The two faces of gesture

Language and thought

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Gesture is typically produced with speech, forming a fully integrated system with that speech. However, under unusual circumstances, gesture can be produced completely on its own — without speech. In these instances, gesture takes over the full burden of communication usually shared by the two modalities. What happens to gesture in these two very different contexts? One possibility is that there are no differences in the forms gesture takes in these two contexts — that gesture is gesture no matter what its function. But, in fact, that's not what we find. When gesture is produced on its own, it assumes the full burden of communication and takes on a language-like form, with sentence-level ordering rules, word-level paradigms, and grammatical categories. In contrast, when gesture is produced in conjunction with speech, it shares the burden of communication with speech and takes on a global imagistic form, often conveying information not found anywhere in speech. Gesture thus changes its form according to its function.

Keywords: gesture with speech, gesture without speech, language-like-gesture, global imagistic gesture, sign language

When people talk, they gesture. Indeed, it is almost impossible for people to talk naturally without gesturing. When gesture is produced along with speech, it forms an integrated system with that speech, sharing with it the burden of communication. However, there are other situations in which gesture is produced on its own. In these contexts, gesture assumes the full burden of communication. For example, congenitally deaf children whose profound hearing losses prevent them from acquiring the spoken language that surrounds them cannot use speech to communicate. If, in addition, these children are not exposed to a conventional sign language, they are also unable to use conventional

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sign to communicate. Spontaneously created gesture is the only accessible means of communicating that these children have, and they use it.

What form does gesture assume in these two very different contexts? One might guess that gesture would assume the same form when produced with speech and without it. But this guess would be wrong. In fact, gesture looks quite different when it shares the burden of communication with speech, compared to when it assumes the full burden of communication on its own. When produced along with speech, gesture is framed by that speech. It takes on a global and holistic form that is interpretable only within the framing that speech provides. In contrast, when produced on its own, gesture assumes the discrete and segmented form characteristic of all linguistic systems. It becomes language-like. Thus, gesture changes its form as it changes its context and its function.

Gesture without speech

Background on deafness and language-learning

When deaf children are exposed to sign language from birth, they learn that language as naturally as hearing children learn spoken language (Newport & Meier, 1985). However, 90% of deaf children are not born to deaf parents who could provide early access to sign language. Rather, they are born to hearing parents who, quite naturally, expose their children to speech. Unfortunately, it is extremely uncommon for deaf children with severe to profound hearing losses to acquire spoken language without intensive and specialized instruction. Even with instruction, their acquisition of speech is markedly delayed (Conrad, 1977; Mayberry, 1992).

We have studied ten children whose severe hearing losses prevented them from acquiring spoken language naturally. Moreover, their parents had decided to educate them in oral schools where sign systems are neither taught nor encouraged (Goldin-Meadow, 2003a). At the time of our observations, the children ranged in age from 1;2 to 4;10 (years;months) and had made little progress in oral language, occasionally producing single recognizable words but never combining those words into sentences. In addition, they had not been exposed to a conventional sign system of any sort (e.g., American Sign Language or a manual code of English). The children thus knew neither sign nor speech.

Sentence level structure: syntax

All of the children used gesture without speech to communicate with the hearing individuals in their worlds. Moreover, all of the children combined their gestures into strings. For example, one child combined a point at a grape with an "eat" gesture to comment on the fact that grapes can be eaten, and then later combined the "eat" gesture with a point at the experimenter to invite her to lunch.

Moreover, the gesture strings that the deaf children produced functioned in a number of respects like the sentences of early child language. On this basis, these strings warrant the label "sentence." The children produced gesture sentences characterized by two types of *surface regularities:* (1) regularities in the production and deletion of elements in a sentence, and (2) regularities in the position within the sentence that those elements occupied.

