaluative sounds (e.g., "oopsie," "uh-oh"), were counted as words. Ritualized games (e.g., patty cake, itsy bitsy spider) were not counted as gestures, nor were hand movements that directly manipulated objects (e.g., twisting open a jar, hammering a toy peg). Thus, real actions performed on real objects (e.g., twisting the lid of a closed jar) were not included in the analyses even if they conveyed information to the listener (i.e., that the child wanted the jar opened). Pretend actions performed on real or toy objects (e.g., pretending to drink from an empty cup) were also not included in the analyses.

Each gesture was classified into one of three types: *conventional* gestures have a form-meaning relation that is prescribed by the culture (e.g., nodding the head to convey YES, shaking the head sideways to convey NO, waving the hand to convey GOODBYE). *Deictic gestures* indicate concrete objects, persons, or locations in the immediate context (e.g., pointing to a dog to convey DOG). *Iconic gestures* depict either actions (e.g., moving an empty fist forcefully forward to convey THROWING; flapping the arms to convey a bird FLYING) or perceptual features associated with objects (e.g., holding cupped hands in the air to convey the ROUNDNESS of a ball; placing the palm high above the head to convey the BIG SIZE of a person). The children produced two other types of gestures that were rare in our data and were thus excluded from all analyses: *beat gestures* (formless hand movements that

convey no semantic information but move in rhythmic relationship with speech to highlight aspects of discourse structure, e.g., flicking the hand or fingers; see McNeill, 1992) and *baby signs* (gestures deliberately taught by the parents).

The decision to classify an iconic gesture as depicting action or perceptual information was based on form. Iconic gestures that were dynamic in form were coded as conveying action meanings; iconic gestures that were static in form were coded as conveying attribute meanings. The specific meaning gloss assigned to each action iconic gesture (e.g., EATING vs. BRUSHING) was based jointly on the form of the gesture and the communicative context, linguistic and nonlinguistic, in which the gesture was produced. Iconic gestures conveying action meanings accounted for the majority of children's early iconic gestures (76%, $M = 9.28$, $SD = 8.45$); iconic gestures conveying perceptual properties associated with objects accounted for the remaining 24% of children's iconic gestures ($M = 3.70$, $SD = 5.15$). Given our focus on actions and verbs, we excluded iconic gestures depicting perceptual information because the form of the gesture seems to convey attribute (e.g., ROUND, BIG) meanings rather than action meanings (e.g., THROW, FLY). For brevity, in the remainder of this paper we use the term "iconic gesture" to refer only to iconic gestures conveying action meanings. The majority of the iconic gestures children produced across observation sessions co-occurred with speech; the only exception was the first observation session at child age 14 months, in which all iconic gestures conveying action (12/12) were produced *without* any accompanying speech.

We used similar criteria in classifying words as "verbs," relying on the form of the spoken word. Only words that are syntactically categorized as verbs in the English language, independent of tense and aspectual marking, were counted as verbs. The only exceptions were the auxiliary "be" and modals (e.g., "can," "should," "must"), which were excluded from all verb counts. For words that can be used as either a verb or a noun (e.g., "comb," "brush"), we relied on the immediate communicative context in which the word was used, as well as the inflectional morphology of the word (e.g., "combing" vs. "my comb"), to determine whether the word was used as a verb or a noun, and we included only instances used as verbs. It is interesting that it was at 26 months of age that children first began to use the same word (e.g., "brush") to convey an action meaning in one instance and an object meaning in another.

In this paper we specifically focus on the speech and gestures that the children produced to convey action/event meanings, namely, verbs (e.g., "eat," "run," "push"),[1] and iconic gestures depicting actions (e.g., moving fist to mouth repeatedly to convey EATING, moving both hands forward forcefully to convey PUSHING; see Özçalışkan & Goldin-Meadow, 2005a, 2005b, 2009, for further details on the other types of gestures and word types that these children produced).

We assessed reliability by having a second coder transcribe a subset of the videotaped sessions. Agreement between coders was 88% ($k = 0.76$; $N = 763$) for identifying gestures (i.e., presence or absence of a gesture), 100% ($k = 1.0$; $N = 247$) for identifying gesture types (i.e., iconic, deictic, or conventional), and 91% ($k = 0.86$; $N = 375$) for assigning meaning glosses to each gesture. The data were analyzed using one-way analysis of variance with age or modality (gesture, speech) as the within-subject factors.

