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Do Speakers Design Their Cospeech Gestures for Their Addressees? The Effects of Addressee Location on Representational Gestures

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Do speakers use spontaneous gestures accompanying their speech for themselves or to communicate their message to their addressees? Two experiments show that speakers change the orientation of their gestures depending on the location of shared space, that is, the intersection of the gesture spaces of the speakers and addressees. Gesture orientations change more frequently when they accompany spatial prepositions such as *into* and *out*, which describe motion that has a beginning and end point, rather than *across*, which depicts an unbounded path across space. Speakers change their gestures so that they represent the beginning and end point of motion INTO or OUT by moving into or out of the shared space. Thus, speakers design their gestures for their addressees and therefore use them to communicate. This has implications for the view that gestures are a part of language use as well as for the role of gestures in speech production.

Key Words: cospeech gestures; spatial prepositions; addressee design; communicative use of gestures.

What are the functions of the spontaneous gestures that people use while they speak? Even though gestures are ubiquitous accompaniments to speech (McNeill, 1985, 1992), the functions they serve for the speaker and the addressees have been controversial (Kendon, 1994). Several investigators claim that speakers gesture for themselves, for example, to organize their own thinking or to facilitate speech production (e.g., Feyereisen, Van de Wiele, & DuBois, 1988; Kita, 2000; Krauss, Chen, & Chawla, 1996). However, it is also possible that speakers gesture for their addressees—that is, in order to help communicate their intended message to others (e.g., Goodwin, 2000; Haviland, 2000; Kendon, 1997). This is an important controversy to resolve for the general claim that gesture is part of language use (Clark, 1996; McNeill, 1985). If gestures change, as the rest of language changes, depending on the addressee (e.g., Clark, 1996; Levinson, 1983; Schober, 1993), this supports the claim that gesture is part of language use. Furthermore, the question of whether gestures are part of the communicative intention of the speaker has been crucial in the debate about whether gesture production can originate within the speech processor (De Ruiter, 2000; Krauss, Chen, & Gottesman, 2000). This article investigates whether gestures are used to communicate by manipulating the location of addressees around the speaker. If speakers gesture for their addressees, then gestures should change depending on the location of the addressee.

PREVIOUS STUDIES OF THE FUNCTION OF GESTURES

Several researchers have claimed that gestures have mainly internal functions for the speaker, such as to help thinking or speaking. One claim is that the main function of gestures is to facilitate speech production (Rime & Schiaratura, 1991). According to this view, gestures appear because in the course of formulating meanings in lexical syntactic form, nonlinguistic modes of encoding are activated. Cospeech gestures are thus just a by-product of

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the process of verbal articulation. Specifically, according to Krauss et al. (1996; 2000), gestures help speakers retrieve words from lexical memory by cross-modal priming, especially in cases of retrieval difficulty. According to these strong views, the communicative function of gestures is minimal or at best incidental.

Another possible internal function of gestures is to help speakers organize their thinking for speaking (Alibali, Kita, & Young, 2000; Kita, 2000; Özyürek & Kita, 1999). According to this view, gestures help organize spatial representations in packages suitable for speaking. Another claim is that gestures facilitate thinking. Gesturing may reduce cognitive burden by freeing up effort that can be allocated to other tasks. For example, pointing improves young children's performance on counting tasks (Alibali & Di Russo, 1999). The idea that gestures have internal functions for speakers is strengthened by the finding that blind people gesture (Iverson & Goldin-Meadow, 1997). Researchers who take this view do not deny the communicative function of gestures, but emphasize the internal functions as primary.

However, according to some other researchers, the main function of gestures is to communicate the intended message to the addressee (Clark, 1996; Goodwin, 2000; Kendon, 1994; LeBaron & Streeck, 2000). These views, based primarily on observational and conversational data, hold that gestures serve to make the verbal behavior meaningful for the participants in conversational interactions and thus have communicative functions. According to Clark (1996) and Engle (1998), gesture and speech together make up *composite signals* that constitute speakers' communicative acts. According to this view, language users have at their disposal several methods of signaling—acts by which one person means something to another. These methods are describing-as, demonstrating, and indicating, which are all part of a single semiotic system. Language researchers have focused primarily on the describing-as aspect of this system, which consists of abstract and conventionalized symbols revealed mainly through the verbal channel. However, communicators also demonstrate actions to their addressees and indicate objects in the speech environment using their eyes and hands. In this sense, gesture and speech play a significant role in communication and together constitute a composite signal that defines language use in a broad sense. When gestures communicate, they do so in coordination with accompanying speech (Engle, 1998).