As an example of the first type of surface regularity, although the children rarely produced gestures for all of the possible thematic roles that could be conveyed within a proposition, they were not haphazard in their selection of which roles to convey in gesture and which to omit. For example, the children were equally likely to produce gestures for the *intransitive actor* (e.g., the mouse in a sentence describing a mouse running to his hole) as for the *patient* (e.g., the cheese in a sentence describing a mouse eating cheese), and were far more likely to produce either of these than gestures for the *transitive actor* (e.g., the mouse in a sentence describing a mouse eating cheese) (Goldin-Meadow & Mylander, 1984). In this way, the likelihood of production served to systematically distinguish among thematic roles and thus mark those roles, an important function of grammatical devices. It is also worth noting that the particular pattern found in the deaf children's gestures — patients and intransitive actors marked in the same way and both different from transitive actors — is an analogue of a structural case-marking pattern found in naturally occurring human languages, ergative languages (cf. Dixon, 1979; Silverstein, 1976).

As an example of the second type of surface regularity, the children distinguished among the thematic roles they did express by placing the gesture for a given role in a particular position in a gesture sentence; that is, the gestures the children produced within their sentences were not produced in haphazard sequence but rather appeared to follow a small set of gesture order regularities (Goldin-Meadow & Mylander, 1984). For example, in a sentence commenting on the child's intention to throw a toy grape, the child first produced a gesture for the grape, the *patient* (typically a pointing gesture at the grape but, at times, an iconic gesture for the grape) before producing a gesture for the *act* "throw" (an iconic gesture). In general, the gesture for the object playing a patient role tended to *precede* the gesture for the act. As a second example of a gesture order, gestures for an object playing the role of recipient or goal tended to *follow* gestures for the act; e.g., in a sentence used to request that an object be moved to a puzzle, the child produced a gesture for the *act* "transfer" (an iconic gesture) before producing a gesture for the *recipient*, "puzzle" (a pointing gesture).

In addition to these regularities at the surface level, the children's gesture sentences were organized at *underlying levels*. Each sentence expressed one or more frames composed of a predicate and 1, 2, or 3 arguments (Goldin-Meadow, 1985: 215–219; Feldman, Goldin-Meadow, & Gleitman, 1978: 385–388). For example, all of the children produced "transfer" or "give" predicates with an inferred frame containing 3 arguments — the actor, patient, and recipient (e.g., *you/sister* give *duck* to *her/Susan*). The children also produced two types of 2-argument predicates: transitive predicates such as "drink" with a frame containing the actor and patient (e.g., *you/Susan* drink *coffee*), and intransitive predicates such as "go" with a frame containing the actor and recipient (e.g., *I/child* go *downstairs*). Finally, the children produced predicates such as "sleep" or "dance" with a 1-argument frame containing only the actor (e.g., *he/father* sleep).

The children frequently concatenated more than one predicate frame within the bounds of a single sentence — that is, they produced complex as opposed to simple sentences, thus demonstrating the important property of recursion in their gesture systems (e.g., a "climb" gesture, followed by a "sleep" gesture, followed by a point at a horse, to comment on the fact that the horse in a picture climbed up the house and then slept). Recursion gives language its generative capacity and is found in all natural language systems. Importantly, when the children concatenated more than one predicate frame within a single sentence, they did so systematically, allocating one "slot" in underlying structure to the arguments and predicates playing a role in both frames (e.g., 'he/horse' is assigned only one slot in underlying structure in the above sentence in which the horse played the actor role in both of the predicates of the concatenated frames, '*he/horse* climbs and sleeps'; Goldin-Meadow, 1982).

Thus, the deaf children conjoined the gestures they produced into sentences characterized by surface regularties (regularities in likelihood of production and deletion and in gesture order), as well as regularities at underlying levels (predicate frames underlying each simple and complex gesture sentence). The gesture strings could therefore be said to conform to a syntax, albeit a simple one.