RESULTS

Children's early iconic gestures and early verbs

Children produced more and more iconic gestures over time. As can be seen in Figure 1a and b (upper panels), children produced more iconic gestures (i.e., tokens) with increasing age, F (5, 170) = 6.66, $p < .001$, and conveyed a more diverse array of meanings in their iconic gestures (i.e., types), F (5, 170) = 10.44, $p < .001$. There were significant increases in children's production of iconic gesture tokens and types from 22 to 30 months (ps $< .01$, Scheffé), and by 26 months, children were producing two iconic gesture tokens per session on average.

The number of children producing iconic gestures also increased over time. At 14 months, only 2 children were producing iconic gestures, but by 26 months, more than half of the children ($N = 22/40$) had produced at least one instance of an iconic gesture. By 34 months, all but 2 of the children in our sample (38/40) had produced an iconic gesture at some point during our observations.[2]

Children also produced more spoken verbs over time and at a much higher rate than for iconic gestures. As can be seen in Figure 1c and d (lower panels), children produced significantly more verb tokens, F (5, 170) = 76.14, $p < .001$, as well as more different verb types, F (5, 170) = 169.53, $p < .001$, with increasing age. Between 18 and 26 months, production of verb tokens rose from 13 to 172 per session. There were significant increases in children's production of verb tokens and verb types between 22 and 26 months ($p < .01$, Scheffé) and between 26 and 30 months ($p < .001$). The number of children producing verbs also increased steadily over time, from 11 children at 14 months to 36 children at 22 months. By 26 months, all 40 children were producing verbs.

Children thus increased their spontaneous production of both iconic gestures and verbs from 14 to 34 months, with the largest jump in production at 26 months. However, the rate of iconic gesture production was very low compared to the rate of verb production (note the difference in scales and in the steepness of the slope in the four graphs in Figure 1). Across the six observation sessions, children produced a total of 32,522 verbs, compared to only 371 iconic gestures conveying action meanings. It is also worth pointing out that the rate of iconic gesture production was low compared to the production of deictic and conventional gestures (for a description of the distribution of iconic gestures in relation to the other gestures these children produced, see Özçalışkan & Goldin-Meadow, 2011). We next turn to our main question: do early iconic gestures pave the way for verbs?

The onset of iconic gestures and verbs

We first asked whether children produced their first iconic gesture before producing their first verb. The answer is clearly *no*. On average, children produced their first iconic gesture at 25.2 months ($SD = 6.55$) and their first spoken verb at 18.2 months, $SD = 3.26$, F (1, 39) = 38.68, $p < .001$. Thus, children produced their first iconic gestures an average of 6.3 months ($SD = 6.5$) *later* than their first verbs. We found the same pattern at the individual level: 29 children produced their first verb before producing their first iconic gesture, compared to 2 children

