to externalize ideas may be what is behind our propensity to use space in thinking wherever we can (witness the ubiquity of spatial metaphor in language). Even without visual diagrams, we are still using "internal imaging processes" in order to access the inferential affordances of visuospatial representation (Larkin and Simon 1987:92). Larkin and Simon (p. 97) speculate "that mental images play a role in problem solving quite analogous to the role played by external diagrams (and that this role is also played in the two memories, internal and external, in concert)." Is the task of verbalization a matter of constructing a linear version of our two- and three-dimensional thoughts? Or, in producing gestures, are we transforming our one-dimensional thoughts by giving them visuospatial properties? Larkin and Simon (p. 72) describe what happens when they give their experimental subjects a complex physics problem. "Everyone we've observed reaches for pencil and paper, and draws a sketch of the situation." Ordinary people trying to communicate their thoughts do much the same thing, not reaching for pencil and paper but sketching with bare hands in mid-air. As Efron wrote in his classic work *Gesture, Race, and Culture,* gestural behavior during speech is "an intrinsic part of the thinking process" (1972 [1941]: 105). Gestures provide a primordial sketch pad for organizing thoughts and displaying them to others, a technology of both the intellect and the body, that supreme tool kit for overcoming our lack of telepathy.

Being context-bound and evanescent, sequences of gestures do not allow the "reflection" that Goody (1977: 109) has identified as such a special affordance of written language and its relatives, but the case for a unique influence of representations in the *printed* modality may have been overstated. Oestermeier and Hesse (2000) show that with diagrammatic/graphical externalizations we can "transform abstract relationships into visible spatial ones, and thereby inspect and control argumentative and causal relationships" (p. 81). But they claim in addition that we can "thereby inspect and control argumentative and causal relationships *in a way completely unknown to illiterate societies*" (p. 81, emphasis added). The Lao data discussed here show that hand gestures can and do transform abstract relationships into visible spatial ones and, indeed, allow us to thereby inspect and control argumentative and causal relationships (cf. esp. Enfield 2003:17–30). Members of all societies, literate or not, make hand gestures while they speak. Do they all produce the kinds of diagrams these Lao-speakers produce when talking about kinship? The domain of kinship is just one among many which will yield fertile data in exploration of this little-charted territory: the body as cognitive artifact.

It is possible to view *all* of culture's visual products as cognitive artifacts, tools at the perceptual interface between individual cognizing minds and the social world they collectively construct and inhabit. Our bodies are not only loci of enculturation. They are important sources of information both for ourselves and for our social associates. With more detailed empirical ethnographic description of how the body reveals and conveys information in concert with speech, we stand to gain a deeper understanding of naturally occurring practices of multimodal representation. Hand gestures and other visible bodily signals provide rich resources for spatial representation of complex and abstract ideas in up to four dimensions (including that of time). They both facilitate and publicize the very organization of thought.

Comments

SUSAN GOLDIN-MEADOW
Committee on Human Development, University of Chicago, 5730 S. Woodlawn, Chicago, IL 60637, U.S.A. (sgm@uchicago.edu). 7 IX 04

If you give people a complex physics problem to solve, they instinctively reach for pencil and paper (Larkin and Simon 1987). What Enfield elegantly shows is that if you give people the task of describing their family relations—and don't offer them paper—they use their hands to sketch diagrams in the air. Gesture thus serves the same purpose as pencil and paper and, in this sense, constitutes a cognitive artifact. One speaker, for example, pointed at a location in front of him when talking about his wife, at a location above that point when referring to her older sister, and at a location below that point when referring to his own younger sibling and then used the grid established by his pointing gestures to explain that older siblings (above his wife on the grid) are not permitted to marry younger siblings (below his wife on the grid) but that two older siblings (both above) and two younger siblings (both below) can marry. The striking aspect of this example is that the grid isn't there. As listeners, we infer a diagram from the speaker's points at a series of locations, but, as with the emperor's new clothes, the diagram is only there because we believe it is—a compelling illustration of Enfield's thesis that gesture is a social communicative process, that gesture is "made public and publicly made." Gesture works well for communication because it allows speaker and listener to exploit the advantages of visual representation. For example, speech is good at giving the listener the sequential steps in an argument, and static diagram is good at displaying a map of the argument. But gesture facilitates both—it allows the speaker to place the steps in the argument on a spatial map and to walk the listener through those steps.

Gesture is useful not only for transferring information to a communication partner but also for easing the speaker's own cognitive burden. It would not be surprising if Enfield's consultants were to create kinship diagrams in the air with their hands even if asked to describe family relations to someone behind a screen or in another room—that is, to a nonvisible listener. Indeed, people often gesture when on the telephone, and even individuals who are blind from birth gesture when talking to both sighted and blind listeners (Iverson and Gol-

din-Meadow 1998). Gesture thus seems to be useful to speakers as well as listeners. In fact, if asked to remember a list of unrelated items while explaining their solutions to a math problem, speakers remember more items when they gesture along with their explanations than when they do not (Goldin-Meadow et al. 2001, Wagner, Nusbaum, and Goldin-Meadow 2004). Gesturing eases the cognitive burden of explanation.