Word level structure: morphology

The deaf children's gestures not only formed parts of longer sentence-units but they themselves were made up of smaller parts. For example, to request the experimenter to lay a penny down flat on a toy, one deaf child produced a downward motion with his hand shaped like an O. In itself this could be a global gesture presenting the shape and trajectory as an unanalyzed whole. The experimenter pretended not to understand and, after several repetitions, the child factored the gesture into its components: first he statically held up the gesture for a round object (the O handshape) and then, quite deliberately and with his hand no longer in the O shape but exhibiting a flat palm, made the trajectory for downward movement. The original gesture was thus decomposed into two elements. This example hints at the presence of a system of linguistic segments in which the complex meaning of "round-thing-moving-downward" is broken into components and the components combined into a gesture. Although the experimenter's feigned lack of understanding was undoubtedly important in getting the child to decompose his gesture at that particular moment, the important point is that when the child did break his gesture into parts, those parts were elements of a wider system — one that accounted for virtually all of the gestures that this child produced.

The child had thus devised a morphological system in which each gesture was a complex of simpler elements (Goldin-Meadow & Mylander, 1990; see also Singleton, Morford, & Goldin-Meadow, 1993). As an example of how this child's gestures formed a system of contrasts, a *CMedium* handshape (the hand shaped in a C with the fingers 1–3 inches from the thumb) meant 'handle an object 2–3 inches wide,' and a *Revolve* motion meant 'rotate around an axis'. When combined, these two components created a gesture whose meaning was a composite of the two meanings — 'rotate an object 2–3 inches wide' (e.g., twist a jar lid). When the same *CMedium* handshape was combined with a different motion, a *Short Arc* (meaning 'reposition'), the resulting combination had a predictably different meaning — 'change the position of an object 2–3 inches wide' (e.g., tilt a cup). As a result, the child's gestures can be said to conform to a framework or system of contrasts.

We have analyzed the gesture systems of four deaf children at this level (Goldin-Meadow, Mylander, & Butcher, 1995), and found that all four produced gestures that could be characterized by paradigms of handshape and motion combinations. Thus, each child:

- used a limited set of discrete handshape and motion forms, that is, the forms were categorical rather than continuous;
- consistently associated each handshape or motion form with a particular meaning (or set of meanings) throughout the corpus, that is, each form was meaningful;
- produced most of the handshapes with more than one motion, and most of the motions with more than one handshape, that is, each handshape and motion was an independent and meaningful morpheme that could combine with other morphemes in the system to create larger meaningful units — the system was combinatorial.

Although similar in many respects, the gesture systems produced by these four children were sufficiently different to suggest that the children had introduced relatively arbitrary — albeit still iconic — distinctions into their systems. For example, in contrast to the first child and one other who used the *CMedium* handshape to represent objects 2–3 inches in width (e.g., a cup or a box), the two other children used the same *CMedium* handshape to represent objects that were slightly smaller, 1–2 inches in width (e.g., a banana or a toy soldier, Goldin-Meadow et al., 1995). The fact that there were differences in the ways the children defined a particular morpheme suggests that there were choices to be made (although all of the choices still were transparent with respect to their referents). Moreover, the choices that a given child made could not be determined without knowing that child's individual system. In other words, we cannot predict the precise boundaries of a child's morphemes without knowing that child's individual system. In this sense the deaf children's gesture systems can be said to be *arbitrary*.