There are relatively few experimental studies that provide evidence for the communicative function of gestures. A few experimental studies have focused on the effects of visual accessibility on gesturing. However, these studies have contradictory findings. Some studies have reported that speakers gesture more when interacting face to face than when they are unable to see their listeners (e.g., Bavelas, Chovil, Lawrie, & Wade, 1992; Cohen, 1977; Emmorey & Casey, in press; Krauss, Dushay, Chen, & Rauscher, 1995). On the other hand, a few other studies have not found reliable differences between the two conditions (e.g., Rime, 1982). According to Alibali, Heath, and Myers (2001), these contradictory results have arisen because these studies have investigated different types of gestures and have used different tasks. By controlling for the type of gesture and using a standardized task, Alibali et al. (2001) have shown that gestures that depict semantic content are used more frequently when listeners are visible than when they are not. However, even if this study shows that gestures are produced more often in the face-to-face than in the nonvisible condition, it does not demonstrate how gestures are designed for different addressees.

Other researchers have tried to prove the communicative function of gestures by showing that gestures have communicative effects. They have shown that gestures can facilitate comprehension of a spoken message (Alibali, Flevares, & Goldin-Meadow, 1997; Kelly & Church, 1998). However, according to Krauss et al. (2000), these findings do not mean that the speakers intended the communicative effects. Furthermore, other studies have shown that the meaning of gestures is opaque and a post-hoc construction deriving primarily from the listener's comprehension of speech (Krauss, Morrel-Samuels, & Colasante, 1991; Rime &

Schiaratura, 1991). Thus, these studies question the communicative effects of gestures.

Whether gestures are communicative is crucial first of all for the claim that gesture is part of language use. If gestures convey speakers' communicative intentions as speech does, this supports the view that gesture can be considered part of language use (Clark, 1996; Kendon, 1994; McNeill, 1992). The potential communicative function of gestures is also important in the debate about where in the speech production process gestures originate. Krauss et al. (2000) claim that since gestures do not convey the communicative intention of the speaker, they cannot originate in the speech processor (i.e., the conceptualizer in Levelt's (1989) speaking model) and thus have to originate in working memory—outside of the conceptualizer. However, according to De Ruiter (2000), who believes that gestures are communicative, gestures originate in the conceptualizer since both speech and gesture convey the communicative intention of the speaker.

THE PRESENT STUDY

The purpose of the present study is to provide experimental evidence for the communicative use of gestures by investigating the influence of changes in addressees' location on speakers' gestures. The hypothesis investigated here is that if gestures are designed for addressees and therefore are used communicatively, then they should differ more across addressees when those addresses are in different locations with respect to the speaker than when they are in the same location. Furthermore, if gestures and speech together make up a composite signal that conveys the intended message of the speaker to the addressee (Clark, 1996), then the changes in gestures should be related to the message conveyed in the accompanying speech. To investigate these hypotheses, this study used a cartoon narration task that has been shown reliably to elicit gestures in prior studies (McNeill, 1992). The location of the addressees is changed during narration and the changes in gestures are observed.

How might changes in addressee location influence gestures? It is expected that gestures will be influenced by changes in the relative position of the addressees because the *shared space* between the speaker and the addressees will change. In this study, shared space is defined as the intersection of the individual gesture spaces of the participants, that is, of the speakers and the addressees in the communication. For example being in a face-to-face versus a side-by-side configuration will create different shared spaces between the speaker and the addressees during narration. In the face-to-face configuration, the intersection of gesture spaces will be in front of the narrator, whereas in the side-by-side configuration it will be to the side of the narrator. Gestures might be sensitive to these changes in the location of shared space, and therefore the beginning and end point of gestures might vary depending on addressee location.

The effect of changes in shared space on gestures was tested in two experiments. In the first experiment, shared space was changed by varying the *number* of addressees around the narrator, that is, by locating either one addressee to one side or two addressees, one on each side of the narrator. In the first experiment, having one addressee to the side is expected to create a shared space to the side of the narrator. Having two addressees, one on each side, might create a shared space in front of the narrator. The second experiment examines more specifically whether it is the number or the location of the addresses that is influential in the construal of shared space. Thus, the second study investigates whether having one addressee in a face-to-face configuration creates a shared space in front of the narrator, similar to having two addressees, as in Experiment 1. This is tested by positioning only one addressee in either a face-to-face (shared space in front) or to-the-side (shared space to the side) configuration with the narrator.

The effect of changes in shared space is investigated on representational gestures of direction. In narrative descriptions, gestures represent direction with respect to imaginary objects and locations in the gesture space (Haviland, 1993; McCullough, 1993). For example, a speaker moves her hand from one location to another in the gesture space as she says “the cat ran across the street” to represent the beginning and end point of the cat’s imaginary motion in the space. Liddell (1995, 2000) has shown that in American Sign Language, the space around the signer, such as the location of the real or imagined addressees, can determine the orientation and the direction of signs such as pronouns or indicating verb signs. It is possible that gestures accompanying speech might also represent the direction of moving figures differently depending on the configuration of the shared space among the participants. Thus, changes in shared space are expected to influence the direction of gestures that represent motion.

