X IS LIKE Y: The emergence of similarity mappings in children's early speech and gesture

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Abstract:
Similarity mapping (e.g., *the butterfly is like a rainbow*) is one of the earliest meta-linguistic abilities children master and is likely to constitute a stepping-stone for the development of analogical and metaphorical mapping abilities. We investigated the initial emergence and later development of this meta-linguistic ability in children's speech and gesture, using longitudinal observations of 40 English-speaking children from ages 1;2 to 2;10. We focused on the construction 'X IS LIKE Y' as the use of the word *like* is one of the earliest signs of similarity mapping ability in young children. Our results showed that children began to produce similarity mappings routinely by age 2;2. They initially conveyed only the source domain of the mapping in their speech and relied on nonverbal modalities (i.e., gesture and communicative context) to convey the target domain. However, with increasing age, children showed a greater tendency to simultaneously convey both the source and target domains of the similarity mapping in their speech. Moreover, the onset of 'X IS LIKE Y' constructions in children's speech was preceded by the onset of gesture-speech combinations expressing similarity relations without the word *like*. Thus, gesture appears to be at the cutting edge of early language development – it both predates and serves as the supporting context for oncoming changes in speech.

Keywords: similarity mapping; x is y like construction; acquisition of constructions; early gesture; development of similarity mapping ability; language development; gesture-speech combination; early metaphor

1. Statement of the problem and overview of findings

One of the biggest challenges of early language development is learning to articulate correspondences between objects or events based on commonalities in their features or relational structure (e.g., *blue crayon is blue like blue shirt*). In this chapter, we examine the initial emergence and subsequent development of similarity mappings. When tested in an experimental setting, children have been found to understand and produce similarity mappings at preschool age. But children may have the ability to convey

similarity mappings at younger ages. We explore this possibility by looking not only at children's speech but also at their gestures.

Children begin to produce combinations in which gesture conveys different information from speech (*eat* + POINT TO COOKIE) between ages 1;2–1;6, and gesture-speech combinations of this sort index oncoming changes in speech: Children take the developmental step that allows them to combine words with gestures to create a sentence-like meaning (e.g., *ride* + POINT TO BIKE) several months before they take the step that enables them to combine words with other words to create a sentence (e.g., *ride bike*). The question we ask here is whether children use gesture in combination with speech to convey similarity-based comparisons (*like ice-cream cone* + POINT TO MUSHROOM; *I go like that over my cup* + ROTATE FINGER AS IF STIRRING) before they convey these comparisons in speech (*ice-cream cone is like mushroom; I move my hand like I am stirring*). To explore this question, we use longitudinal observations of 40 typically-developing children, all raised as monolingual English speakers. The children were videotaped for 90 minutes in their homes every four months while interacting with their primary caregivers.

To preview our results, we found that children are able to produce similarity mappings in their spontaneous speech two years earlier than they produce them in experimental settings. Initially, children convey only the source domain of the mapping in speech, typically relying on gesture to convey the target domain. Thus, gesture grounds children's early similarity mappings in the here-and-now. Even more interesting, the onset of gesture-speech combinations expressing similarity relations without the word *like* (e.g., *doggie* + POINT TO CAT) heralds the onset of 'X IS LIKE Y' constructions in the children's speech. In other words, children use the juxtaposition of gesture and speech to convey a similarity relation before they use the word *like* to do so. Moreover, gesture-speech combinations conveying a similarity relation without *like* decline in frequency just when the 'X IS LIKE Y' construction appears in the children's speech.

Our results place gesture at the cutting edge of early language development – gesture both presages oncoming changes in children's speech and serves as a forerunner of linguistic advances. At a point when children do not have the words to express similarity mappings, gesture provides them with a tool to express such mappings. And by doing so, it acts as a harbinger of change in the child's developing language system.

2. Children's early uses of similarity mappings

Children spontaneously produce a variety of novel expressions that highlight similarities between objects during the preschool years (Billow 1981; Chukovsky 1968; Carlson and Anisfeld 1969; Elbers 1988; Winner 1979). They use speech to describe a bald man as *having a barefoot head*, a mint candy as *making a draft in the mouth* (Chukovsky 1968), or a spinning top as *wobbling like a snake* (Winner 1979). At these early ages, children also use gesture and speech together to convey similarities between objects (Billow 1981; Elbers 1988; Winner 1979). They point to an upward facing pacifier and call it a *candle*, point to a car-shaped bread crumb and say *car that* (Elbers 1988), hold up a rubber animal next to hair and say *it is going to eat some grass* (Billow 1981), or hold up a horn upside down and turn it in circles while uttering the word *mixer* (Winner 1979).

Experimental work on children's understanding of similarity mappings also points to early onset. Four- to five-year-old children can build simple mappings between two objects based on feature-based similarity (Billow 1975; Epstein and Gamlin 1994; Gardner, Kircher, Winner and Perkins 1975; Mendelsohn, Robinson, Gardner and Winner 1984; Vosniadou and Ortony 1983; Winner, McCarthy and Gardner 1980) and between two events based on action-based similarity (Dent 1984, 1987). For example, when asked to complete the statement, *An eye is like a* ____*,* children were more likely to choose a similarity-based match (e.g., a button) than an anomalous match (e.g., a fork; Epstein and Gamlin 1994). Similarly, when asked to pick two objects that go together, children were more likely to group a cone-shaped block with a toy rocket-ship which was similar in shape, rather than matching it with another block of a different shape (Winner, McCarthy and Gardner 1980). Five-year-olds could also provide similarity-based interpretations when asked about expressions that involved comparisons between objects such as *her hair is spaghetti, a cloud is like a sponge, or the butterfly is like a rainbow* (Gardner, Kircher, Winner and Perkins 1975; Gentner 1988; Billow 1975; Malgady 1977). For example, they make sense of the statement *a cloud is like a sponge* by saying that *both clouds and sponges are round and fluffy* (Gentner 1988), or they complete the statement *he looks as gigantic as …* by selecting from among multiple choice alternatives an ending that draws on a similarity-based comparison – *he looks as gigantic as a double-decker cone in a baby's hand* (Gardner, Kircher, Winner and Perkins 1975).

Gardner and his colleagues (Gardner, Winner, Bechhofer and Wolf 1978) suggest that the ability to make similarity-based comparisons emerges in-

itially in pretend play contexts in the form of object substitutions (e.g., using a block as if it were a doll). Beginning from age 1;5–2;0, children start verbalizing these object substitutions (e.g., calling the block *a doll*), typically in activity contexts where they are manipulating the objects. Gradually, the physical features of objects become more salient, and children begin to rename objects based on perceptual similarities (e.g., calling a potato chip *a cowboy hat*) roughly between ages 2;0–3;0. And by 3;0 to 4;0, children begin to use appropriate syntactic packaging to make explicit comparisons (e.g., *That pencil looks like a rocket ship*; Gardner et al. 1978).

3. Early similarity mappings provide the stepping-stones for more complex mapping abilities

Children's early ability to make feature-based similarity comparisons is considered to be the initial step in the development of more complex types of mappings (e.g., analogical, metaphorical), mappings that involve not only within domain but also across domain comparisons (Gardner et al. 1978; Gentner 1988; Vosniadou 1987). For example, Gentner and her colleagues (Gentner 1988; Gentner and Rattermann 1990, 1991) propose a shift from mappings based on object commonalities (i.e., similarity matches, e.g., a red apple as similar to a red block) to mappings based on commonalities in relational structure (i.e., analogies, e.g., apple falling from a tree as analogous to book falling from a table). However, under certain conditions, children are able to perform simple cross-domain analogical mappings as early as age four (Gardner 1974; Gentner 1977; Goswami and Brown 1989): they can successfully match pairs of polar adjectives (happy-sad, hard-soft) to pairs of stimuli in various sensory modalities (cold-warm, loud-quiet, light-dark; Gardner 1974), and map spatial relations among human body parts (e.g., nose, knee) onto another concrete object (e.g., they point to the upper middle part of a tree when asked the question *If a tree had a nose where would it be?* Gentner 1977). Children's analogical ability improves over time with their growing grasp of different knowledge domains (Gentner 1988), but these findings clearly show that the basic analogical ability to map familiar domains is already well developed in preschool years.

