# Distributed Cognition and Gesture in Impromptu Teaching

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**Abstract:** On a beach in France, a lifeguard makes three unplanned attempts to teach a colleague how to find compass directions using a wristwatch and the sun. The lifeguard's challenge is how to represent the elements of this distributed system and their functional coordination such that the novice can learn to perform the task successfully. The lifeguard meets this challenge by using his hands, eyes, and body to build and link representations in four spaces: in the sand, in the surroundings, on a digital wristwatch (construed as analog), and in the air (gesture space). Our paper explores the roles of gesture, gaze, and bodily enactment in this instructional discourse, emphasizing a situated view of instruction and embodied view of teaching.

## Purpose

This paper examines aspects of distributed cognition and gesture (Williams 2013) in impromptu teaching in an outdoor work setting. Through micro-analysis of three short instructional attempts on a beach in France, the paper highlights the role of the hands, eyes, and body in guiding others to instantiate the functional systems through which cognitive activities are accomplished. The paper also explores the affordances of different media employed in the instruction and how gesture and gaze link representations in different spaces.

## Theoretical Framework: Distributed Cognition and Gesture Studies

Hutchins (1995) argues for a distributed view of human cognition, claiming that human cognitive activities are accomplished through coordinations of conceptual and material elements (sometimes involving multiple actors and technologies); he refers to these successful coordinations as "functional systems." Take, for example, the everyday activity of time-telling: here, the successful coordination of material and conceptual structure transforms a clock state into a time reading (Williams 2012). Cultural processes preserve the material artifacts, cognitive models, and bodily practices of conventional functional systems, and much of schooling is devoted to keeping these systems extant in our culture. The challenge of instruction is how to represent the elements and coordinations of a system in such a way that a learner can comprehend them and become able to instantiate the system in other times, places, and situations. Our claim is that in face-to-face instruction, a teacher uses his body—especially his hands and eyes—to create, highlight, and link representations of the material and conceptual elements of functional systems and to enact the process of bringing these elements into coordination to achieve the targeted outcome.

## Methods: Ethnography and Video Analysis

The data in this paper are taken from an ethnographic study of workplace gestures by the second author, who is a trained lifeguard and who participated for several years in the community of lifeguards under scrutiny before initiating the study. The impromptu teaching examined in this paper arose as a secondary activity during work on the beach and is unrelated to the primary activity of lifeguarding, which continued during the interaction.

The data were recorded on the beach at Anglet, in southwestern France, in July 2011 at about 1:45 p.m. In the video, the head lifeguard makes three attempts to teach a member of his team (the second author, who is recording the interaction) how to locate cardinal directions using an analog wristwatch and the position of the sun. Five minutes of video were transcribed and annotated using ELAN (from the Max Planck Institute for Psycholinguistics), with notations for speech in French and English translation, for actions and gestures, for representational spaces (where the actions and gestures were performed), and gaze direction. Each of the three instructional attempts was rendered as a series of annotated still images in order to analyze, step by step, the creation and coordination of representations in different spaces and the role of the hands, eyes, and body in these processes.

## Analysis: Functional System, Teaching Situation, and Instructional Attempts

### The Functional System: Using a Wristwatch and the Sun to Find Compass Directions

Figure 1 depicts the functional system the lifeguard is trying to teach (from "Use your wristwatch as a compass" at lifehacker.com). The directions on the lifehacker website are simple: "Hold a watch with 12 o'clock at left. Move your arm so the hour hand points at the sun. The spot halfway between the hour hand and the 12 is

south." During Daylight Saving Time, find the spot halfway between the hour hand and 1. This system works in the northern hemisphere when the sun is visible and an analog wristwatch is present. Once south is fixed, the user can use a mental model of the compass rose to locate north, east, and west. In our data (collected during the summer), the head lifeguard finds the spot halfway between the hour hand and 2 because Anglet, while slightly west of the Greenwich Meridian (UTC), is on Central European time (UTC+1).