If changes in gestures are observed, then one must also consider the possibility that the changes might be derived from speech. Variations in shared space might change the choice of spatial prepositions, and thus gestures might be influenced by changes in speech. If this is the case, it might be difficult to attribute the changes in gestures to addressee location. However, since English has only a limited number of spatial prepositions that encode direction of motion events (e.g., *into*, *out*, *across*, etc.), it seems likely that these prepositions would be used across contexts. Thus, no significant changes in speech were expected with variations in shared space.

The last hypothesis concerns the relations between changes in gesture and the content of speech. If gesture and speech together make up a composite signal (Clark, 1996) and together reveal the communicative intentions of speakers, then changes in gestures should be related the content of the accompanying speech. If we expect the beginning and end points of gestures to change with variations in shared space, then changes in gestures might occur for certain verbal expressions that encode specifically the beginning and end point of the motion. Spatial prepositions such as *in*, *into*, *out*, and *out of* depict motion along a bounded path that has a source as a beginning point and a goal as an end point (Jackendoff, 1983; Lindner, 1981). Thus, speakers might be more likely to change their gesture orientations for these prepositions so that gestures move into or out of the shared space, wherever it is located, in order to represent motion INTO or OUT. On the other hand, speakers might be less likely to modify gestures that accompany prepositions that do not encode a specific beginning and end point. For example, the preposition *across* depicts unbounded motion from one side to the opposite side of a ground starting and ending near (within, on, or beyond) the boundary (Jackendoff, 1983). Thus gestures do not have to accommodate to changes in shared space when they accompany preposition *across*. Therefore, if gestures are designed for the addressees and thus are communicative, one expects the changes in gestures to be related to the intended message conveyed in speech.

EXPERIMENT 1

In the first experiment, the shared space was varied by changing the number of addressees. Participants were assigned randomly to two groups: an experimental group (variable addressee number) and a control group (constant addressee number). In the experimental group the participants narrated the story once in the two-addressee configuration, that is, having the shared space in front, and once in the one-addressee configuration, that is, having the shared space located to the side. Participants in the control group also told the story twice, both times in the one-addressee configuration (see Fig. 1).

If variations in the number of addressees influence gesture directionality, there should be more changes in gestures from one narration to the other in the experimental group, in which addressee number changes, than in the control group, in which addressee number remains constant. No changes in speech were expected, since the spatial prepositions in English that encode direction should generalize across different shared space contexts due to the fact that there are few of them. Last, according to the composite signal hypothesis, it is expected that changes in gestures should occur in coordination with the semantic content in speech. Thus, gestures might change if they accompany certain spatial prepositions but not others. We expect changes in gestures that accompany prepositions such *in*, *into*, *out*, and *out of* because the beginning and end point of gestures might be more likely to be influenced by the changes in the location of the

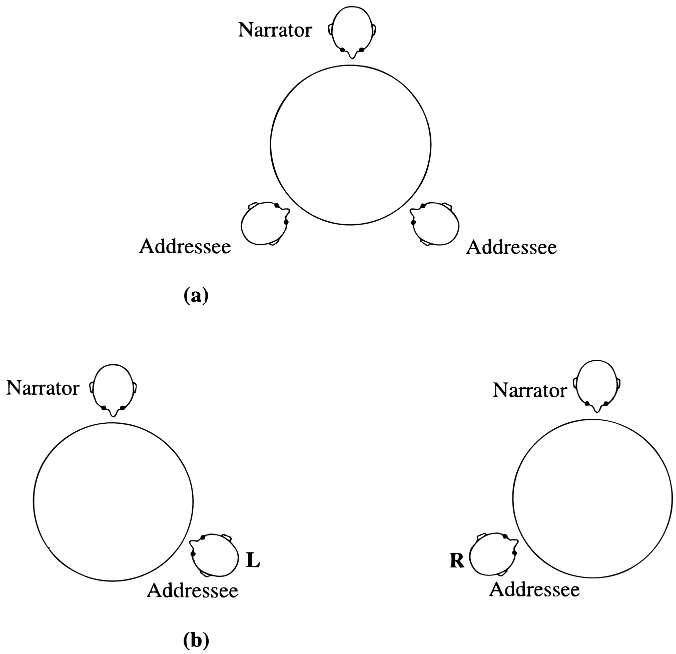

FIG. 1. Two-addressee (a) and one-addressee (b) configurations used in Experiment 1.

shared space in order to represent motion INTO and OUT for the addressees. In contrast, we expect gestures that accompany *across* to remain the same since ACROSS depicts motion along an unbounded path and speakers do not have to change their gestures with variations in the location of shared space.