Furthermore, children also understand metaphorical mappings that are based in familiar domains at around the same age. By age 4;0, they can choose the appropriate meaning for a metaphorical statement that is structured by motion (e.g., *time flies by, ideas run through the mind, sick-*

ness crawls through the body) from among forced-choice alternatives, and by age 5;0, they can provide explicit verbal explanations for these metaphorical expressions (e.g., *time crawls by means it goes slowly, ideas slip from the mind means you forget them;* Özçalışkan 2002, 2003, 2005, under review). Thus mappings based on object similarity and simple analogical relations, along with familiar metaphorical mappings, are within the communicative repertoire of the preschool child.

However, not surprisingly, the ability to understand more complex analogical and metaphorical mappings involving less familiar domains (e.g., mapping physical sensations onto psychological traits) or higher order relations (i.e., mapping situations based on common higher order relations, such as the similarity between an apple falling from a tree permitting a cow to reach it and a book falling from a shelf permitting a child to reach it; Gentner and Rattermann 1990) increases with age and achieves adult-like quality somewhere between ages 10;0–14;0 (Asch and Nerlove 1960; Cicone, Gardner and Winner 1981; Gardner et al. 1975; Schechter and Broughton 1991; Winner, Rosentiel and Gardner 1976). But the ability to understand an analogy or metaphor is not determined solely by a child's age; the nature of the conceptual domain also matters (Gentner and Rattermann 1991; Keil 1986). For example, five-year-old children can correctly map animate terms onto cars (e.g., *the car is thirsty*), but have difficulty understanding metaphors that involve mappings between taste terms and people (e.g., *she is a bitter person*; Keil 1986). From this perspective, the development of analogical or metaphorical ability is a learning process that extends well into adulthood and shows different developmental trajectories for different conceptual domains based on one's knowledge of the domain.

4. The emergence of similarity mappings in children's early spontaneous communications

The research just reviewed clearly shows that children can form similarity mappings by preschool age when tested in an experimental setting. However, we might find that children are able to convey similarity mappings even earlier if we look at their spontaneous language, particularly when that language is produced along with gesture, simply because a child's initial grasp of an idea is often evident first in gesture. For example, children begin to produce combinations in which gesture conveys different information from speech (*eat* + POINT TO COOKIE) somewhere between ages

1;2–1;6, and gesture-speech combinations of this sort index oncoming changes in their speech. They combine words with gestures to create a sentence-like meaning (e.g., *ride* + POINT TO BIKE) several months before they combine words with other words to create a sentence (e.g., *ride bike*; Capirci, Iverson, Pizzuto and Volterra 1996; Goldin-Meadow and Butcher 2003; Greenfield and Smith 1976; Iverson and Goldin-Meadow 2005; Özçalışkan and Goldin-Meadow 2005a, 2005b). In fact, children routinely produce a number of constructions – argument+argument (*mommy* + POINT TO CUP), predicate + argument (*peg* + MOVE FIST UP AND DOWN AS IF HITTING), and predicate + predicate (*I like it* + MOVE HAND BACK AND FORTH TO MOUTH AS IF EATING) – first in a gesture-speech combination before producing each of these constructions entirely in speech (i.e., *mommy cup; hammer the peg; I like eating it*; Özçalışkan and Goldin-Meadow 2005a, 2006). Thus, a child's ability to convey a construction across gesture and speech serves as an early signal that the child will soon be able to convey the same construction entirely within speech (Özçalışkan and Goldin-Meadow 2005a).

The question we pursue in this chapter is whether children use gesture in combination with speech to convey similarity-based comparisons (*like ice-cream cone* + POINT TO A MUSHROOM CAP; *I go like that over my cup* + ROTATE FINGER IN AIR TO INDICATE STIRRING) before they convey these comparisons in their speech (e.g., *bunny looks like me; the cow is like that cow there*). Our aim is to identify the initial emergence and subsequent development of constructions that convey similarity mappings. We use longitudinal observations of 40 children, all raised as monolingual English speakers in the Chicago area, between ages 1;2 to 2;10. The children were videotaped for 90 minutes in their homes every four months while interacting with their primary caregivers in their everyday routines (see Table 1 for a summary of the sample categorized according to the ethnicity and the income level of the families). All meaningful sounds and communicative gestures were transcribed, and divided into communicative acts.[1] We considered hand movements to be communicative gestures if they were used to convey information to a listener and did not involve direct manipulation of objects (e.g., banging a toy) or a ritualized game (e.g., patty cake). Sounds were considered meaningful words if they were used reliably to refer to specific referents or events; onomatopoeic sounds (e.g., *meow, choo-choo*) and conventionalized evaluative sounds (e.g., *oopsie, uh-oh*) were also included as words. Data were analyzed using ANOVAs, with either one (age) or two (age x domain, age x comparison type) within-subject factors, or chi-squares, as appropriate.

Table 1. The sample of children classified according to ethnicity and family income

Family income	**Parents' ethnicity**					
	African American	*Asian*	*Caucasian*	*Hispanic*	*Mixed*	*Total*
Less than $15,000	1	0	1	0	0	2
$15,000-$34,999	2	1	2	2	1	8
$35,000-$49,999	2	0	3	0	1	6
$50,000-$74,999	2	1	6	0	0	9
$75,000-$99,999	1	0	5	1	0	7
$100,000 or more	0	0	7	0	1	8
Total	8	2	24	3	3	40

Mixed: two or more ethnic groups

5. Developmental changes in children's overall production of speech and gesture

A broad look at the children's speech showed that they steadily increased their speech production over time. As can be seen in Table 2, children produced more communicative acts containing speech ($F(5,170)=84.09$, $p<0.001$), more different word types ($F(5,170)=174.74$, $p<0.001$), and more words overall (i.e., tokens, $F(5,170)=95.32$, $p<0.001$) with increasing age. There was a significant increase in the number of communicative acts containing speech and word types between ages 1;6 and 1;10 (*p's*<0.001, Schéffe), and significant increases in all three measures from age 1;10 to 2;2 (*p's*<0.001, Schéffe). In addition, children continued to increase their word tokens and word types from age 2;2 to 2;6 (*p's*<0.01, Schéffe). Children's verbal lexicons showed a steep increase from 11 word types and 44 word tokens at age 1;2 to 239 word types and 1741 word tokens at age 2;10, and the majority of the children (37/40) were producing multiword combinations by age 1;10.

Children also increased their gesture production over time. They produced more communicative acts with gesture ($F(5,170)=10.22$, $p<0.001$), more gesture tokens ($F(5,170)=10.82$, $p<0.001$), and more gesture-speech combinations ($F(5,170)=34.29$, $p<0.001$) with increasing age. There were significant increases in the mean number of communicative acts with ges-

ture and in gesture tokens between ages 1;2 and 1;6 (p's<0.05, Schéffe), and a significant increase in the mean number of gesture-speech combinations between ages 1;6 and 1;10 (p<0.01, Schéffe). By 1;2, only half of the children (21/40) were producing gesture-speech combinations, but by 1;6, all but one child were combining gesture with speech. Thus, overall children showed steady increases in their speech and gesture production over time.

Table 2. Summary of children's speech and gesture production [a.]