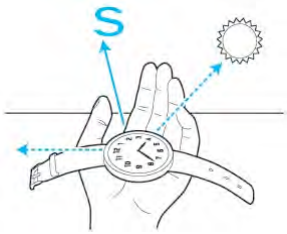


Figure 1. Using a Wristwatch to Find South.

### The Teaching Situation: On the Beach

In the video, the head lifeguard is trying to teach another lifeguard how to find south using this system, while a third lifeguard watches. The sun is visible, but it is early afternoon, and the sun is so close to the reference position that there is no angle to bisect. Upon discovering this problem, the lifeguard attempts to alleviate it by introducing a hypothetical time, complicating the scenario. The lifeguard is also wearing a digital wristwatch, so he must act as if his watch were analog, a further complication. Finally, there are no traditional drawing or writing tools at hand. Given these limitations, the lifeguard must represent the elements of the system and the process of bringing them into coordination to locate south, and he must do so in such a way that the novice can understand the system and learn to use it successfully. In this case, he must do all this while simultaneously monitoring the swim zone, his primary work task.

### First Attempt: Sand and Surroundings

The first attempt at instruction is rendered in Figure 2 below (adapted from Williams & Harrison 2012), with representational spaces coded by color: sand in blue, surroundings in green, digital watch in lavender, and air in front of the speaker's body (gesture space) in red. Speech is rendered as text in English (translated from French), and actions are indicated by arrows in the images. The first attempt involves the construction of a diagram in the sand, gestural enactments over the diagram, and coordinated gesture and gaze shifts to link the represented elements to the geographic surroundings.