Method

Participants

Sixteen participants (8 female, 8 male) participated as narrators and an additional 40 participants (20 female, 20 male) served as addressees. All the participants were native English speakers who were students at the University of Chicago. All the narrators were right-handed, as shown by a short questionnaire administered after the experiment. All participants were paid for their participation.

Materials

Each narrator watched an animated cartoon, entitled "Canary Row," in two 4-min segments. Each segment consisted of four action episodes, each including a series of motion events. In each episode, Sylvester the Cat attempts to catch Tweety Bird in a different way.

Experimental Setup and Procedure

Participants were randomly assigned to the experimental and control groups and to narrator and addressee roles. The instructions were given separately to the narrators and the addressees. Narrators were told that the study focused on storytelling. An instruction sheet explained that a cartoon would appear on the TV screen. The narrator would watch the cartoon and then tell it to one or two addressees who were brought in for each telling. The narrators were also told that the addressee would retell the narration to another listener who had not seen the movie. The addressees were told separately to listen to the narration carefully so that they would be able to retell it to somebody who had not seen it. Both narrations were videotaped with a camera situated across from narrator. The location of the camera was the same across conditions.

Narrators in the experimental group (variable addressee number) told the story in two different addressee configurations. In the one-addressee configuration, the addressee was seated to one side (either left or right and 60° offset) of the narrator. In the two-addressee configuration, the addressees were seated to either side of (each 60° offset) the narrator. In the control group (constant addressee number), one addressee was seated to one side of the narrator during each narration. Each narrator told the cartoon twice in the one-addressee configuration. Different individuals served as addressees each time the narrator told the story in both experimental and control groups.

Design

A within-subject design was used. Each narrator in the experimental group described the same cartoon under the two different configurations. The order of conditions was counterbalanced across narrators. Four narrators told the cartoon first in the two-addressee configuration and then in the one-addressee configuration. The remaining four narrators told the cartoon first in the one-addressee configuration and then in the two-addressee configuration. Furthermore, in the one-addressee configuration, half of the narrators had addressees seated to their right side, and the remaining four narrators had them seated to their left side, thereby counterbalancing the location of the addressees across narrators.

The narrators in the control group also told the narration twice, but did so both times in the one-addressee configuration. The position of the single addressee to the right or the left of the narrator was counterbalanced. Four narrators told the cartoon twice with the addressee seated to the left and four with the addressee seated to the right.

In order to balance the order of telling for the control group in a way similar to that in the experimental group, half of the narrators in the control group were categorized randomly as if they were in the one-addressee configuration first and half of them as if they were in the two-addressee first configuration first, even though they all were in the one-addressee configuration.

Coding

Twelve motion events were selected from the cartoon for analysis. In these events, the beginning and the end point of the moving figure were visible on the scene. The other motion events in the cartoon did not contain a clear beginning and end point on the screen and were thus not included in the analysis. For a list of the selected motion events see the Appendix, and for a scene-by-scene description of the cartoon see McNeill (1992).

The speech segments in each narration that described these selected events were transcribed and broken into separate verbal clauses (e.g., "Sylvester runs into the hotel"). The gestures accompanying each of these motion event clauses were then coded following McNeill's (1992) conventions.

According to McNeill (1992), gestures have three phases: a preparation phase, a stroke, and a retraction phase. The three phases together constitute a *gesture phrase*. In the present study the gesture phrase was the basic unit of analysis. Each gesture phrase was classified into one of three categories based on the axis of its trajectory: (a) *lateral*, (b) *sagittal*, or (c) *vertical*. In order to consistently and objectively classify gesture axes, coders traced the gesture's trajectory from the video onto a transparent sheet placed directly onto the monitor screen. Later coders classified these traces into one of the three axes.

In order to determine if narrators changed their verbal and gestural descriptions of the motion events across narratives, the following coding was conducted. For speech, *verbal pairs* that referred to the same motion event in both narratives by the same speaker were selected. For these verbal pairs, coders further determined whether a narrator used the *same* or a *different* verb of direction (e.g., *enter* vs. *exit*) or spatial preposition (e.g., *across* vs. *down*) in the two narratives. For example, if a narrator said "she throws him *out onto* the street" in one of his narratives but said "she throws him *across* the street" in the second, this verbal pair was coded as different. Even if a narrator said "she throws him *out onto* the street" in one narrative, but only "she throws him ø *onto* the street" in the other, this was also coded as different since the encoding of the trajectory of the motion differs in the two narratives. For gesture, *gesture pairs* that referred to the same motion event in both narratives by the same speaker were selected. Later, each gesture pair was coded for whether the two gestures had the same or different direction (e.g., lateral versus sagittal) in the two narratives. In the rare cases where the narrator used a directional gesture in one narrative but not in the other, this pair was not included into the final analysis.