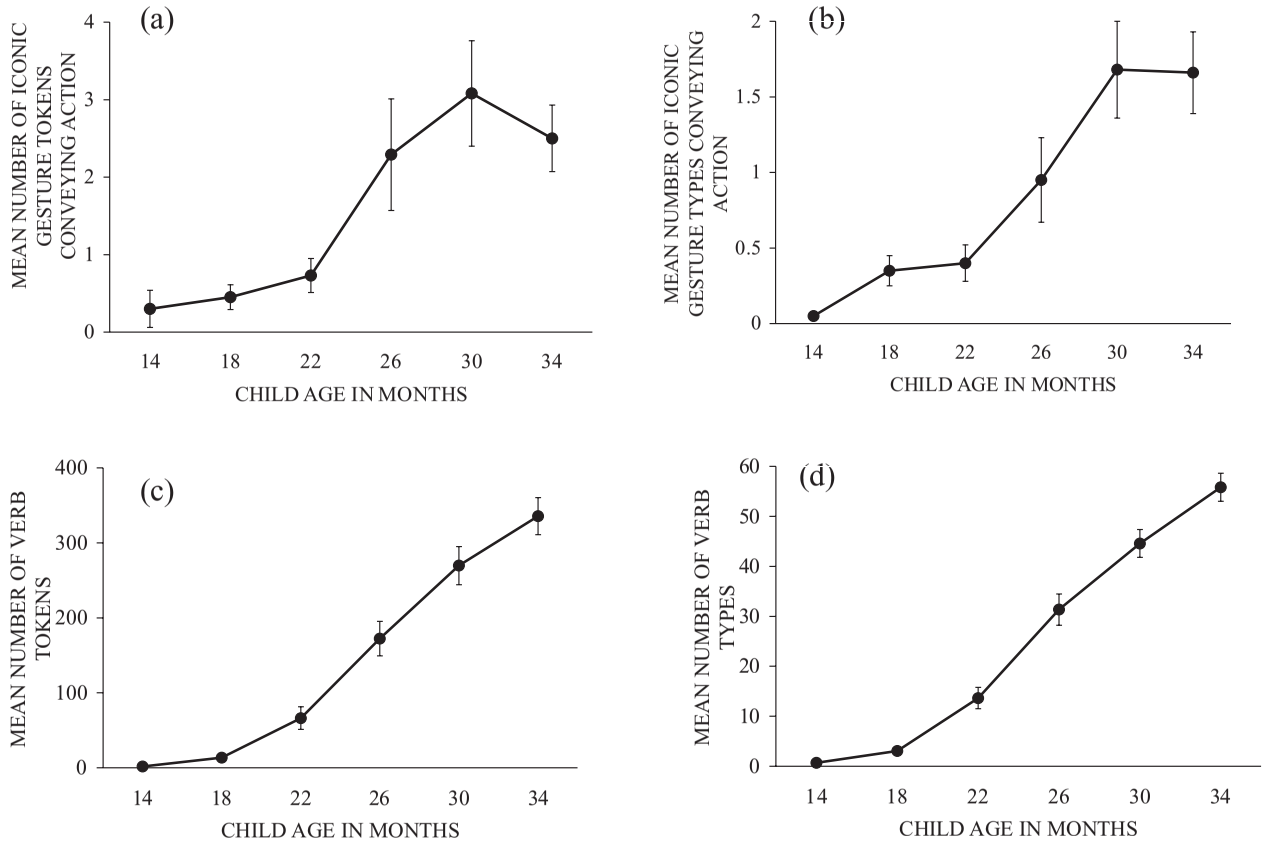

Figure 1. Mean number of action iconic gesture (a) tokens, (b) types, (c) verb tokens, and (d) verb types that children produced at 14, 18, 22, 26, 30, and 34 months of age. Children's iconic gesture production was much lower than their verb production, as captured here by the different scales on (a) and (b) versus (c) and (d).

who produced their first iconic gesture before producing their first verb, χ^2 (1) = 35.6, $p < .001$. Of the remaining 9 children, 7 produced their first verb and first iconic gesture during the same observation session, and 2 produced their first verb but had not yet produced an iconic gesture by the last observation session at 34 months. Thus, far from presaging the onset of verbs, iconic gestures were first produced several months *after* verbs.

We next asked whether gesture preceded speech at the level of individual verbs; that is, whether a particular action meaning was conveyed in gesture before that meaning was conveyed in speech. For example, a child might produce the iconic gesture THROW before producing the verb "throw." We explored this question by classifying the action meanings that children conveyed in their verbs into four categories: (a) the verb meaning was produced only in speech and not in gesture during the six observation sessions, (b) the verb meaning was produced first in speech and later in gesture, (c) the verb meaning was produced first in gesture and later in speech, or (d) the verb meaning was produced in gesture and speech during the same observation session. We found that 98% (M = 138.50, SD = 61.45) of the meanings children conveyed in their early verbs across the six observation sessions were meanings conveyed uniquely in speech. The remaining few verbs were distributed as follows: 0.06% (M = 0.88, SD = 1.34) appeared first in speech, 0.04% (M = 0.53, SD = 0.78) appeared first in gesture, and 1.00% (M = 1.55, SD = 1.91) appeared in gesture and speech during the same session.

Thus, unlike deictic gestures, which preceded and predicted the onset of children's nouns, iconic gestures did *not* precede the onset of children's verbs. Children not only produced their first verbs earlier than their first iconic gestures but also relied almost exclusively on speech to convey their early action meanings.

Do iconic gestures play any role in the acquisition of verbs?

Children showed a large increase in their production of verbs between 22 and 26 months, precisely the period during which they increased their production of iconic gestures. However, the evidence just discussed argues against the possibility that early iconic gestures pave the way for verb acquisition. This leaves us with a question: why do these two spurts co-occur?

One possibility is that the spurt in iconic gestures is a direct by-product of the spurt in verbs; that is, a given action meaning becomes available for an iconic gesture only after the corresponding verb has been acquired. If so, children ought to convey the same meanings in gesture as they do in speech, and there should be a high degree of overlap between the kinds of meanings conveyed in early iconic gestures and early verbs.