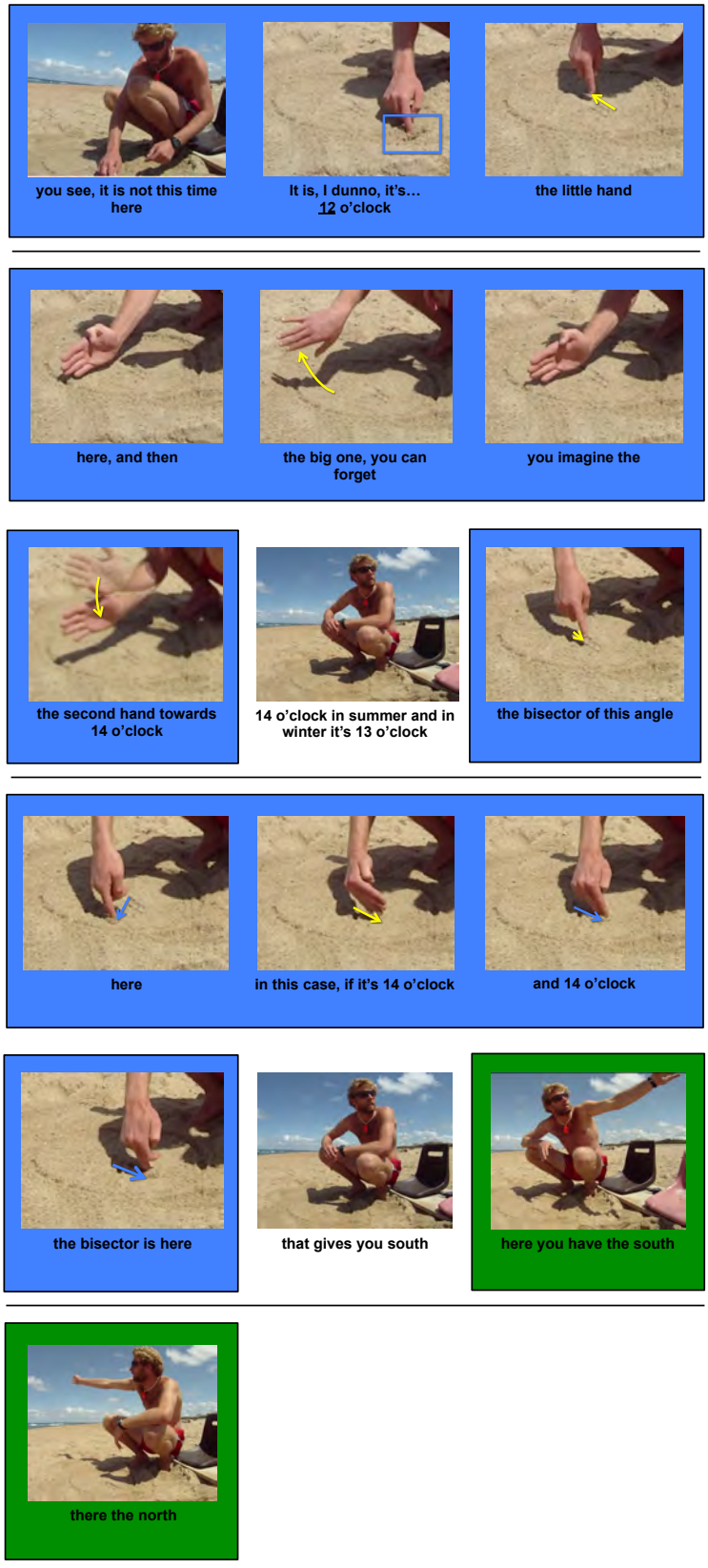


Figure 2. The First Attempt.

### Second Attempt: Sand, Digital Watch, and Air (Gesture Space)

The second attempt is rendered in Figure 3 below. Most of the instructional gestures are enacted over the diagram in the sand or the digital watch (construed as analog), with only a brief interlude of depictive gesture in

the speaker's personal gesture space, first to establish a virtual structure (a clock face) and then to model an object (the hour hand) in relation to it.