	1;2	*1;6*	*1;10*	*2;2*	*2;6*	*2;10*
Speech [b.]						
Mean number of communicative acts containing speech (SD)	38 (44)	157 (125)	351 (249)	549 (257)	608 (234)	642 (253)
Mean number of word tokens (SD)	44 (53)	179 (142)	479 (401)	1054 (658)	1475 (795)	1741 (789)
Mean number of word types (SD)	11 (12)	35 (25)	91 (62)	162 (79)	213 (76)	239 (74)
Percentage of children producing at least one two-word combination [c.]	25% (10/40)	63% (25/40)	93% (37/40)	97% (37/38)	100% (37/37)	100% (38/38)
Gesture						
Mean number of communicative acts containing gesture (SD)	53 (36)	90 (63)	117 (73)	126 (88)	115 (62)	105 (59)
Mean number of gesture tokens (SD)	54(36)	91(64)	119(75)	131(90)	123(68)	112(65)
Mean number of gesture-speech combinations (SD)	6(9)	30(32)	67(49)	95(66)	97(55)	88(51)
Percentage of children producing at least one gesture-speech combination	52% (21/40)	98% (39/40)	98% (39/40)	97% (37/38)	100% (37/37)	100% (38/38)

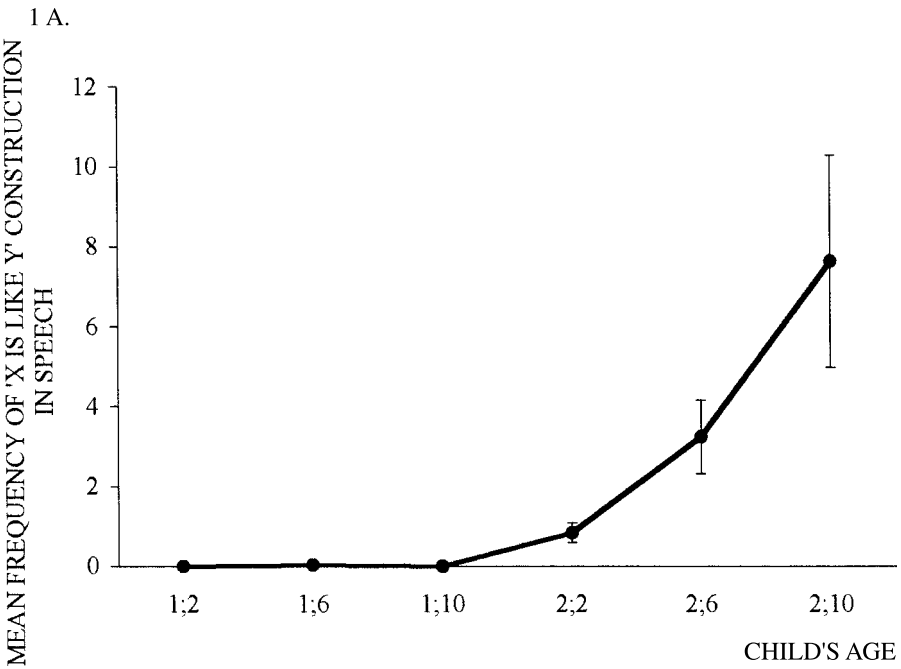
[a.] SD = standard deviation

[b.] All speech utterances are included in the top part of this table, even those produced with gesture.

[c.] As with most longitudinal designs, we missed a few sessions for some of the children, which led to slight differences in sample size at later data points. Therefore, the total number of children with respect to sample size at each data point is provided in parentheses.

6. Developmental changes in children's production of 'X IS LIKE Y' construction in their speech

We focus our analysis on the 'X IS LIKE Y' constructions because the word *like*[2] is one of the earliest signs of similarity mapping ability in young children. Figure 1A shows children's mean production of 'X IS LIKE Y' constructions in speech, and Figure 1B shows the number of children who produced this construction in speech at least once over the six time periods. As the figures illustrate, children did not routinely produce the 'X IS LIKE Y' construction in speech until age 2;2.[3] At 2;2, there were 15 children who produced the construction at a mean frequency of 0.84. Children significantly increased their production of the construction over time ($F(5, 170)=6.9$, $p<0.001$), showing a reliable increase from age 2;2 ($M=3.24$) to age 2;10 ($M=7.63$; $p<0.005$, Schéffe). The number of children who produced the construction also increased with age. At age 2;2, about 40% of the children used the construction in their speech, but by age 2;10, almost 80% of the children produced at least one instance of the construction in their speech.



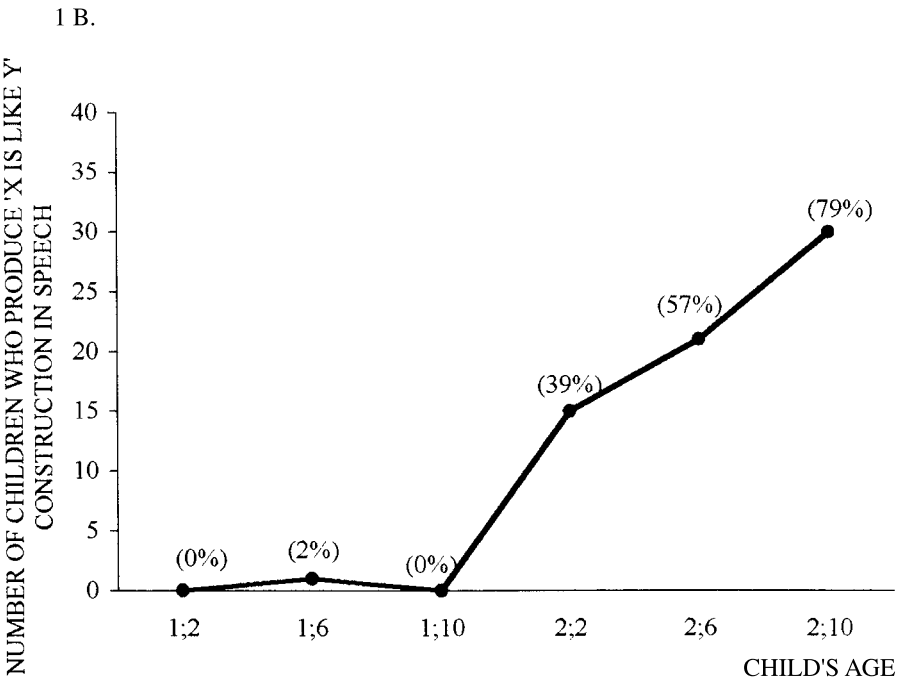


Figure 1. Children's mean production of 'X IS LIKE Y' construction in speech (Panel A) and the number of children who produced at least one instance of 'X IS LIKE Y' construction in speech (Panel B; percentage of children is indicated in parenthesis).

The construction 'X IS LIKE Y' involves both a source (Y, e.g., *rainbow* in *Butterfly is like a rainbow*) and a target domain (X, *e.g., butterfly* in *Butterfly is like a rainbow*). Initially children's uses of the construction did not contain both domains. They expressed only one domain (typically the source) and the other (typically the target) could be inferred from context (examples 1–3).

(1) *Look like a house* + CHILD IS LOOKING AT A CHURCH PAINTING [2;2][4]
'Church painting looks like a house'

(2) *Just like potato-head* + CHILD IS PLAYING A COMPUTER GAME SIMILAR TO POTATO-HEAD [2;6]
'Computer game is like potato-head'

(3) *Like a mean monster* + CHILD HAS BEEN TALKING ABOUT TORNADOS [2;10]
'Tornado is like a mean monster'

Thus, children's initial uses of the construction showed an effect of domain type ($F(2, 68)=16.17$, $p<0.0001$). As Figure 2 illustrates, once children began producing the 'X IS LIKE Y' construction, they were significantly more likely to express the source domain on its own than either the target domain on its own ($p<0.0001$, Schéffe) or the source and target domains together ($p<0.03$, Schéffe).

There was also an effect of age in the children's expression of source and target domains ($F(5, 170)=6.77$, $p<0.0001$), which interacted with domain type ($F(10, 340)=6.88$, $p<0.0001$). Children increased the number of 'X IS LIKE Y' constructions they produced containing the source domain on its own over time ($F(5, 170) = 8.25$, $p<0.0001$) and the source and target domains together ($F(5, 170) = 4.66$, $p<0.001$), with significant changes from age 2;2 to age 2;10 for both ($p's<0.05$, Schéffe). However, no such developmental trend was observed for the target domain on its own – whenever the children expressed the target domain of a similarity mapping, they also expressed the source domain (see examples 4–6).