Grammatical categories

Do the deaf children have the category 'noun' and, if so, does it contrast grammatically with the categories 'verb' and 'adjective'? To address this question, we examined all of the iconic gestures that one deaf child produced over a two-year period (Goldin-Meadow, Butcher, Mylander, & Dodge, 1994). We identified iconic gestures used to focus attention on the discourse topic as *nouns*, and iconic gestures used to comment on that topic as predicates — *verbs* if the particular comment described an action, *adjectives* if it described an attribute. We found that gestures playing noun-like roles were distinguished from those playing verb-like roles in two ways — by the form of the gesture (akin to a morphological marking), and by its position in a gesture sentence (akin to a syntactic marking). The distinction between nouns and verbs is most strikingly seen in gestures used in both roles. For example, if the child used a "twist" gesture to focus attention on a jar as the discourse topic (i.e., as a noun), the gesture was likely to be abbreviated in form (one twist of the hand rather than several — an alteration internal to the gesture and therefore a morphological marking) and not inflected, and was likely to *precede* a deictic pointing gesture at the jar (a relation across gestures and therefore a syntactic marking). If, on another occasion, that same stem "twist" was used to say something about the jar (i.e., as a verb), the gesture was likely to be inflected in form (produced in a space near the jar, the patient of this particular predicate, rather than in neutral space — a morphological marking) and not abbreviated, and was likely to *follow* a deictic pointing gesture at the jar (a syntactic marking).

While all languages distinguish nouns and verbs, only certain languages make a further distinction between nouns and verbs and a third class, the class of adjectives (Schachter, 1985). We found that, in the deaf child's system, gestures used as adjectives were treated like nouns with respect to morphology (i.e., adjectives tended to be abbreviated but not inflected), but like verbs with respect to syntax (i.e., adjectives tended to follow pointing gestures rather than precede them). The deaf child's adjective gestures consequently appear to behave as adjectives do in natural languages — sharing some morpho-syntactic properties with nouns and others with verbs (cf. Thompson, 1988). Maintaining a distinction between nouns, verbs, and adjectives thus appears to be a property of gestures when they assume the full burden of communication.

Where does this language-like structure come from?

The deaf children are inventing their gesture systems without input from a conventional language model. They are not, however, inventing their gesture systems in a vacuum. Like all speakers (Goldin-Meadow, 2003b), the children's hearing parents gesture when they talk, and the deaf children have access to those gestures. The children could be modeling their gesture systems after the gestures that their parents produce. Although perfectly reasonable, this hypothesis is incorrect. When we analyze the hearing parents' gestures with the same tools that we use to analyze the deaf children's gestures, we find that the two sets of gestures have little in common.

Beginning with sentence level structure, we analyzed the gestures that the hearing mothers of six of our deaf children produced as they talked to their children, looking for production probability and gesture order patterns

(Goldin-Meadow & Mylander, 1983, 1998). We found that the mothers rarely combined their gestures with other gestures and thus rarely produced gesture "sentences". Moreover, the few gesture sentences that they did produce patterned differently, in terms of both production probability and gesture order, from their children's gestures. Unlike the deaf children, all of whom displayed the same pattern across both devices (production probability and gesture order), the mothers showed no uniformity, either across individuals or across devices within an individual. In addition, the mothers began using recursion in their gesture sentences *after* their children and used it significantly less often than their children.

To examine word level structure, we analyzed the gestures that the hearing mothers of four of our deaf children produced (Goldin-Meadow et al., 1995) and found that, here again, the mothers' gestures were quite distinct from their children's. Each mother used her gestures in a more restricted way than her child, omitting many of the morphemes that the child produced (or using the ones she did produce more narrowly than the child), and omitting completely many of the handshape/motion combinations that the child produced. In addition, while there was good evidence that the gestures of each deaf child could be characterized in terms of handshape and motion components which mapped onto a variety of related objects and a variety of related actions, respectively, there was no evidence that the mothers ever went beyond mapping gestures as wholes onto entire events — that is, the mother's gestures did not appear to be organized in relation to one another to form a system of contrasts. Finally, when the mothers' gestures were analyzed with the same procedures used to analyze the children's gestures (that is, when the mother's gestures were treated as a system unto itself), the resulting systems for each mother did not capture her child's gestures well at all. Most importantly, the arbitrary differences that were found across the children's systems could *not* be traced to the mothers' gestures, but seemed instead to be shaped by the early gestures that the children themselves created. In other words, the differences could be traced to the gestural input that the children provided for themselves rather than to gestural input that their mothers provided for them.