An alternative possibility is that children use their iconic gestures to convey meanings that they do not yet express in speech, thus expanding their communicative powers. If so, there should be minimal overlap between the kinds of meanings conveyed in early iconic gestures and early verbs. It is, of course, possible that both alternatives are correct, as discussed below.

To explore these alternatives, we classified the types of action meanings children conveyed in their iconic gestures (rather than in their verbs, as in the previous

analysis) into four categories: (a) the action meaning was conveyed in gesture and not in speech during the six observation sessions, (b) the meaning was conveyed first in gesture and later in speech, (c) the meaning was conveyed first in speech and later in gesture, or (d) the meaning was conveyed in gesture and speech during the same observation session. Even though the majority of iconic gestures occurred during the last two sessions, only 18% ($M = 0.88$, $SD = 1.34$) were conveyed first in speech and later in gesture. We found that 42% ($M = 1.8$, $SD = 1.76$) of the action meanings that the children conveyed in their iconic gestures were produced uniquely in gesture, and an additional 11% ($M = 0.53$, $SD = 0.78$) were conveyed first in gesture and only later in speech. The remaining 29% ($M = 1.55$, $SD = 1.91$) were conveyed in the same session in gesture and speech.

Thus far, the composition of iconic gestures dovetails with the patterns discussed earlier: that the first verb was produced at about 18 months and the first iconic gesture at about 25 months (with 29 of the 40 children producing their first verb before their first iconic gesture) and that 98% of children's action meanings were conveyed uniquely in speech. Together these findings are consistent with the first possibility: that children learn about possible verb meanings through language and that these meanings are then expressed in gesture. However, the fact that 42% of meanings conveyed in iconic gestures were conveyed uniquely in gesture suggests that the second possibility also holds: that gesture serves to expand a child's vocabulary, conveying ideas for which the child lacks an existing verb. Many instances of iconic gestures that co-occurred with speech accompanied *bleached verbs* (e.g., "go like this" + move fisted empty hand in circles as if STIRRING [34 months]), *modals* (e.g., "I have to" + move open palm up and down quickly as if BOUNCING [30 months]), *verb complements* (e.g., "you making me" + move open palm downward forcefully as if FALLING [30 months]), *nouns* (e.g., "balloon" + clenches hand in air as if GRABBING string of imaginary balloon [30 months]), or onomatopoeic sounds (e.g., "ribbit" + jumps fingers up and down as if HOPPING [26 months]). Thus, it appears that children often used their iconic gestures to fill lexical gaps in their action vocabularies.

Table 1 lists the types of action meanings children conveyed in their iconic gestures at each of the six observation sessions. The majority of the meanings (55%, $M = 2.62$, $SD = 2.51$) that the children expressed in their iconic gestures during this period were symbolic representations of everyday transitive actions (e.g., EATING, DRAWING, BRUSHING, WASHING, THROWING, and LIFTING). The remaining meanings conveyed in the iconic gestures were symbolic representations of intransitive actions, for example, FLYING, BOUNCING, CRAWLING, or SWIMMING (38%, $M = 1.79$, $SD = 1.58$), including directional actions, such as GOING-DOWNWARD or GOING-AROUND (7%, $M = 0.46$, $SD = 0.91$). Gestures conveying meanings *not found in speech* (i.e., filling lexical gaps in their action vocabularies) were just as frequent for transitive actions ($N = 46$, $M = 1.15$, $SD = 1.27$) as for intransitive actions ($N = 45$, $M = 1.13$, $SD = 1.16$).

In sum, speech was clearly the earliest and the preferred modality for expressing action meanings at this initial stage of language development. Nonetheless, even though iconic gestures emerged later and were produced at much lower rates than were verbs, they did allow the children to communicate a set of meanings that they had not yet conveyed in speech. In this sense, iconic gestures served