(4) *That one like this one* + CHILD IS HOLDING AN ORNAMENT AND LOOKING AT ANOTHER ORNAMENT IN HER MOTHER'S HAND [2;2]
'Child's ornament is like mother's ornament'
(5) *Bunny looks like me* + CHILD IS TALKING ABOUT A BUNNY CHARACTER ON TV [2;6]
'Bunny looks like child'
(6) *The cow is like that cow there* + CHILD IS TALKING ABOUT THE TWO COWS IN THE TWO PUZZLES HE IS PLAYING WITH [2;10]
'The cow in one puzzle is like the cow in the other puzzle'

Children also showed developmental changes in the linguistic means they used to express the source and target domains of the 'X IS LIKE Y' construction. As can be seen in Table 3, they predominantly relied on demonstrative (*this, that, these, those*) and personal (*it, he, she, me*) pronouns to express the source domain and reliably increased their use of pronominal references over time ($F(5, 170)=7.95$, $p<0.0001$, $M=0.68$ at age 2;2 vs. $M=4.71$ at age 2;10). They used explicit nouns (e.g., *baby, spider*) or verbs (e.g., *climb, eat*) to express the source domain far less often. Nevertheless, their use of nominal devices also increased reliably

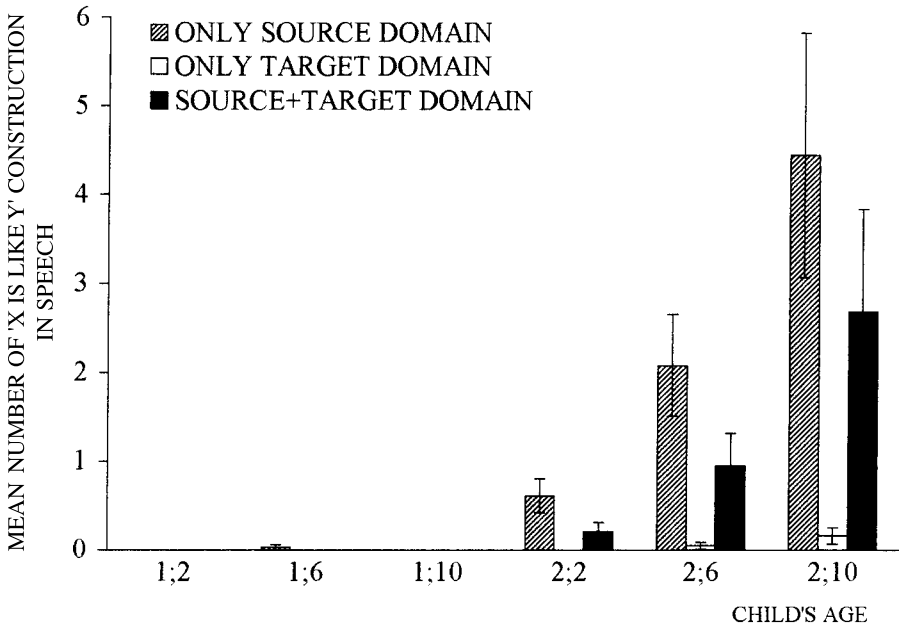


Figure 2. Mean number of 'X IS LIKE Y' constructions for which only the source (hatched bars), only the target (gray bars), or both the source and the target domains (black bars) were encoded in speech.

with age ($F(5, 170)=4.81$, $p<0.001$, $M=0.16$ at age 2;2 vs. $M=2.42$ at age 2;10) (see examples 7–9).

(7) *Looks like* ***it*** + CHILD IS COMPARING BINGBONG IN BOOK TO SQUIRREL OUTSIDE [2;2]
'Bingbong looks like squirrel'

(8) *Just like* ***Dori*** + CHILD IS COMPARING HER VOICE TO THAT OF DORI IN MOVIE [2;6]
'Child's voice like Dori's voice'

(9) *Look like* ***a whale*** + CHILD IS LOOKING AT A WHALE PICTURE IN ALBUM [2;10]
'Whale picture looks like a whale'

The pattern was slightly different for the target domain. Children used both linguistic devices (pronominal and nominal) at roughly equal rates at each age. Their use of nouns and verbs to express the target domain in-

creased reliably over time (F(5, 170)=11.56, $p<0.0001$; M=0.08 at age 2;2 vs. M=1.42 at age 2;10), but their use of pronominal reference to express the target domain did not (F(5, 170)=1.97, *ns*; M=0.13 at age 2;2 vs. M=1.39 at age 2;10) (see examples 10–12).

(10) *Do you* **close** *it like this?* + CHILD CLOSES DOOR BY PUSHING IT WITH FOOT [2;6]
'Do you close door like you close it by pushing it with foot?'

(11) ***Baby*** *like the one at grandma's* + CHILD IS PLAYING WITH A BABY DOLL [2;2]
'Baby doll is like the baby doll at grandmother's house'

(12) ***Dad*** *is like D and dog* + CHILD IS LEARNING HOW TO SPELL LETTER D [2;10]
'D in dad is like D in dog'

Table 3. Types of linguistic means children used to encode source and target domains of the 'X IS LIKE Y' construction in their speech[a.]

	1;2	*1;6*	*1;10*	*2;2*	*2;6*	*2;10*
Source domain						
Mean number of source domains that are encoded by a noun or a verb in speech (SD)	0 (0)	0 (0)	0 (0)	0.16 (0.55)	0.89 (2.17)	2.42 (6.30)
Mean number of source domains that are encoded by a personal or a demonstrative pronoun in speech (SD)	0 (0)	0.03 (0.16)	0 (0)	0.68 (1.36)	2.14 (3.54)	4.71 (9.32)
Target domain						
Mean number of target domains that are encoded by a noun or a verb in speech (SD)	0 (0)	0 (0)	0 (0)	0.08 (0.27)	0.57 (1.32)	1.42 (2.23)
Mean number of target domains that are encoded by a personal or a demonstrative pronoun in speech (SD)	0 (0)	0 (0)	0 (0)	0.13 (0.53)	0.43 (1.26)	1.39 (5.71)

[a.] SD = standard deviation

In summary, children began to use the 'X IS LIKE Y' construction in their spontaneous speech by age 2;2, a time period much earlier than what has been reported in earlier experimental studies and anecdotal reports. Although their initial uses of the construction typically encoded only the source domain, they showed an increasing tendency to encode both the source and the target domains over time.

6.1. Types of 'X IS LIKE Y' constructions in children's speech

Children produced two types of 'X IS LIKE Y' constructions: those involving a comparison of an action to an ongoing action (i.e., *action-based comparison*), and those involving a comparison of an entity (a person or an object) to another entity present in the immediate context (i.e., *feature-based comparison*).

The action-based comparisons typically involved specifying the source action encoded by a demonstrative pronoun (*this, that*) and were actualized in three distinct ways based on the specification of the target domain. In the first and most frequent type of action-based comparison, the source domain was conveyed with a demonstrative pronoun (i.e., *like this*/*that*) and the target domain could be inferred from context (see examples 13, 14).

(13) *Like this* + CHILD DIPS WASHCLOTH IN WATER AND WIPES HER FACE WITH IT [2;2]
'Wash face like wash it by wiping it with washcloth'
(14) *Like this* + CHILD PRETENDS TO TYPE VERY RAPIDLY ON TOY COMPUTER [2;6]
'Type like type rapidly on keyboard'

In the second type of action-based comparison, the source domain was conveyed by a demonstrative pronoun (*like this*/*that*) and the target domain was conveyed with a strong verb (e.g., *walk*/*eat*/*swim*) (see examples 15–17).

(15) *I want to climb like that* + CHILD ATTEMPTS TO CLIMB UP ON A LADDER [2;2]
'I want to climb like I climb up using a ladder'
(16) *It can run like that* + CHILD MAKES DOLL RUN WITH OUTSTRETCHED LEGS [2;6]
'Doll can run like run by stretching its legs'

(17) *We have to rock her like this* + CHILD ROCKS DOLL GENTLY IN THE TOY CAR SEAT [2;10]
'We have to rock the doll like rock her gently'

In the third type of action-based comparison, the source domain was conveyed with a demonstrative pronoun (*like this*/*that*) and the target was conveyed by a bleached verb (*go, do*) (see examples 18–20).

(18) *I go like this* + CHILD HOPS UP AND DOWN LIKE A FROG [2;6]
'I go like I hop like a frog'
(19) *You do it like this* + CHILD PAINTS PICTURE BY STAMPING ON IT [2;6]
'You do the picture like you paint by stamping on it'
(20) *No go like that* + CHILD RIDES BIKE BY WALKING HIS FEET ON THE SIDES [2;10]
'Go like you ride bike by walking your feet on the sides'

Of the three types of action-based comparisons, the first type in which the target had to be inferred from context was the most frequent and the first to emerge. As Table 4 illustrates, children used the 'like+demonstrative pronoun' construction at age 2;2 (M=0.42) and increased their use of this construction over time (M=2.21 at age 2;10). 'Like this/that' constructions were followed by 'strong verb+like this' type constructions. Only a few children produced this construction at age 2;2 (M=0.05) but these constructions became more frequent at age 2;6 (M=0.46) and by age 2;10, half of the children were using the 'strong verb+like this' construction (M=1.08). The 'bleached verb + like this/that' type constructions emerged later. Children did not begin to use bleached verbs to express the target domain until age 2;6 and then only 8 of the 40 children used this construction (M=0.97). Children remained relatively stable in their use of bleached verbs to mark the target domain through age 2;10 (M=0.68).