Finally, we found that the mother of the deaf child who distinguished among nouns, verbs, and adjectives did not use the same morphological and syntactic devices in her gestures that her child used in his to make these distinctions (Goldin-Meadow et al., 1994). Indeed, certain of the devices that the child used to distinguish these categories (abbreviation and gesture order) either were not used at all or were not used distinctively by mother. These devices were therefore likely to have been initiated by the child. The child's third device (inflection) was used by mother; however, the child's inflections patterned systematically with the predicate structure of the verb and consistently marked entities playing particular thematic roles in those predicates — that is, they functioned as part of a system — while mother's did not. Thus, while the child may have used the gestural input his mother provided as a starting point for part of his system, he went well beyond that input — fashioning it into an integral component of the system and grammaticizing it as he did so.

Two points are worth noting. First, the mothers' gestures could not have served as a model for the structure found in their children's gestures. Second, the deaf children's gestures were not forced by the modality to assume sentence and word level structure — the mothers' gestures were also produced in the manual modality yet they did *not* assume language-like forms at these levels.

I suggest that the mothers' gestures appear random and without structure only because we have examined them through the wrong lens. These gestures were produced along with speech and were meant to be interpreted in the context of speech. Constrained by the speech with which they co-occurred, the mothers' gestures were not at liberty to assume the language-like form that characterized their children's gestures (cf. Goldin-Meadow, McNeill, & Singleton, 1996). They assumed instead the form that all speech-occurring gestures take on. We look next at the gesture that accompanies speech in the way it was meant to be seen — with speech.

Gesture with speech

Gesture and speech form an integrated system

Gesture is pervasive. It occurs with speech in all contexts and, importantly, it is not just hand-waving. Unlike the deaf children's gestures which resemble beads on a string, the gestures that hearing speakers produce along with their talk are global and synthetic in form (McNeill, 1992). For example, a deaf child might point at a jar and then, with a C-shaped hand, produce a twisting motion several times in the direction of the jar to comment on jar-opening. A hearing speaker, by contrast, would be more likely to loosely rotate a floppy hand several times in front of the body while saying the word "open". Nevertheless, and despite their less well-articulated handshapes and motions, the gestures that accompany speech do convey substantive meaning (Clark, 1996; Goldin-Meadow et al., 1996; Kendon, 1980; McNeill, 1992).

Gestures are integrated both semantically and temporally with the speech they accompany (McNeill, 1992). In the next sections, I focus on one compelling aspect of the gesture-speech relationship — the fact that gesture reflects the cognitive state of the speaker (Goldin-Meadow, 2003b). I argue that gesture can provide a unique perspective on that state, one that is not reflected in speech.

Gesture offers a unique perspective on the cognitive state of the speaker

I begin with an example. Consider a child asked to justify his responses to a Piagetian conservation task. The child is shown two rows, each containing six checkers and is asked to verify that the rows have the same number of checkers. The experimenter then spreads the checkers in one of the rows out, and again asks whether the rows have the same or a different number of checkers. The child says "different." To justify his belief that the number of checkers has changed, the child indicates in speech that "you moved them." However, he does *not* refer to moving the checkers in gesture. Rather, he uses a pointing gesture to pair the first checker in one row with the first checker in the other, the second with the second, and so on. In other words, he indicates the one-to-one correspondence between the checkers in the two rows *in gesture*, while at the same time describing how the experimenter moved the checkers *in speech*. The child has produced a gesture-speech mismatch — he has conveyed information in gesture that is different from the information he conveyed in speech.

Gesture-speech mismatch is a widespread phenomenon. It occurs in many cognitive tasks and over a large age range: in toddlers experiencing vocabulary spurts (Gershkoff-Stowe & Smith, 1997); preschoolers explaining games (Evans & Rubin, 1979); elementary school children explaining mathematical equations (Perry, Church, & Goldin-Meadow, 1988) and seasonal change (Crowder & Newman, 1993); children and adults discussing moral dilemmas (Church et al., 1995); adolescents explaining Piagetian bending-rods tasks (Stone, Webb, & Mahootian, 1991); and adults explaining gears (Perry & Elder, 1996; Schwartz & Black, 1996) and problems involving constant change (Alibali et al., 1999).