Table 1. *Types of meanings conveyed in iconic gestures*

14 Months	18 Months	22 Months	26 Months	30 Months	34 Months
BRUSHING	BITING	CRAWLING	ATTACKING	ATTACKING	ATTACKING
LIFTING	BOUNCING	DRAWING	CLIMBING	BITING	BOUNDING
WAGGING	BRUSHING	EATING	CRAWLING	BLINKING	BRUSHING
	DRAWING	FLYING	DRAWING	BLOCKING	CLOSING
	FANNING	GOING-AROUND	DRUMMING	BLOWING	CRAWLING
	FLYING	GOING-UP	EATING	BOUNCING	DIGGING
	GOING-DOWN	HUGGING	FALLING	CLENCHING	DIPPING
	HAMMERING	LIFTING	FLAPPING	CRAWLING	DRAWING
	LIFTING	NIPPING	FLYING	DIGGING	FALLING
	PINCHING	OPENING	GOING-DOWN	DRIBBLING	FLAPPING
	RIDING	POUNDING	GOING-UP	DRIPPING	FLIPPING
	SWINGING	PUSHING	JUMPING	EATING	FLYING
	WASHING	SLEEPING	KNOCKING	EXERCISING	GALLOPING
		THROWING	LIFTING	FALLING	GOING-AROUND
			MIXING	FANNING	GOING-UP
			MOVING	FLAPPING	GRABBING
			PLAYING	FLYING	HANGING
			POUNDING	GOING-AROUND	HOPPING
			POURING	GOING-DOWN	HUGGING
			PUSHING	GOING-OVER	JUMPING
			SHUFFLING	GOING-OUT	KICKING
			SLEEPING	GOING-UP	MESSING
			SWINGING	GRABBING	MOVING
			THROWING	HAMMERING	OPENING
			TOUCHING	HITTING	PECKING
			WASHING	HOPPING	PINCHING
			WAVING	JUMPING	POURING
				KNOCKING	PRESSING
				LIFTING	PULLING
				MOVING	PUSHING
				OPENING	RECEIVING
				PAINTING	SKIING
				PEEING	SLEEPING
				PLAYING PIANO	SMILING
				PULLING	SPITTING
				PUSHING	STEPPING
				PUTTING	STIRRING
				RELEASING	SWIMMING
				RUNNING	THINKING
				SPIRALING	THROWING
				SPRINKLING	TOUCHING
				STEPPING	TURNING
				STIRRING	
				SURFING	
				SWIMMING	
				SWINGING	
				THINKING	
				THROWING	
				TYING	
				TOUCHING	
				WALKING	

to widen the children's repertoire of action meanings, even though this unique gesture repertoire was still quite limited compared with the meanings conveyed through early verbs.

DISCUSSION

Previous research has shown that gesture both precedes and is tightly related to changes in early language development (Butcher & Goldin-Meadow, 2000; Goldin-Meadow, 1998, 2003; Goldin-Meadow & Butcher, 2003; Özçalışkan & Goldin-Meadow, 2005a, 2009, 2010). Deictic gestures, for example, pave the way for children's first nouns (Iverson & Goldin-Meadow, 2005), and combinations in which gesture conveys one semantic element and speech another (e.g., point at jar + "open") pave the way for children's first two-word combinations ("open jar"; Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005). Producing deictic gestures early in development could merely be a good early indicator of the underlying skills that children are going to need to make linguistic progress. However, producing deictic gestures could actually play a role in bringing about linguistic progress, either by providing children with the opportunity to "practice" referring to objects before they have the verbal means to do so (Goldin-Meadow, 2003, 2007) or by making it more likely that children will receive verbal input when it is most useful (e.g., a mother responds to her child's point at a duck by saying, "Yes, that's a duck," thus exposing the child to the word *duck* just when he has ducks on his mind (Goldin-Meadow, Goodrich, Sauer, & Iverson, 2007; Golinkoff, 1986; Masur, 1982).

In this paper we explored whether iconic gestures serve the same function for verbs as deictic gestures do for nouns. We found that they do not. Children actually produced their first iconic gestures 6 months *later* than they produced their first verbs. Thus, unlike the onset of deictic gestures, which precede and predict children's first nouns, the onset of iconic gestures conveying action meanings did *not* precede children's first verbs. Nonetheless, children frequently used their iconic gestures to convey a different set of meanings than they conveyed in their early verbs. In this way, the children used gesture to expand their repertoire of action meanings.

Why do children produce so few iconic gestures early in development?

We have shown that children produce most of their action meanings in speech before producing them in gestures. We consider four possible explanations for this finding. The first possibility is that iconic action gestures might be relatively difficult to produce motorically. In other words, the difficulty may be in the production of the symbol itself. However, at least some iconic gestures involve nothing more than moving a pointing finger across space (e.g., moving a point down to indicate DOWNWARD TRAJECTORY), and even iconic gestures of this type are not used frequently before 26 months.

A second possibility is that the frequency of iconic gestures in parental input is low. Parents show a significant increase in their iconic gesture production just around the time their children go through a similar spurt in iconic gesture

production, roughly around 26 months of age (Özçalışkan & Goldin-Meadow, 2011), thus displaying patterns in their gesture use that parallel changes that their children go through. As a result, very young children are not exposed to frequent models of iconic gestures (unless their parents have been instructed to provide such models deliberately, as in teaching "baby signs" (see Acredolo & Goodwyn, 1985, 1988; Acredolo, Goodwyn, & Abrams, 2006).