Reliability

All the data were initially coded by a single coder, and reliability was established by having a second trained coder code 25% of the videotape data. Agreement between the two coders was 93% for identifying gestures and 87% for categorizing gestures as lateral, sagittal, or vertical. In cases of disagreement, the choice of the original coder was used in the final analysis.

Results

The results are organized into three sections. In the first section, the number of changes in gesture direction is investigated. This is followed by an analysis to examine which gestures (sagittal, lateral or vertical) change more frequently in the experimental group than in the control group. In the second section, changes in speech are considered. The last section examines whether changes in gesture direction are related to the semantic content of verbal expressions that encode direction (*in*, *into*, *out*, *out of* versus *across*) and examines how these changes are related to the location of shared space. Except where noted, there was no effect of order of telling in any comparisons.

Changes in Gesture

The first goal was to examine whether changes in addressee number affected narrators' representations of direction in gestures. More changes in gesture direction across narratives were expected in the experimental group (variable addressee number) than in the control group (constant addressee number).

The analysis was conducted on gesture pairs that referred to the same notion event in both narratives. Overall there were 101 gesture pairs in the experimental group and 103 gesture pairs in the control group. The proportion of total gesture pairs that differed in terms of their direction from one telling to the other was calculated across narrators. In the experimental group, more than half of the gesture pairs were different ($M = 0.62$, $SE = 0.05$). Many fewer gesture pairs were different in the control group ($M = 0.40$, $SE = 0.03$). A 2×2 ANOVA was conducted on these proportions with group (experimental vs. control) and order of telling (one-addressee configuration first vs. two-addressee configuration first) as factors. The results revealed a main effect of group ($F(1, 14) = 5.2$, $p < .05$). Confirming the initial expectation, narrators modified their gesture direction across tellings more frequently when the addressee number varied than when it remained constant.

The next set of analyses investigated which type of gestures (sagittal, lateral, or vertical) changed more frequently in the experimental group than in the control group. The proportion of total gestures performed along each gesture axis (sagittal, lateral, and vertical) in each configuration was calculated for each narrator in the experimental and control groups (see Table 1).

TABLE 1

Mean Proportion of Total Gestures Performed with Different Gesture Axes When the Addressee Number Changes versus Remains Constant (Experiment 1)

			Gesture axes		
Group	Addressee configuration	*N*	Sagittal	Lateral	Vertical
Experimental (variable addressee number)	One-addressee	101	0.19 (0.03)	0.55 (0.05)	0.26 (0.05)
	Two-addressee	102	0.48 (0.03)	0.25 (0.04)	0.27 (0.04)
Control(constant addressee number)	One-addressee A	103	0.17 (0.05)	0.52 (0.07)	0.31 (0.05)
	One-addressee B	105	0.16 (0.04)	0.46 (0.05)	0.38 (0.06)

Note. Standard errors are in parentheses.

The first analysis of these data examined whether sagittal gestures changed more frequently when the addressee number varied than when it remained constant. A repeated measures $2 \times 2 \times 2$ ANOVA was conducted on the proportion of sagittal gestures, with addressee configuration (one-addressee vs. two-addressee or one-addressee A vs. one-addressee-B), group (experimental vs. control), and order of telling as factors. Results revealed an interaction of addressee configuration with group ($F(1, 14) = 17.49$, $p < .01$). In the experimental group narrators used more sagittal gestures in the two-addressee configuration than in the one-addressee configuration, but there was no change in sagittal gestures from one narrative to the other in the control group.

A similar repeated measures $2 \times 2 \times 2$ ANOVA was conducted on the proportion of total gestures performed along the lateral axis. This analysis also revealed an interaction of addressee configuration with group ($F(1, 14) = 6.12$, $p < .05$). As seen in Table 1, speakers used more lateral gestures in the one-addressee than in the two-addressee configuration in the experimental group, but there was no change in lateral gestures from one narration to the other in the control group.

The proportion of total gestures performed along the vertical axis was comparable across conditions in both the experimental and control groups.

Thus, changes in addressee number influenced gestures performed along the lateral and sagittal axes, but not gestures performed along the vertical axis. Narrators used more sagittal gestures in the two-addressee configuration than in the one-addressee configuration and more lateral gestures in the one-addressee than in the two-addressee configuration.

Changes in Speech

The next goal was to determine whether variation in addressee number had an effect on narrators' choice of directional verbs and spatial prepositions. This analysis was conducted on verbal pairs that referred to the same motion event in both narratives. The mean proportion of total verbal pairs that differed in terms of the use of directional verbs or spatial prepositions from one telling to the other was calculated across narrators. The mean proportion of different verbal clause pairs was 0.35 for the experimental group ($N = 100$) and 0.32 for the control group ($N = 103$). A 2×2 ANOVA with group and order of telling as factors revealed no significant effect of group ($F(1, 14) = 1.48$, $p > .24$). Narrators did not change their choice of directional verbs or spatial prepositions more frequently when the addressee configuration varied than when it remained constant.