In addition to being pervasive, mismatches can be uniquely informative. We examined the problem-solving strategies fourth grade children gave when explaining their solutions to math problems of the following type, 4+5+3=__ +3 (Goldin-Meadow, Alibali, & Church, 1993). If a child produced a strategy for solving the problem *only* in gesture across all six problems, that strategy was assigned to the "gesture only" repertoire. If, however, the child also produced that strategy in speech at some point over the six problems, it was assigned to the "speech+gesture" repertoire. We followed the same criteria in assigning strategies to the "speech only" repertoire.

The children varied in the number of gesture-speech mismatches they produced on the math task. Moreover, the children who produced many mismatches on the task had much larger gesture-only repertoires than those who produced few. But the two groups did not differ in their speech+gesture or speech-only repertoires. What this means is that mismatchers had a larger number of different strategies for solving the task at their disposal than matchers, and that all of the "extra" strategies could be found *only* in gesture. If we want to know what mismatchers understand about a task, we cannot just listen to them — we have to look at them too.

Thus, gesture can convey information that is not found *anywhere* in the speaker's verbal repertoire. In addition, as I show in the next three sections, the relation between gesture and speech can provide insight into how speakers learn, solve problems and remember.

Gesture can predict who will learn

To explore whether the relation between gesture and speech predicts who will profit from instruction, we took children who failed initially on either a math task (Perry et al., 1988) or a conservation task (Church & Goldin-Meadow, 1986). We first asked the children how they solved the problems on the task and, on the basis of their explanations, classified the children into those who produced many mismatches and those who produced few. We then gave all of the children instruction in how to solve the math or conservation task, followed by yet another test of their knowledge. We found that, on both the math and conservation tasks, children who produced many mismatches during their initial explanations were far more likely to show significant gains on the follow-up test after instruction than children who produced few mismatches (see also Pine, Lufkin, & Messer, 2004, who replicated the phenomenon on a balancing task).

Why might children who produce many mismatches be more ready to learn than children who produce few? As described in the previous section, children who mismatch often on a task have more substantive knowledge about that task than children who mismatch less often. However, all of this additional knowledge is accessible only to gesture and not to speech. Thus, the extra knowledge cannot be explicitly articulated and cannot be integrated into the child's framework for solving the problem. Mismatchers have the pieces in place to make progress on a task, but have not yet pulled those pieces together. Instruction provides the impetus and perhaps the framework for reorganizing the pieces, and leads to success on the task. The mismatch between gesture and speech allows us to tell, before the fact, who will profit from instruction and who will not.

Gesture can predict how a problem will be solved

To explore whether an adult's gestures predict how that adult will solve a problem, we gave adults a series of word problems of the following sort: "A bookcase has six shelves; the number of books on each successive shelf increases by a constant number. If there are 15 books on the top shelf and 45 on the bottom, how many books total are there?" This problem can be solved in one of two ways — in terms of discrete units of books added, or in terms of a continuous rate of books added. Discrete verbal descriptions are typically accompanied by short, choppy, step-like gestures, i.e., iterations of discrete movements. Continuous verbal descriptions are typically accompanied by longer, more flowing gestures, i.e., smooth curving movements. We ask the adults, first, to restate the problem for us and, then, to describe how they would go about solving the problem. We then attempted to predict how speakers would solve the problem as a function of the gestures and speech that they produced in their initial problem descriptions (Alibali et al., 1999).

When we looked at the initial descriptions adults gave of the problems, we found that they often produced gestures that reinforced their verbal descriptions, i.e., they produced discrete gestures along with discrete verbal descriptions, and continuous gestures along with continuous verbal descriptions. However, at times, the speakers' gestures either were neutral with respect to the verbal description they accompanied (neither discrete nor continuous), or they conflicted with the verbal description (discrete gestures with a continuous verbal description, or continuous gestures with a discrete verbal description).