Table 4. Mean number of different types of action-based comparisons in children's speech[a.]

	1;2	*1;6*	*1;10*	*2;2*	*2;6*	*2;10*
∅ + like this (SD)	0 (0)	0.03 (0.16)	0 (0)	0.42 (1.0)	0.76 (1.4)	2.21 (3.06)
Strong verb + like this (SD)	0 (0)	0 (0)	0 (0)	0.05 (0.23)	0.46 (0.99)	1.08 (1.38)
Bleached verb + like this (SD)	0 (0)	0 (0)	0 (0)	0 (0)	0.97 (2.61)	0.68 (1.36)

[a.] SD = standard deviation, ∅ = no mention of target domain

The feature-based comparisons highlighted similarities in perceptual features (e.g., shape, size, color) between two entities. The most typical linguistic construction for feature-based comparisons consisted of a noun encoding the source domain without any mention in speech of the target domain; the verb *look* often accompanied these constructions (see examples 1–3, repeated below).

(1) *Look like a house* + CHILD IS LOOKING AT A CHURCH PAINTING [2;2]
'Church painting looks like a house'
(2) *Just like potato-head* + CHILD IS PLAYING A COMPUTER GAME SIMILAR TO POTATO-HEAD [2;6]
'Computer game is like potato-head'
(3) *Like a mean monster* + CHILD HAS BEEN TALKING ABOUT TORNADOS [2;10]
'Tornado is like a mean monster'

In the second type of feature-based comparison, both the source and target domains were encoded in a noun or a pronoun, frequently accompanied by the verb *look*. Interestingly, most of these feature-based comparisons highlighted the general appearance of the two objects, without specifying the exact basis of the comparison, as can be seen in examples 21-to-23.

(21) *That looks like Scooby* + CHILD IS LOOKING AT A DOG PICTURE [2;2]
'Dog picture looks like Scooby the dog'
(22) *It looks like a skirt* + CHILD IS HOLDING HER UNDERSKIRT [2;6]
'Underskirt looks like a skirt'
(23) *I want to make a boat like that one* + CHILD HAS BEEN BUILDING BOATS WITH BLOCKS [2;10]
'I want to make a boat like my previous boat'

There were, however, a few feature-based comparisons, which specified the basis of comparison between the two objects. The two dimensions that were explicitly mentioned were color (examples 24–25) and size (example 26).

(24) *It is like blue like this one* + CHILD POINTS TO BLUE SCRIBBLE WHILE PLAYING WITH A BLUE TOY [2;6]
'Blue toy is blue like the blue scribble'
(25) *It is brown like my hair* + CHILD IS DRAWING WITH A BROWN CRAYON [2;10]
'Brown crayon is brown like child's brown hair'

(26) *It is big like that* + CHILD IS MAKING CHURCHES OF DIFFERENT SIZES WITH BLOCKS [2;10]
'Church A is big like church B'

The children were also able to highlight these dimensions using contextual cues (see examples 27–28 for color, example 29 for size, and examples 30–31 for shape).

(27) *Like the man with the yellow hat* + CHILD IS PLAYING WITH YELLOW TRIANGLE [2;10]
'Yellow triangle is yellow like the man with the yellow hat'
(28) *And this one is like this* + CHILD COMPARES GREEN CRAYON TO GREEN STRIPE ON HIS SHIRT [2;10]
'Green crayon is green like green stripes'
(29) *Like this* + CHILD PINCHES FINGERS TO PRODUCE THE ICONIC GESTURE OF SMALL [2;10]
'Size of ponytail is small like the size of my finger'
(30) *Like a tunnel* + CHILD HOLDS HAND IN THE SHAPE OF AN ELONGATED HOLLOW OBJECT [2;10]
'Child's hand is elongated like a tunnel'
(31) *Like a circle* + CHILD IS PLAYING WITH LETTER O [2;10]
'Letter O is circular like a circle'

Children's production of action-based and feature-based comparisons showed a main effect of age ($F(5, 170)=6.96$, $p<0.001$), but no effect of comparison type ($F(1, 34)=0.63$, *ns*) and no interaction ($F(5, 170)=0.39$, *ns*). As can be seen in Figure 3, children reliably increased their production of both action-based ($F(5, 170)=16.49$, $p<0.0001$) and feature-based comparisons ($F(5, 170)=2.78$, $p<0.05$) over time, with significant changes occurring between ages 2;2 and 2;10 ($p's< 0.001$, Schéffe). However, their production of action-based and feature-based comparisons was comparable at each age.

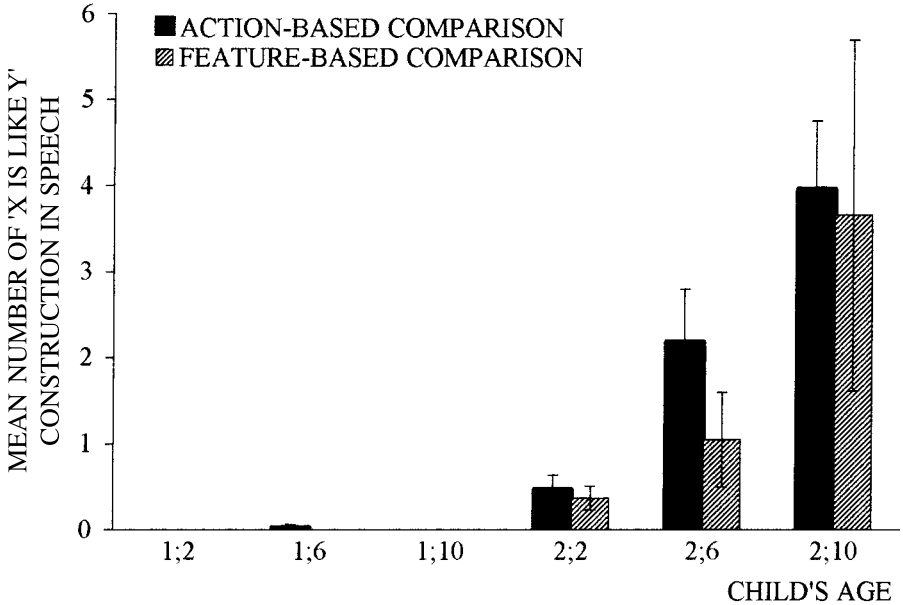


Figure 3. Mean number of 'X IS LIKE Y' constructions that involve action-based comparisons (black bars) or feature-based comparisons (hatched bars).

To summarize thus far, children produced two types of 'X IS LIKE Y' constructions in their speech – those comparing two actions, and those comparing two objects. They used each type of comparison at roughly equal rates, and their production of each type increased with age. Note that the children in our study produced 'X IS LIKE Y' constructions in their spontaneous speech earlier than children have been reported to produce or understand these constructions in experimental settings. One of the reasons for this early appearance of the construction may be that there was typically a great deal of contextual support for these constructions. Children relied on a variety of non-verbal tools to specify both their action- and feature-based comparisons. As can be seen in Table 5, across the different ages, 80 to100% of action-based comparisons were accompanied by an ongoing action that specified the source domain (see examples 13–20), and 40 to 70% of feature-based comparisons were accompanied by a present object that clarified either the source or the target domain (see examples 21–23). Thus, children's initial uses of the 'X IS LIKE Y' construction were highly context-dependent, typically accompanied by

an ongoing action, visible object, or gesture. In the next sections, we focus on one of these non-verbal devices, namely gesture, asking whether gestures play a role in helping children to convey the 'X IS LIKE Y' construction before they can convey it entirely in speech.