The changes that occurred in speech were not systematic and did not reveal differences in conceptualization of the direction of movement. In the experimental group, 60% of the changes were variations in spatial prepositions compared to 65% for the control group. However, most of these variations did not reveal changes in the conceptualization of direction (e.g., "he flies *in* the window" changed to "he flies *into* the window"). The rest of the changes were mostly among *go* verbs and manner of motion verbs (e.g., *go* out changed to *run out*). Since the verb *go* implies change of location rather than direction (Wilkins & Hill, 1995), these types of changes cannot be taken as revealing differences in conceptualization of direction. Instead, these types of changes reveal that the semantic content of spatial prepositions in English generalizes across different shared spaces, and speakers' selections are split among the various synonymous prepositional phrases (e.g., *in* and *into*). Thus, the possibility that the changes in gestures are derived from changes in speech is not supported.

Changes in Gestures in Relation to Verbal Descriptions of Motion INTO, OUT, and ACROSS

According to the composite signal hypothesis, both speech and gesture together constitute the communicative act of the speaker. Therefore, if speakers change their gestures for their addressees, these changes should occur in coordination with the message conveyed in the accompanying speech. In the motion events analyzed in this sample, changes should occur frequently among gestures that accompany prepositions such as *in*, *into*, *out*, or *out of* that specifically encode the beginning (source) and end (goal) point of the motion. Thus, speakers might be more likely to change the beginning and end point of their gestures for these prepositions with variations in the location of the shared space. The reason for this change might be that their gestures move into or out of the shared space in order to represent motion INTO or OUT. On the other hand, speakers might be less likely to modify gestures that accompany prepositions that do not encode a specific beginning and end point. For example, the preposition *across* depicts unbounded motion from one side to the opposite side of a ground starting and ending near (within, on, or beyond) the boundary (Jackendoff, 1983). Thus, changes should occur less frequently among gestures that accompany the preposition *across* since the beginning and end points of the directional gestures do not need to be sensitive to the changes in the location of the shared space in order to represent the motion ACROSS.

For this analysis, 8 motion event descriptions (from the original 12) that represented a character's motion INTO, OUT, or ACROSS were selected from each of the narratives. The Appendix contains descriptions of the 8 motion events. Three of these events represented a character's motion INTO a building or window (motion from right to left in the original cartoon), 2 of them represented motion OUT of a building or window (motion from left to right in the original cartoon), and 3 of them represented motion ACROSS from one building to another (motion from right to left in the original cartoon). The verbal clauses and gesture directions used to refer to these scenes were analyzed further.

The verbal descriptions speakers used to refer to these scenes consisted of motion verbs combined with the prepositions *in*, *into*, *out*, *out of* or *across*. Speakers were consistent in matching their verbal descriptions with the conceptualization of the scenes of motion INTO, OUT, and ACROSS.

If gesture directionality is related to what is expressed in speech and to the shared space among the participants, speakers should use more sagittal gestures in the two-addressee configuration than in the one-addressee configuration for depictions of motion INTO and OUT, but not for motion ACROSS. In the two-addressee configuration, the shared space is in front of the narrator, and therefore a forward gesture will point to the shared space as the end point of motion INTO and a backward gesture will point to the place out of the shared space as the end point of motion OUT. On the other hand, in the one-addressee configuration a lateral gesture is more suitable to point to the shared space on the side to represent the beginning and end point of motion INTO and OUT. However, the shift between sagittal and lateral gestures is not necessary to convey the meaning of ACROSS in different shared space locations since *across* depicts motion along an unbounded path across space.

To examine this hypothesis, the proportion of total gestures performed along the sagittal axis was calculated for each narrator in the experimental group for motion INTO, OUT, and ACROSS. A repeated measures 2 × 3 ANOVA was conducted on these proportions with configuration (one-addressee vs. two-addressee) and motion event type (INTO vs. OUT vs. ACROSS) as factors. As predicted, there was an interaction between configuration and motion event type ($F(2, 10) = 5.05$, $p < .05$). Posthoc tests using Fisher's least-significant difference showed that the proportion of sagittal gestures used for motion INTO and OUT was higher in the two-addressee configuration (INTO, $M = 0.73$, $SE = 0.13$; and OUT, $M = 0.72$, $SE = 0.10$) than in the one-addressee configuration (INTO, $M = 0.19$, $SE = 0.11$; and OUT, $M = 0.09$, $SE = 0.07$). However, there was no difference in the proportion of sagittal gestures used for the motion ACROSS in the two-addressee configuration ($M = 0.65$, $SE = 0.13$) and the one-addressee configuration ($M = 0.50$, $SE = 0.11$). This analysis shows that changes in gesture axes were specific to the meaning expressed in the concurrent speech, specifically to the encoding of motion INTO and OUT, as expected.