Given the scarcity of iconic gestures in early parent input, children might not be getting the same kind of exposure in input that they routinely receive for pointing gestures, which in turn might explain why iconic gestures appear later in children's nonverbal repertoires. There is evidence suggesting that children growing up in linguistic environments with richer iconic gesture input, such as Italy, produce a greater variety of iconic gestures and produce them at an earlier age than do children learning English in North America (Capirci, Contaldo, Caselli, & Volterra, 2005; Iverson, Capirci, Volterra, & Goldin-Meadow, 2008; Volterra, Caselli, Capirci, & Pizzuto, 2005). Future training studies in which the number of iconic action gestures children receive in their input is manipulated are needed to determine whether early exposure to iconic gestures has an impact on children's production of iconic gestures and whether those gestures in turn play a role in children's later acquisition of verbs.

A third possible explanation for the low number of iconic gestures children produce early in development could lie in the conceptual difficulties involved in producing iconic gesture itself. Unlike pointing gestures, iconic gestures involve representing a referent with a particular symbol and thus are likely to impose greater cognitive demands than do deictic gestures, which involve using the same form (the index finger) for all referents. If iconic gestures are cognitively demanding, they might even compete with verbs in conveying particular action meanings, rather than in complementing them (Tomasello, 2008). As suggested by Liszkowski (2010), words might be easier to use as symbols than are gestures simply because words are not iconic; in contrast, iconic gestures rely on actions to do their representational work. Using an iconic gesture to represent an action involves both "decoupling the action schema from an action goal and reinterpreting it as standing in for something else" (Lizkowski, 2010, p. 28); words do not need to be decoupled or reinterpreted. The added difficulty of this dual task might make iconic gestures difficult, more difficult than arbitrary gestures (for related discussions, see DeLoache, 2004). There is evidence to support this possibility (Namy, 2001; Namy, Campbell, & Tomasello, 2004; Namy & Waxman, 1998; Tolar, Lederberg, Gokhale, & Tomasello, 2007). In a series of gesture comprehension experiments, Namy and her colleagues (2004) found that, at 18 months, children are as likely to associate an arbitrary gesture with an object (moving the hand sideways to represent a RABBIT) as they are an iconic gesture (hopping two fingers up and down to represent the RABBIT), suggesting that the children may not recognize the iconic relation between hand movement and object. It is not until 26 months that children seem to discover the iconic possibilities of gesture, at which point they briefly lose the ability to make arbitrary mappings and make only iconic mappings. Along the same lines, deaf children learning American Sign Language acquire signs that are arbitrary in form as early as signs that are iconic (Orlansky & Bonvilian, 1984), suggesting that deaf children do not recognize the

iconicity in the signs they are learning. It is interesting that the children in our study showed a steep increase in the number of iconic gestures that they spontaneously produced at 26 months, the age at which children first became aware of iconicity in gesture in Namy's gesture comprehension studies (Namy, 2008; Namy et al., 2004).

In a related vein, iconic gestures might require the types of complex representational abilities that do not develop until sometime between ages 2 and 3. For example, it is during this period that children begin to grasp the representational relation between a miniature scale model of a room (symbol) and the real sized room (referent) and can correctly search for toys in the real room when provided only with information about the hiding location in the model room (for a review, see DeLoache, 2004). It is also during this time that we see increases in symbolic play (Bach, 2012; Leslie, 1987; Lillard, 1993). Symbolic play provides children with opportunities to use empty-handed movements (e.g., pretending to pour juice from an empty toy pitcher), which could serve as precursors to iconic action gestures (e.g., using a pouring gesture to ask mother to pour juice). Thus, the relatively late emergence of iconic gestures might be closely tied to, and explained by, changes in other cognitive skills.