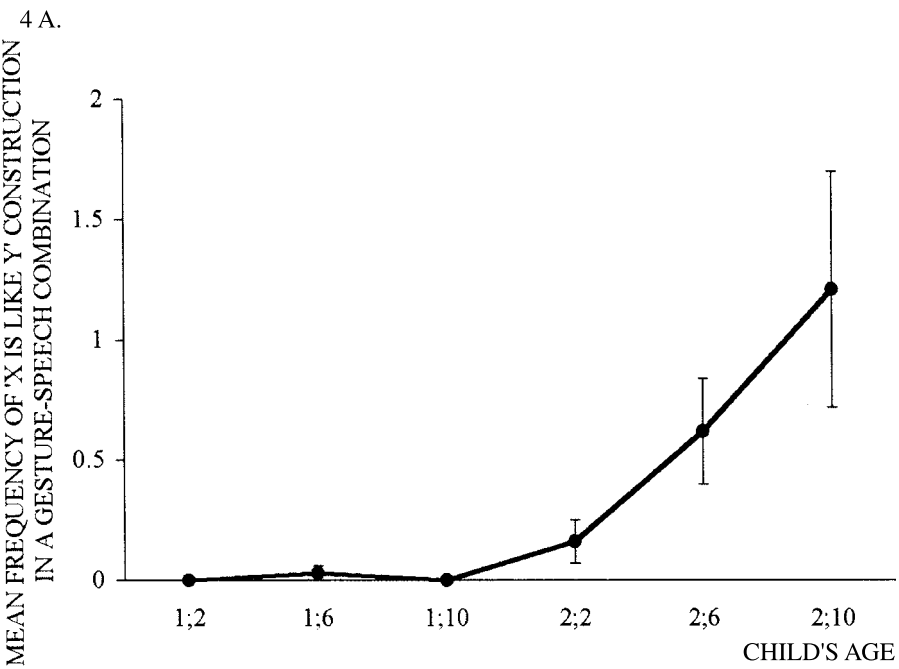
Table 5. Number of action-based comparisons that are accompanied by an ongoing action and number of feature-based comparisons that are accompanied by a present object[a.]

	1;2	*1;6*	*1;10*	*2;2*	*2;6*	*2;10*
Number of action-based comparison that are accompanied by an action specifying the source domain	0	1 (100%)	0	17 (94%)	63 (78%)	126 (83%)
Number of action-based comparison that are accompanied by an action specifying the target domain	0	0	0	0	2 (2%)	9 (6%)
Total number of action-based comparisons	0	1	0	18	81	151
Number of feature-based comparison that are accompanied by a present object specifying the source domain	0	0	0	7 (50%)	15 (38%)	61(44%)
Number of feature-based comparison that are accompanied by a present object specifying the target domain	0	0	0	10 (70%)	28 (72%)	96 (69%)
Total number of feature-based comparisons	0	0	0	14	39	139

[a.] Percentages of action-based or feature-based comparisons that are accompanied by an action or an object are provided in parenthesis. For action-based comparison percentages were computed by dividing the total number of action-based comparisons that are accompanied by an action by the total number of action-based comparisons. For feature-based comparisons, percentages were computed by dividing the total number of feature-based comparisons that are accompanied by a present object by the total number of feature-based comparisons.

7. Children's use of gesture in their 'X IS LIKE Y' constructions

We begin by asking how often children used gesture (as opposed to other non-verbal cues) to specify either the target or the source domain in an 'X IS LIKE Y' construction. Figure 4A shows children's mean production of gesture in 'X IS LIKE Y' constructions and Figure 4B shows the number of children who produced gesture in these constructions over the six time periods. As the figures illustrate, gesture was used in 'X IS LIKE Y' constructions as soon as children began producing these construction in speech, that is, at age 2;2. The number of times the children used gesture in the 'X IS LIKE Y' construction increased steadily over time ($F(5, 170)=4.61$, $p<0.001$), as did the number of children who used gesture. Four children used gesture in these constructions at age 2;2 ($M=0.16$);[5] at 2;6, one third of the children (N=12/37) used gesture in at least one instance of the construction ($M=0.62$); and by age 2;10, almost half of the children (N=17/38) used gesture in the construction ($M=1.21$). Thus, gesture was used more and more often in the 'X IS LIKE Y' constructions over time.



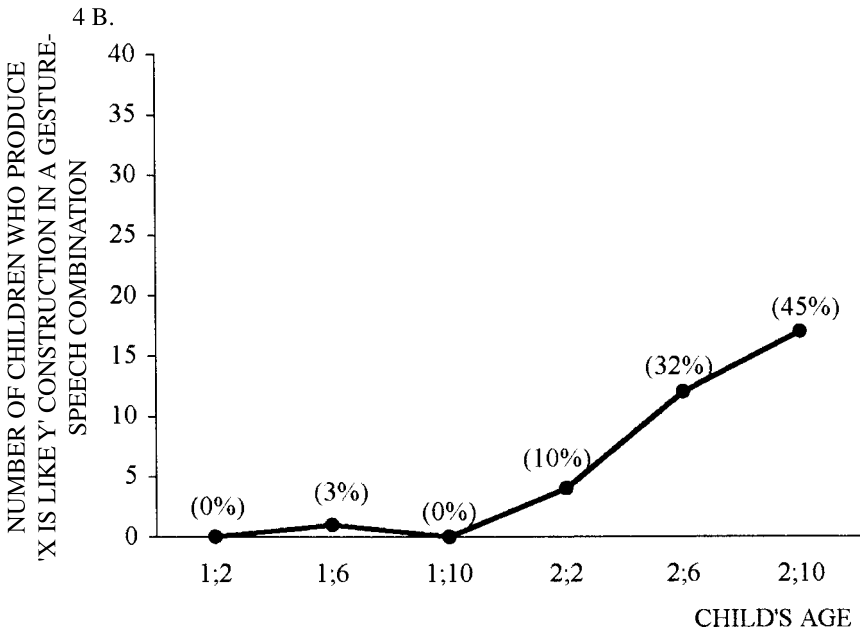


Figure 4. Children's mean production of 'X IS LIKE Y' construction in their gesture-speech combinations (Panel A) and the number of children who produced at least one instance of 'X IS LIKE Y' construction in a gesture-speech combination (Panel B).

Gesture served two functions in children's 'X IS LIKE Y' constructions. First and most often, gesture clarified a source or a target domain that was conveyed by a pronominal in speech. Second, gesture conveyed a source or a target domain that was not conveyed in speech at all.

In terms of clarifying a pronominal reference in speech, pointing gestures were used to specify the entity in either the target domain (see examples 32–34) or the source domain (see examples 35–36) and iconic gestures were used to specify the action in the source domain (see examples 37–41).

(32) *This like earl grey* + CHILD POINTS TO CUP OF COFFEE [2;2]
'Coffee is like earl grey tea'

(33) *Those are like strawberries but they are not strawberries* + CHILD POINTS AT TOY TOMATOES [2;6]
'Toy tomatoes are like strawberries but they are not strawberries'

(34) *Is that look like grandpa Johndeer?* + CHILD POINTS AT TRACTOR PICTURE [2;6]
'Does the tractor picture look like grandpa's Johndeer tractor?'
(35) *Shelley has sticky tape just like this one* + CHILD POINTS AT STICKY TAPE ON DESK [2;10]
'Shelley has sticky tape just like the sticky tape on desk'
(36) *I can hug a baby like this one* + CHILD POINTS AT BABY MOUSE IN BOOK [2;6]
'I can hug a baby like the baby mouse in book'
(37) *I eat like this* + CHILD PERFORMS THE ICONIC GESTURE OF EATING WITH FIST BY MOVING FIST BACK AND FORTH TO MOUTH [2;2]
'I eat like I eat with my fist'
(38) *Like this* + CHILD PERFORMS THE ICONIC GESTURE OF PLAYING THE ACCORDION BY MOVING ARMS INWARD AND OUTWARD [2;6]
'I play the accordion like I play it in a particular style'
(39) *Give it to me like this* + CHILD PERFORMS THE ICONIC GESTURE OF PUTTING PRETEND NECKLACE ON NECK BY HOLDING TWO PINCHED FINGERS IN AIR [2;6]
'Give the necklace to me like you put it around my neck'
(40) *I go like that over my cup* + CHILD PERFORMS THE ICONIC GESTURE OF DROPPING SOMETHING INTO THE CUP BY OPENING A CLOSED FIST IN AIR (iconic) [2;10]
'I go like I drop something into my cup'
(41) *Knocked over like this* + CHILD PERFORMS THE ICONIC GESTURE OF SWAYING BY MOVING ARM OUTWARD FORCEFULLY (iconic) [2;10]
'I knocked it over like I knocked it over by swaying it'