Interestingly, the strategy speakers said they would use to solve the problem was much more likely to match the verbal strategy they used in their initial description of that problem when their gestures also conveyed this same strategy. For example, speakers were significantly more likely to say that they would solve the problem using a discrete strategy if their speech and gestures in their initial problem descriptions were both discrete than if their gestures were continuous (or neutral) and their speech was discrete. It is very likely that the adults were completely unaware of the conflicting information that they displayed in gesture in their initial description of the problem. Nonetheless, these unacknowledged difficult-to-integrate pieces of information appeared to have an impact on the adults' plans for solving the problem. And, once again, we would not have had access to these plans had we not looked at the speakers while we listened to them.

Gesture can lighten cognitive load and thus improve memory

To explore whether gesturing can affect how much a speaker will remember, we asked adults and children to remember a list of words (for the children) or letters (for the adults) while explaining their answers to a math problem (Goldin-Meadow, Nusbaum, Kelly, & Wagner, 2001). The children and adults did their explaining under two conditions — on half the problems, they were allowed to move their hands freely; on the other half, they were asked to keep their hands still on the table (gesture *per se* was not mentioned at any time during the study).

A priori we might expect gesturing to add to a speaker's cognitive load. After all, a speaker who is producing gestures while talking must coordinate the two modalities; doing two things at once, in principle, ought to take more cognitive effort than doing only one. If so, speakers should remember *fewer* words when they gestured on their explanations than when they did not gesture. If, however, gesture and speech form a synergistic system in which effort expended in one modality reduces effort expended overall, speakers should remember *more* words when they gestured on their explanations that when they did not gesture.

We found that both children and adults remembered more words when they gestured than when they did not gesture, suggesting that gesturing can actually lighten a speaker's cognitive load. It is possible, however, that rather than gesturing lightening the load, being told to keep one's hands still is adding to the load. Our data provided us with a simple way of addressing this concern. Some of the adults and children did not gesture on all of the problems that they explained when their hands were free. Thus, for these speakers, we effectively had three conditions: gesture by choice, no gesture by choice, and no gesture by instruction. If the instructions themselves are creating a cognitive load for the speakers, speakers should remember significantly fewer words when told not to gesture than when they spontaneously chose not to gesture. However, this is not the pattern we found. Adults and children remembered the same number of words whether they were told not to gesture or chose by themselves not to gesture, and this number was significantly smaller than the number of words they remembered when they chose to gesture.

Perhaps counter intuitively, gesturing appears to *save* cognitive resources, resources that can then be allocated to another task (e.g., a memory task). Thus, gesturing may not only reflect a speaker's cognitive state but, in reducing cognitive load, it may also play a role in shaping that state.

The two faces of gesture

Gesture is chameleon-like in its form. Moreover, the form gesture assumes appears to be tied to the function it serves. When gesture assumes the full burden of communication, acting on its own without speech, it takes on a language-like form. It has sentence-level structure, word-level paradigms, and grammatical categories — all forms that are *not* found when gesture is produced along with speech.

When gesture shares the burden of communication with speech, it loses its language-like structure, assuming instead a global and synthetic form. Although not language-like in structure when it accompanies speech, gesture stills forms an important part of language. It conveys information imagistically and, as such, has access to different information than does the verbal system. Gesture thus allows speakers to convey thoughts that may not easily fit into the categorical system that their conventional language offers (Goldin-Meadow & McNeill, 1999). Gesture therefore offers us a window into the mind that is distinct from the window that speech offers. Indeed, it is only by looking at *both* gesture and speech that we can predict how people learn, remember, and solve problems. Although not language-like in form, gesture is nevertheless an integral part of language, cropping up whenever there is talk. As language researchers, we cannot afford to ignore it.

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