Relation between Gestures of Motion INTO and OUT and the Location of Shared Space

The last analysis tested more specifically whether gestures of motion INTO and OUT also moved into or out of the shared space in different addressee configurations. In all the gestures that depicted these scenes the dominant hand was the right hand.

In the two-addressee configuration, the shared space is expected to be located in front of the narrator. In descriptions of motion OUT, 94 % of the sagittal gestures moved backward and out of the shared space, away from the addressees. Even though the motion of the character flying out the window (appearing from left to right on the screen) could not be represented by a backward motion, narrators consistently performed backward gestures so that gestures moved out of the shared space. On the other hand 100% of all the sagittal gestures used to depict motion INTO moved forward, that is, into the shared space.

In the one-addressee configuration, the shared space is expected to overlap with either the left or the right gesture space of the narrator depending on where the addressee is located. In depictions of motion INTO, when the shared space was to the left, narrators usually moved their hands from their right gesture space to their left gesture space (83% of the lateral gestures used when the addressee was to the left in the experimental group). In contrast, when the shared space was to the right, narrators moved their hands from their peripheral right side toward their right gesture space so that their gestures could move into the shared space (71% of the lateral gestures used when the addressee was to the right in the experimental group). Similarly, in all the scenes of motion OUT, the location of the lateral gestures changed in relation to the narrator's body, depending on where the shared space was located. When the shared space was to the left, the narrators moved their hands from their left gesture space to their right gesture space (85% of the lateral gestures used when the addressee was to the left in the experimental group). In contrast, when the shared space was to the right, narrators moved their hands from the right side of their bodies toward the periphery and further right, moving out of the shared space (78% of the lateral gestures used when the addressee was to the right in the experimental group).

In sum, the findings of Experiment 1 showed that speakers were likely to change their gesture direction with variation in the number of addressees. This change was most prominent along the sagittal and lateral axes. Even though narrators did not change their speech with changes in addressee number, their gesture axes changed in relation to the semantic content encoded in speech. Narrators modified gestures that accompanied verbal encoding of motion INTO and OUT, but not gestures that accompanied verbal descriptions of motion ACROSS. The one-addressee and two-addressee configurations created different shared spaces at different locations, which in turn changed speakers' gesture direction in ways related to what was encoded in speech.

EXPERIMENT 2

The findings of Experiment 1 lead to other questions about how narrators mentally construe the shared space around them. For example, what is the role of having two addressees in construing a shared space located in front of narrator? Is it the number or the location of addressees that is influential in creating a shared space, which in turn shapes narrators' representations of directionality?

The goal of Experiment 2 was to answer these questions by testing the influence of shared space through another change in the addressee configuration. In this experiment, the number of addressees was kept constant at one, but the location of the addressee was changed. The aim was to test whether having only one addressee in a face-to-face configuration creates a shared space in front of the narrator similar to the one in the two-addressee configuration (see Fig. 2).

The participants in this experiment were assigned to experimental (variable addressee location) and control groups (constant addressee location). In the experimental group, the addressees' location was varied from a face-to-

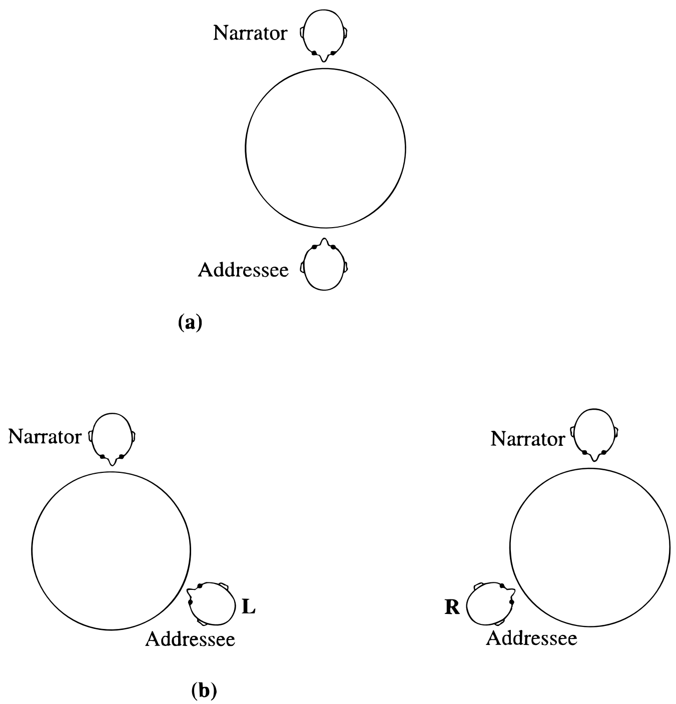

FIG. 2. Face-to-face (a) and to-the-side (b) configurations used in Experiment 2.

face to a to-the-side configuration. If the face-to-face configuration creates a shared space similar to that in a two-addressee configuration, then it is expected that narrators in the experimental group will change their gesture direction more frequently than narrators in the control group, as found in Experiment 1. If a significant number of changes in gesture direction is observed in the experimental group, then these changes are also expected to be related to what is expressed in the accompanying speech and to the location of the shared space.