The fourth possible explanation for the low number of iconic gestures children produce early in development lies in the mapping between the symbol and its referent, rather than in properties of the symbol itself. As discussed earlier, unlike concrete nouns, which tend to denote the same types of entities cross-linguistically, verbs (even "concrete" verbs, such as verbs of motion) show a variable mapping between concepts and words across languages (Bowerman, 1996; Bowerman & Choi, 2003; Gentner, 1981, 1982, 2006; Talmy, 1975, 1983) and are generally hard words to learn (Gentner, 2006; Gleitman, Cassidy, Napa, Papafragou, & Trueswell, 2005). Consistent with this reasoning, there is considerable evidence suggesting that nouns dominate over verbs in children's early vocabularies cross-linguistically (e.g., Au et al., 1994; Bornstein et al., 2004; Gentner, 1982, 2006; Gentner & Boroditsky, 2001; Tardiff, Gelman, & Xu, 1999).[3] Gentner (1982, 2006) suggested that the slow acquisition of verbs (relative to nouns occurring equally often or even less often in a child's input) results from the fact that verb meanings, which vary across languages, cannot be derived simply from experience with the world, in contrast to the meanings of concrete basic-level nouns. That is, "for verbs and other relational terms, children must discover how their language combines and lexicalizes the elements of the perceptual field" (Gentner, 1982, pp. 323–325). Further, verbs express relations between entities, and relational concepts are generally slower to be learned than are object concepts. Studies by Gleitman and colleagues (Gillette, Gleitman, Gleitman, & Lederer, 1999; Gleitman et al., 2005) support the claim that it is hard to derive verb meanings purely from world experience; adults find it more difficult to identify the referent of a verb than to identify the referent of a noun when asked to watch a videotape of a mother–child interaction and guess the word using only the nonverbal context.

Under this hypothesis, the difficulty involved in learning verbs stems from having to work out which aspects of the world are incorporated into verb meanings in the particular language that the child is learning. If this hypothesis is correct, iconic gestures, which are derived from world experience, are not likely to be

much help in acquiring verbs. Children have to choose which pieces of an action or a relation to incorporate in an iconic gesture to communicate effectively (just as they must do for verbs). Thus, iconic gestures may be no easier to produce and may even be harder than verbs.

Whatever the reason, children produce their first verbs several months before they produce their first iconic gestures. However, we do see a noticeable increase in children's iconic gesture production at just around the time they go through a surge in verb production. Once children begin to understand how verbs work in their language and begin to produce them routinely, they may develop a sense of possible verb meanings and begin to be aware of the lexical gaps they have in their verb vocabularies. Having a pattern for how to lexicalize action meanings, they might then begin to use iconic gestures to fill those gaps, the pattern we observed in our data.

Does verb learning foster the use of gestures for actions and events?

The above line of reasoning suggests that learning verbs might pave the way for children to use iconic gestures. Children may learn how to extract relational meanings by observing and using verbs, which are directly modeled for them in their conversations with adults. If this hypothesis is correct, it leads to the intriguing prediction that children learning languages that show relatively early acquisition of verbs (i.e., greater verb-to-noun ratios) will also begin to produce iconic action gestures earlier than children who are learning less "verb-friendly" languages, such as English. It is interesting that previous research with children learning Turkish, a language in which parental discourse patterns encourage verb use (Küntay & Slobin, 1996), suggests that this might be the case. On average, children learning Turkish develop verb vocabularies earlier than do children learning English (Aksu-Koç & Slobin, 1985), and their iconic gesture production also spurts at an earlier age (Furman, Özyürek, & Küntay, 2010). Furman et al. (2010) found that many of the children learning Turkish were routinely using iconic gestures conveying action meanings by 19 months of age, 7 months earlier than the children learning English.

This pattern is consistent with the hypothesis that verb learning gives children a kind of template or guide for extracting relational meanings from the world, which can be used in constructing iconic gestures. Initially, many iconic gestures reflect meanings already incorporated in the children's verbs. However, at some point, children become sufficiently adept to want to go beyond the meanings they have learned, and they may use new iconic gestures to do so.

Under this hypothesis, we would predict that children's growing understanding of verbs should influence the kinds of iconic gestures they produce. The types of action meanings that the children in our study conveyed in gesture provide some evidence for the hypothesis (see Table 1). Sixty percent of the iconic gestures that the children used conveyed information about how an action should be carried out, that is, its manner (e.g., CRAWLING, BOUNCING, THROWING, KICKING), and only 10% conveyed information about the action's direction, that is, its path (e.g., GOING DOWN, GOING-UP, GOING-AROUND).[4] This pattern mirrors the predominance of manner over path verbs in the English language in general (Talmy, 1975, 2000) and

in the early verbs that English-learning children produce (i.e., the predominance of manner over path verbs) more specifically (Özçalışkan, 2009; Özçalışkan & Slobin, 1999; Slobin, 2004). It is important to note that manner is not the default pattern in iconic gestures. Deaf children whose hearing losses prevent them from acquiring the spoken language around them and whose hearing parents do not expose them to sign language invent their own gesture systems to communicate with the hearing individuals in their worlds. These children are more likely to produce path information than manner information in their homemade gestures (Zheng & Goldin-Meadow, 2002), suggesting that manner is not necessarily easier to convey in the manual modality than path and is certainly not the default pattern. In light of these findings, our data suggest that the early iconic gestures that the children in our study produced are influenced by the language-specific patterns of the verb semantics in English.