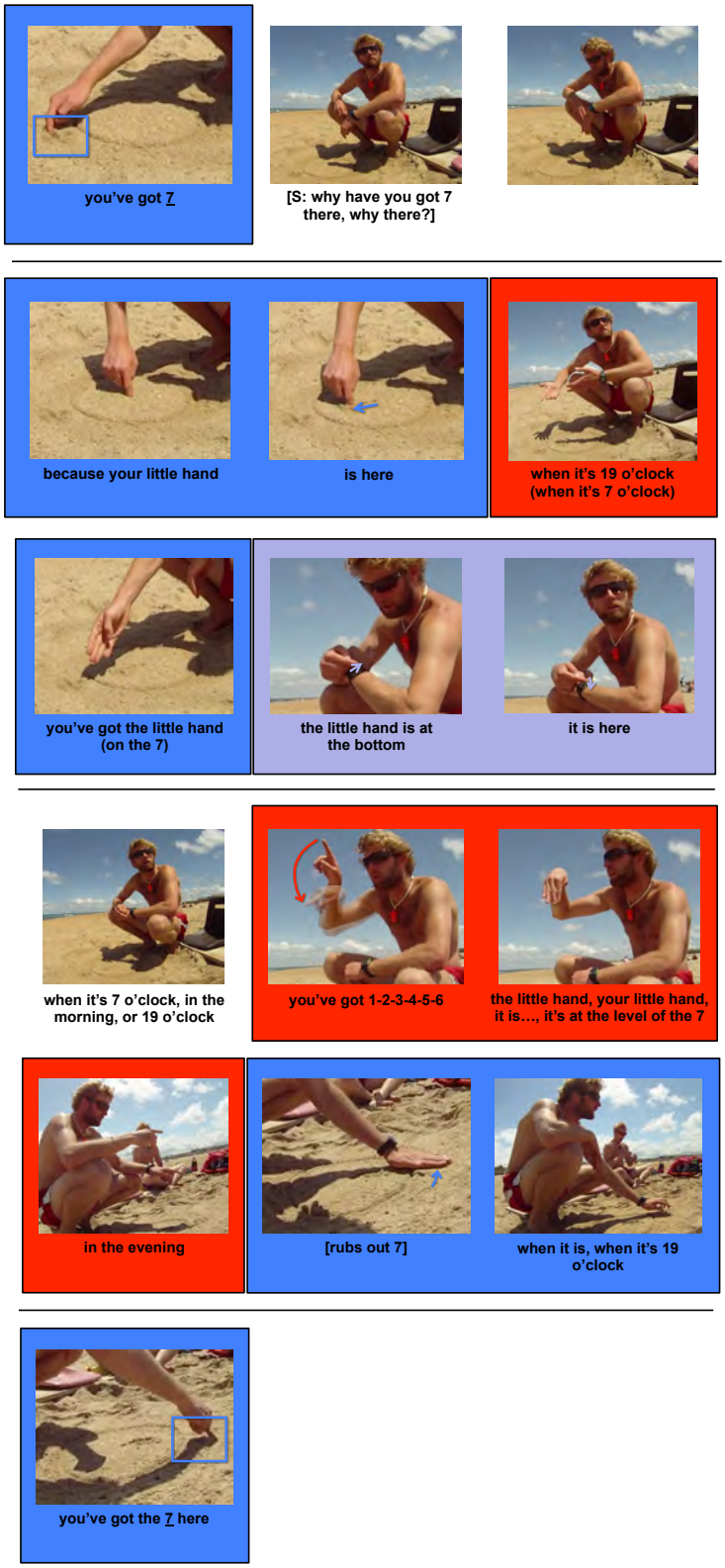


Figure 3. The Second Attempt.

### Third Attempt: Watch, Surroundings, and Enactment

The third attempt is rendered in Figure 4 below. It includes a full-body enactment of the process of rotating the watch to align the hour hand with the sun. The speaker then removes his watch and holds it with his left hand while gesturing over it with his right, and he uses shifting gaze and gestures that move beyond the watch face to link represented structure to locations in the surroundings.

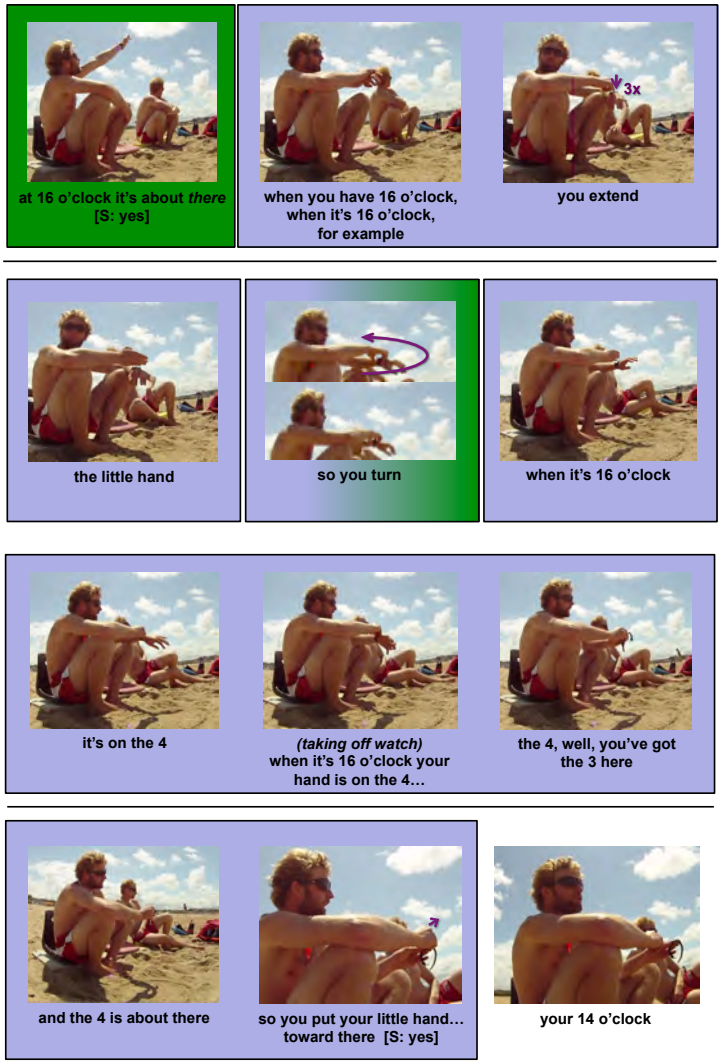


Figure 4. The Third Attempt.