In terms of specifying a source or a target domain that was *not* encoded in speech, pointing gestures were used to convey the entity in the target domain that was not mentioned in speech (examples 42–45) and iconic gestures were used to convey the action in the source domain that was not mentioned in speech (example 46).[6]

(42) *Like ice-cream cone* + CHILD POINTS TO MUSHROOM [2;2]
'Mushroom is like ice-cream cone'
(43) *Like a sun* + CHILD POINTS TO CIRCULAR OBJECT ON TV [2;10]
'Object on TV is like a sun'
(44) *Like a sheep* + CHILD POINTS TO SHEEP PICTURE [2;10]
'Sheep picture is like a sheep'

(45) *Like a square* + CHILD POINTS TO BLOCK STRUCTURE [2;10]
'Block structure is like a square'
(46) *You do it like* + CHILD PERFORMS THE ICONIC GESTURE OF THROWING BY MOVING HER HAND FORWARD FORCEFULLY [2;6]
'You do it like you throw it forcefully'

8. Does gesture pave the way for 'X IS LIKE Y' constructions?

As examples 32 to 45 illustrate, gesture was often used to convey a target or a source domain in an 'X IS LIKE Y' construction that was not specified in speech. The question we turn to next is whether gesture served as a precursor, signaling the onset of the 'X IS LIKE Y' construction in speech, as has been found with respect to a number of other linguistic constructions (Özçalışkan and Goldin-Meadow 2005a, 2006). In other words, did children use gesture and speech together to highlight a comparison between objects *before* they were able to produce the word *like*? The short answer to this question is *yes* (see also Özçalışkan and Goldin-Meadow, under review).

We found a number of gesture-speech combinations in which the relation between the object conveyed in gesture and the object conveyed in speech was similarity. For example, the child points at a cat and says *doggie*. An utterance of this sort might be an error on the child's part. Alternatively, the utterance could reflect the child's intent to highlight dimensions of similarity between the cat and the dog (e.g., four-legged, furry). Gesture-speech combinations of this sort might constitute the child's earliest efforts in similarity mapping and, accordingly, might serve as a stepping-stone for the onset of 'X IS LIKE Y' constructions in their speech (i.e., *a dog is like a cat*). If so, we would expect the emergence of gesture-speech combinations that highlight the similarity between two objects to precede the appearance of the 'X IS LIKE Y' constructions in children's speech. Moreover, we would expect children to produce fewer gesture-speech combinations of this sort once they have begun to use 'X IS LIKE Y' constructions routinely in their speech.

The children in our study produced many gesture-speech combinations in which the object conveyed in gesture and the object conveyed in speech were similar in overall appearance, shape, or color (see examples 47–61). These utterances thus resembled the types of comparisons found in the children's early 'X IS LIKE Y' constructions, with the exception that they did not contain the word *like*.

(47) *Dog* + CHILD POINTS TO SQUIRREL [1;2]
(48) *Juice* + CHILD POINTS TO MILK [1;2]
(49) *Mommy* + CHILD POINTS TO FEMALE EXPERIMENTER [1;6]
(50) *Car* + CHILD POINTS TO TRUCK [1;6]
(51) *A butterfly* + CHILD POINTS TO BOW TIE [1;10]
(52) *Boot* + CHILD POINTS TO SOCK [1;10]
(53) *Donkey* + CHILD POINTS TO HORSE [1;10]
(54) *Raining* + CHILD POINTS TO SNOW FALL [2;2]
(55) *Purple* + CHILD POINTS TO BLUE BLOCK [2;2]
(56) *He has the moon* + CHILD POINTS TO WHITE HAIR ON NOAH'S HEAD [2;2]
(57) *They have a penis* + CHILD POINTS TO PIG'S TAIL [2;6]
(58) *A square* + CHILD HOLDS UP A DIAMOND SHAPE [2;6]
(59) *More sugar* + CHILD POINTS TO FLOUR [2;10]
(60) *Every whale loves a bubble bath* + CHILD POINTS TO OCEAN WITH WAVES [2;10]
(61) *I think these are cats* + CHILD POINTS TO FOX [2;10]

As can be seen in Figure 5 (see below), the frequency of children's gesture-speech combinations expressing similarity relations without the word *like* changed significantly over time ($F(5, 170)= 3.45$, $p<0.01$), increasing from age 1;2 ($M=0.40$) to age 1;6 ($M=2.23$). Children's production of these combinations remained relatively unchanged between ages 1;6 and 2;6, but began to decline thereafter. Importantly, the decline at age 2;6 coincided with an increase in 'X IS LIKE Y' constructions. Thus, the children became less likely to produce gesture-speech combinations expressing similarity relations without the word *like* at just the point when they began producing similarity-based mappings in appropriate syntactic packaging (i.e., with the word *like*).

Consistent with the hypothesis that gesture is playing a bootstrapping role in the emergence of 'X IS LIKE Y' constructions, the onset of gesture-speech combinations expressing similarity relations without the word *like* routinely preceded the onset of 'X IS LIKE Y' constructions in speech. Of the 40 children in our sample, 29 (73%) produced a gesture-speech combination of this sort before producing an 'X IS LIKE Y' construction in speech, compared to only one child who displayed the opposite pattern (29 vs. 1, $X^2(1) = 38.88$, $p<0.001$). Of the remaining 10 children, 5 produced gesture-speech combinations of this sort but had not yet produced the 'X IS LIKE Y' construction in speech; we expect these children to produce 'X IS LIKE Y' in speech in subsequent sessions. The remaining 5

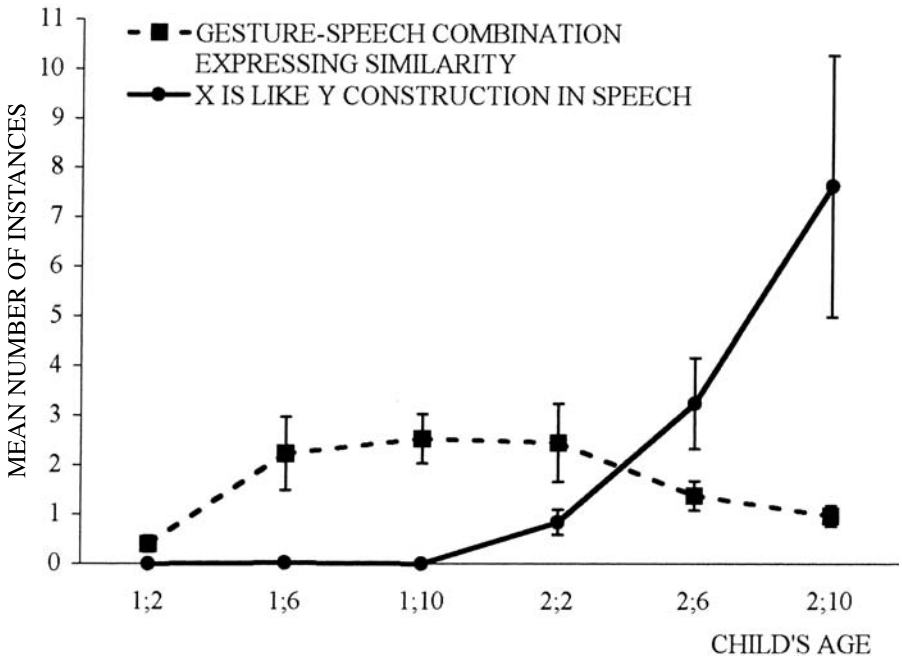


Figure 5. Mean number of gesture-speech combinations expressing similarity (dotted line) and mean number of 'X IS LIKE Y' constructions in speech (straight line).

children produced their first gesture-speech combination expressing a similarity relation without the word *like* and their first 'X IS LIKE Y' construction in speech during the same observation session; it is likely that we missed the onset time for the constructions in these children, possibly due to the relatively long time interval between observations (~4 months). As a result, the data for these 5 children neither support nor refute our predictions. Thus, 34 (97%) of the 35 relevant children in our sample first produced a gesture-speech combination expressing a similarity mapping without the word *like*, compared to 1 (2%) who first produced the 'X IS LIKE Y' construction in speech. Thus, gesture-speech combinations expressing a similarity relation clearly preceded the 'X IS LIKE Y' construction in speech, signaling a child's readiness to make similarity-based mappings in appropriate syntactic packaging.