Gesture is also of value to scientists. It offers an additional view of a speaker's thoughts, and, as many of Enfield's examples illustrate, those thoughts are often not conveyed in the speaker's words. In other words, gesture can provide a *unique* picture of a speaker's thoughts. Moreover, gesture may convey beliefs that are so deeply entrenched within a culture that they do not need to be expressed. For example, deaf children whose hearing losses prevent them from acquiring spoken language and whose hearing parents have not exposed them to a sign language create gestures to communicate with the hearing individuals in their worlds. Many of the properties of these gestures turn out to be the same across cultures (Goldin-Meadow and Mylander 1998), but the stories that the deaf children tell with them differ in culturally appropriate ways. Chinese deaf children of hearing parents produce gestural stories that have an evaluative tone comparable to the moralistic tone in verbal stories told in Chinese cultures (Miller, Fung, and Mintz 1996, Miller et al. 1997); no such tone is evident in the gestural stories that American deaf children of hearing parents produce (Phillips, Goldin-Meadow, and Miller 2001). The Chinese deaf children cannot hear the stories that their parents tell, but they are able to learn the evaluative tone from their parents' gestures—from emblems, gestures that can substitute for words and that vary across cultures (Ekman and Friesen 1969); for example, *shame* (index finger drawn diagonally down the cheek or forehead) and *bad* (pinkie shaken in the air). The moral message is instantiated in nonverbal as well as verbal practices in Chinese cultures. Some aspects of culture may be so important that they cannot be entrusted to a single medium.

As Enfield so beautifully illustrates, gesture is a window through which culture can be viewed. It is a tool that is there for the taking to facilitate not only communication but also everyday thinking and scientific discovery.

SPENCER KELLY
Psychology Department/Neuroscience Program, Colgate University, 13 Oak Dr., Hamilton, NY 13346, U.S.A. (skelly@mail.colgate.edu). 8 IX 04

Enfield's research takes an embodied perspective on the role that hand gestures play in linguistic representations of sociocultural knowledge. The work advances two hypotheses: (1) that gestures affect the way communicators conceptualize their own knowledge of kinship structures and (2) that gestures influence the way interlocutors understand those structures. My commentary will provide empirical psychological and neuroscience evidence for these claims.

Enfield uses McNeill's (1992) gesture-speech theory to argue that hand gestures are crucial to the verbal expression of kinship relationships. Although he touches upon experimental support for this claim, I will elaborate. Enfield briefly explains research demonstrating that gesture plays a special role in spatial memory processes when people verbally explain their understanding of conceptual problems (Goldin-Meadow et al. 2001). The study asked people to explain answers to math problems under conditions in which they were, and were not, allowed to gesture. The main finding was that when participants did gesture, they performed better on a secondary cognitive task (remembering lists of letters/words) than when they did not. One interpretation of these findings is that gesture freed up cognitive resources that people needed to explain their understanding of the problems. In much the same way, Enfield's participants may have used gesture to externalize information about kinship structures, thereby "offloading" the cognitive resources needed to conceptualize and verbally express that knowledge.

In addition to this psychological evidence, neuroscience researchers have argued that the brain is optimally designed to communicate with gesture and speech (for a review, see Kelly et al. 2002). For example, Binkofski and Buccino (2004) have demonstrated that Broca's area (located in the left posterior frontal lobe) is involved not only in language production but also in the production and comprehension of hand movements. This speech-gesture relationship has been observed in brain-damaged patients with language deficits. Hanlon, Brown, and Gerstman (1990) noted that patients with Broca's aphasia—a deficit involving problems with language production—performed better in a word-naming task when they produced hand gestures during the test. Gesture and speech are psychologically and neurologically linked, and therefore it may be their combination that allowed Enfield's participants to represent their complex knowledge about kinship relationships so eloquently.

In addition to language production, Enfield suggests that gestures help interlocutors *comprehend* kinship information. Although he provides no empirical evidence for it, this hypothesis is supported by several experiments in psychology and neuroscience. My research has demonstrated that interlocutors not only pay attention to gestures that naturally accompany speech (Kelly et al. 2002) but combine gesture and speech in a *synergistic fashion* when comprehending language (Kelly 2001, Kelly et al. 1999). For example, when someone says, "It's getting loud in here" while pointing to an open door to a noisy hall, most interlocutors integrate speech and gesture to understand the intended meaning: "Please close the door." Interestingly, interlocutors do not understand the intended meaning when they hear only speech or see only gesture. In this way, speech and gesture may *mutually disambiguate* one another. It would be interesting to investigate this phenomenon in people interacting with Enfield's participants. I wonder how much inter-