## Discussion

In his instructional discourse, the lifeguard constructs representations in four different spaces: in the sand, in the surrounding environment, on top of his digital wristwatch (construed as analog), and, most briefly, in the air in front of his body (gesture space). Each of these has different affordances. The sand is inscribable and durable (for the duration of instruction) but immobile. Here the lifeguard can create a partial diagram of the analog watch at a scale for ready perception and action (Latour 1986), and he can annotate it and gesture over it, but he cannot rotate the diagram to show the action of aligning the hour hand to the sun. The surroundings are fixed and circumscribe the area of action; while their half-sphere of sky and horizon is essential for locating the sun and linking south to the visible geography, they cannot be manipulated and can be referenced only at a distance. The digital wristwatch is easily repositionable and in the third attempt is removed from the wrist to facilitate its use as a representational tool, but it is so small that gestures over the watch are hard to see, and they must be interpreted in relation to the imagined structure of an analog watch face. Finally, the air in front of the speaker's body—his personal gesture space—is readily available and conventionally understood as a locus for depicting objects with the hands, but the durability of representations is restricted to gesture holds and the listener's ability to keep the image or locus of a completed gesture in mind during the ensuing discourse. The speaker also treats this space as having a vertical orientation, so the clock face depicted there would have to be reoriented and rotated to be incorporated into the system being described.

In his three attempts at instruction, the lifeguard shifts multiple times between these representational spaces. The data suggest that he begins in a space that affords representation of the focal element of the discourse (so, for example, he begins drawing in the sand to create a durable clock representation to which he can refer and with which subsequent gestures can "couple" [Goodwin 2007]) but then switches to a new space when he encounters a limitation (for example, switching from the sand to the watch when he wants to show how to rotate the watch to align the hour hand with the sun). Analogous structure in different spaces is linked by repeated gesture forms or recurring handshapes (such as the palm-left handshape used to represent the hour hand) accompanied by repeated verbal labels, or by gestures that cross space boundaries (such as the palm-left hand sweeping from the watch into the air to point toward a location in the surroundings). Gaze is used to secure the addressee's attention or seek signs of understanding (through conventional eye contact), to model attention to the representation in focus (as when the speaker gazes at his own gesturing hands), and to shift attention from one space to another (as when shifting gaze from the sand to the surroundings).

In stark contrast to the conversational and narrative gestures studied by Kendon (2004) and McNeill (1992), the instructional gestures that appear in our data occur primarily in relation to representational structure in material spaces (sand, surroundings, watch), with only a single momentary use of depictive gesture in the space in front of the speaker. And at only one point (in the third attempt) does the speaker briefly shift his gestures from observer viewpoint (modeling objects in front of him) to character viewpoint (inhabiting the space being represented) in order to perform a full-body enactment of the process of bringing the hour hand into alignment with the sun. We predict that instructional discourse will be characterized by greater proportions of environmentally coupled gestures and depictive gestures with observer viewpoint (with speakers more likely to attend to their own gestures) in comparison with gestures in ordinary conversation. Instructional discourse appears to be inherently multimodal.

## Conclusion

Activities as basic as direction-finding and time-telling rely upon situated ways of perceiving and acting that coordinate conceptual and material elements into distributed cognitive functional systems. The challenge for instructional discourse is twofold: how to represent the visible (material) and invisible (conceptual) elements of these systems as well as the processes of bringing them into coordination such that novices grasp the meaning and learn to perform the coordinative actions correctly on their own. Here the affordances of different representational media are critically relevant, and the teacher's body (aligned with talk) becomes the central tool for creating, highlighting, and linking representations and enacting the functional coordinations that yield desired outcomes.

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