Our findings also extend previous work showing language-specific patterns in the iconic gestures that older children produce when talking about spatial scenes. Gullberg, Hendricks, and Hickmann (2008) studied 4- and 6-year-old children learning French, a language that (unlike English) has a predominance of path over manner verbs (Talmy, 1975, 2000), and found that children conveyed predominantly path information in both speech and gesture. Taken together, these findings provide further evidence for the close coupling between linguistic and gestural expressions of simple actions, possibly even a shared conceptual representation that underlies both gesture and speech production (see Kita & Özyürek, 2003).

In sum, our results show that, unlike deictic gestures, which precede and predict children's first nouns, iconic gestures do not pave the way for children's first verbs. The reverse may be true. Children are far more likely to express their initial action meanings in speech than in gesture. However, iconic gestures increase in frequency at the same time as verbs do, and it is interesting that at that time they begin to convey a small number of meanings not yet expressed in speech. Thus, we suggest that iconic gestures may offer young children a technique for filling in lexical gaps in their action vocabularies. Children take advantage of this technique, but only after they have begun to acquire the verb system underlying their language.

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NOTES

1. The acquisition patterns conveying attribute meanings (i.e., perceptual properties associated with objects) were exactly the same. At 14 months, only 2 children produced 2 instances of iconic gestures conveying perceptual information. The use of iconic gestures conveying attributes continued to remain low both at 18 months (7 gestures)

and at 22 months (9 gestures), with only 5 children producing gestures of this type. As with iconic gestures conveying action, there was a large increase at 26 months, with 13 of the children producing a total of 51 iconic gestures conveying perceptual information at this age.

2. Verbs can convey pure action, but they can also convey other kinds of events. For example, "stir" conveys a kind of action, but "mix" indicates a change of state (increased homogeneity) without specifying the particular action by which this change was achieved, which is a distinction that is not easily captured in gesture. For brevity, we hereafter use the term "action" to refer to both types of meanings.
3. Gentner's (1982) hypothesis that nouns cross-linguistically predominate over verbs in early acquisition has led to challenges from researchers studying acquisition in non-Indo-European languages. It has been particularly relevant to study "verb-friendly" languages, that is, those in which aspects of the input language should promote verb learning. These include languages whose grammar allows for omitting nouns in sentences (pro-drop), as in Mandarin (Tardiff, 1996) and Korean (Choi & Gopnik, 1995); or those with verbs whose meanings incorporate features of their objects, as in Tzeltal (Brown, 1998); or those with parental discourse patterns that emphasize verbs over nouns, as in Kaluli (Schieffelin, 1985) and Turkish (Ketrez & Aksu-Koç, 2009; Küntay & Slobin, 1996). Some early studies using data from transcribed sessions argued that noun dominance did not appear in Mandarin (Tardiff, 1996) or Korean (Choi & Gopnik, 1995). However, studies using vocabulary checklists have verified the predicted predominance of nouns over verbs in early vocabulary, even in verb-friendly languages such as Mandarin (Tardiff et al., 1999), Korean (Au et al., 1994; Pae, 1993), Navajo (Gentner & Boroditsky, 2001), and Tzeltal (Brown, Gentner, & Braun, 2005). Likewise, studies using parental diaries have shown noun dominance in Kaluli (Schieffelin, 1985; see Gentner, 1982) and Turkish (see Gentner, 1982). It appears that some of the early conclusions were based on data using inadequate methodology, such as transcripts of fairly brief sessions (see Gentner & Boroditsky, 2001, and Pine, Lieven, & Rowland, 1996, for methodological discussions). The *degree* of noun dominance over verbs is generally lower in these verb-friendly languages than in English (Gentner, 1982; Gentner & Boroditsky, 2001; Tardiff et al., 1999). This is consistent with the idea that early vocabularies are shaped by the salience of words in the linguistic input as well as by the ease of picking out their conceptual referents in the world.
4. The remaining 30% of the iconic gestures that the children produced conveyed neither manner nor path information (e.g., SLEEPING, EATING, OPENING, THINKING).

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