9. Conclusion

In the process of learning a language children have to learn not only to map a word onto a particular referent or an event (e.g., calling a red block *a red block)* but also to articulate correspondences between objects or events based on commonalities in their features or relational structure (e.g., *a red block is red like a red crayon*). In this chapter, we examined the beginnings of this mapping ability in a sample of English-speaking children from ages 1;2 to 2;10, as indexed by their use of the 'X IS LIKE Y' construction. Our analysis showed an early onset of the 'X IS LIKE Y' construction. Children began to produce the construction in their spontaneous speech routinely by age 2;2 – two years earlier than they have been found to produce such similarity mappings in experimental settings. However, these early uses of the 'X IS LIKE Y' construction were highly constrained. First, the source and target domains of the mapping were typically bound by the here-and now, involving objects that were present in the immediate environment or actions that were often being executed by the child. Second, the linguistic forms that the children used to describe either domain were context dependent. Children typically used pronominal references to encode the source and/or the target domain and relied on non-verbal cues (i.e., ongoing action, gesture) to clarify these references. Thus, at the early ages, speech provided a skeletal structure for the 'X IS LIKE Y' construction and children relied on non-verbal means to flesh out this structure.

Children produced two types of 'X IS LIKE Y' constructions, those involving comparison of an object to another object (i.e., feature-based comparison) and those involving comparison of an action to an ongoing action (i.e., action-based comparison). In line with earlier work (Gentner and Rattermann 1991), children's initial feature-based comparisons were typically holistic and global, involving mappings based on overall appearance of objects (e.g., *pizza picture looks like pizza*) rather than particular aspects or dimensions of the objects (e.g., *blue scribble is blue like a blue stripe*). Similarity mappings in which the children made it clear which part or dimension of the objects they were highlighting were infrequent in our data. Indeed, in most instances, the dimension of similarity had to be inferred from non-verbal cues and other aspects of context. Moreover, all instances of the 'X IS LIKE Y' construction involved similarity mappings, rather than more complex types of mappings (e.g., analogical, metaphorical), providing further support for the hypothesis that similarity mappings between objects act as precursors to more complex mapping types (Gentner 1988; Vosniadou 1987).

However, unlike earlier work, a large portion of the 'X IS LIKE Y' constructions the children in our study produced involved action-based comparisons, which functioned in slightly different ways from feature-based comparisons. Action-based comparisons provided children with a linguistic frame that they could use to specify an action for which they lacked a lexical item. The children framed the action-based comparison in general terms, using phrases such as *like this* or *go like this* and then acting out or gesturing the specific action they intended to convey (e.g., CLIMB UP A LADDER; MOVE HAND FORWARD FORCEFULLY TO INDICATE THROWING). Interestingly, even in cases where the children produced a strong verb to encode the action (e.g*., I run/eat … like this …*), they often produced an action or a gesture to provide a more detailed rendition of the action specified by the verb (e.g., MAKE DOLL RUN RAPIDLY WITH OUTSTRETCHED LEGS; PERFORM THE ICONIC GESTURE OF MOVING FIST BACK AND FORTH TO MOUTH TO CONVEY EATING WITH FIST).

This type of framing is not unique to similarity mappings and is commonly observed in metaphorical types of mappings at later ages. As shown in earlier work (Özçalışkan 2003, under review), when 3- and 4-year-old children are asked to provide verbal explanations for different types of metaphorical mappings (e.g., *How does time fly? What does it mean when ideas escape from your mind?*), they typically produce a *like this/that* construction in speech and act out whole body gestures to further specify the source domain (*Like this* + CHILD CRAWLS ON FLOOR TO INDICATE HOURS CRAWLING BY; *Like that* + CHILD MOVES ARMS UP AND DOWN TO INDICATE IDEAS FLYING BY). This type of response typically disappears by age 5;0 when children begin to produce more elaborate verbal descriptions, along with semantically well-integrated gestures (e.g., *time drips by means it goes really slowly like that* + CHILD MOVES FINGER DOWNWARD WITH SMALL PAUSES LIKE DRIPPING WATER; Özçalışkan 2002, under review). Thus, the particular way children framed action-based comparisons in our study might be their initial step on the way to verbally more elaborate 'X IS LIKE Y' constructions. Moreover, gesture and bodily action might be signaling the child's readiness to take the next step towards more complete linguistic constructions.

Indeed, as shown in this paper, gesture played two important roles in children's production of 'X IS LIKE Y' constructions. First, gesture served as the supporting context for children's early 'X IS LIKE Y' constructions. Children initially expressed either the target or the source domains of the similarity mapping, and used gesture to convey the other domain. Even in cases where children expressed both of the domains in

speech, they typically used demonstrative pronouns to do so. In these cases, gesture clarified the object or action to which the source or target domain was being compared. Thus, gesture grounded children's early similarity mappings in the here-and-now, making those mappings much easier to understand.

Second, the onset of gesture-speech combinations expressing a similarity relation without the word *like* heralded the onset of 'X IS LIKE Y' constructions. The vast majority of the children in our study used the juxtaposition of gesture and speech to convey a similarity relation well before they seemed able to make the similarity mapping explicit with the word *like*. The children's gesture-speech combinations without the word *like* highlighted similarities between objects and events based on attributes of shape, size, or movement (cf. Clark 1973), and thus set the stage for the 'X IS LIKE Y' constructions that the children were about to produce. Importantly, the children's gesture-speech combinations conveying a similarity relation without *like* not only showed a rapid increase at age 1;6–a time point where we also observed rapid changes in lexicon (as has been found in previous observations, e.g., Gershkoff-Stowe & Smith, 1997) – they also showed a marked decline at just the moment that the 'X IS LIKE Y' construction appeared in the children's speech. Furthermore, the gesture-speech constructions conveyed similarity mappings based on shape, size, color, movement, all of which became dimensions of comparison in early 'X IS LIKE Y' constructions. Gesture-speech combinations expressing a similarity relation without *like* thus constituted the children's first attempts to build similarity mappings. But once the job was done – that is, once the child was able to produce the 'X IS LIKE Y' construction in speech – gesture-speech combinations of this sort disappeared.

In summary, our findings place gesture at the cutting edge of early language development. Gesture both preceded and served as the supporting context for oncoming changes in children' speech. Children in our study not only produced 'X IS LIKE Y' constructions in their speech at an earlier age than reported in previous research, but even this onset age seemed to underestimate children's abilities – children were able to use gesture and speech together to express similarity mappings without the word *like* well before they produced their first 'X IS LIKE Y' construction. Thus, at a point when children did not have the spoken language skills to express similarity mappings explicitly, gesture offered them an easy-to-use tool to convey such meanings. And the use of this tool is likely to have served as a stepping-stone for learning to convey similarity mappings entirely in speech.

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Notes

1. Communicative acts are words or gestures, alone or in combination, which were preceded and followed by a pause, a change in conversational turn, or a change in intonational pattern.
2. The word *like* in children's speech became polysemous at age 2;2, functioning as a verb in some instances (e.g., *I like ice-cream*) and as a comparative marker in others (e.g., *ice-cream cone is like mushroom*). Beginning at age 2;6, a few children occasionally used *like* as a discourse marker. In this paper, we focus exclusively on the uses of *like* as a comparative marker.
3. The only exception was one child who produced one instance of such a construction at age 1;6.
4. Speech is provided in italics and any nonverbal information (e.g., gesture, communicative context) is given in small caps; the age of each child is indicated in brackets. Each example is followed by a gloss that approximates what the child is intending to convey in his/her communication.
5. The only exception was one child who produced one instance of the construction in a gesture-speech combination at age 1;6; this was the same child who also produced one instance of the construction in speech at age 1;6.
6. Children also produced several gesture-speech combinations that drew on a similarity-based comparison by using linguistic devices other than the word *like*. In these instances, gesture encoded the target domain of the mapping, and speech conveyed information about the source domain (e.g., *It is chocolate–**kind** of chocolate* + CHILD HOLDS UP BROWN MARKER; ***Color is** an apple* + CHILD POINTS TO A GREEN BALLOON THAT LOOKS LIKE A GREEN APPLE). We first observed such instances at age 2;6, after the onset of the 'X IS LIKE Y' construction in children's speech.

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