Method

Participants

A total of 16 participants (8 males and 8 females) served as narrators and an additional 32 (16 males, 16 females) served as addressees. All of the participants were native speakers of English who were college students at the University of Chicago. All of the narrators were right-handed.

Experimental Setup and Procedure

The participants in the experimental group were randomly assigned to narrator and addressee roles. Each narrator watched the same cartoon and then told it to two different addressees two different times. The narrators in experimental group (variable addressee location) retold the narrative in two configurations. In one of the configurations, the addressee was seated 180° in front of the narrator (face-to-face). The other configuration (to-the-side) was the same as that used in Experiment 1; one addressee was seated either to the left or to the right of the narrator (60° offset).

The control group had only one addressee located to the side, and the addressee's location remained constant across the two narratives. The arrangement in this group was the same as that in the control group in Experiment 1, but with different subjects. The instructions and the camera location were the same as those in the first experiment.

Design

The order of telling in each configuration in the experimental group was counterbalanced across narrators. Four narrators told the cartoon first in the face-to-face configuration and then retold it in the to-the-side configuration. The remaining four narrators told the cartoon first in the to-the-side configuration and then retold it in the face-to-face configuration. Furthermore, in the to-the-side configuration, four of the narrators had addressees seated to their right and the remaining four narrators had addressees seated to their left, thereby counterbalancing the location of the addressees across narrators.

The narrators in the control group also told the narration twice, but both times in the to-the-side configuration. This time, the position of the single addressee, to the right or the left of the narrator, was counterbalanced. Four narrators told the cartoon with the addressee seated to the left and four with the addressee seated to the right.

As in Experiment 1, in order to balance the order of telling for the control group in a way similar way to that in the experimental group, half of the narrators in the control group were categorized randomly as if they were in the to-the-side configuration first and half of them as if they were in the face-to-face configuration first, even though they all were in the to-the-side configuration.

Reliability

The same coding procedure as in Experiment 1 was used. All the data were coded by a single coder, and reliability was established by having a second trained coder assess 25% of the videotape data. Agreement between the two coders was 95% for identifying gestures and 92% for categorizing gestures as lateral, sagittal, or vertical. In cases of disagreement, the choice of the original coder was used in the final analysis.

RESULTS

Changes in Gestures

As in Experiment 1, narrators changed their gesture direction more frequently in the experimental group, when the addressee location changed, than in the control group, when it remained constant. Overall there were 103 gesture pairs in the experimental and 102 in the control group. Narrators changed their gesture orientation for more than half of all gesture pairs in the experimental group ($M = 0.55$, $SE = 0.05$) and did so for many fewer pairs in the control group ($M = 0.35$, $SE = 0.03$). A 2 × 2 ANOVA conducted with group (experimental vs. control) and order of telling (to-the-side first vs. face-to-face first) revealed a main effect of group ($F(1, 14) = 4.75$, $p < .05$).

The next analysis showed that changes in direction were more frequent along sagittal and lateral axes, as in Experiment 1. Separate 2 × 2 × 2 repeated measures ANOVAs were conducted on the proportion of sagittal gestures and the proportion of lateral gestures, with addressee configuration (to-the-side vs. face-to-face or to-the-side-A vs. to-the-side-B), group (experimental vs. control), and order of telling as factors. The analyses revealed an interaction of addressee configuration with group for both the sagittal ($F(1, 14) = 16.5$, $p < .01$) and the lateral gestures ($F(1, 14) = 7.4$, $p < .05$). As seen in Table 2, narrators used more sagittal gestures in the face-to-face than in the to-the-side-configuration in the experimental group, but this difference was not observed in the control group. Lateral gestures on the other hand were more frequent in the to-the-side than in the face-to-face configuration in the experimental group, but this difference was not observed in the control group.

Last, the proportion of sagittal gestures in the face-to-face configuration in this experiment was compared with that in the two-addressee configurations in Experiment 1, to investigate whether having the shared space in front had the same effect on the use of these gestures in both cases. The results showed that sagittal gestures were used to a similar extent in both configurations, $t(14) = 0.58$, *n.s.* The proportion of lateral gestures was also comparable in the two configurations, $t(14) = 0.52$, *n.s.*

Changes in Speech

As in Experiment 1, the analysis of speech showed that narrators did not change their ver-

TABLE 2

Proportion of Total Gestures Performed with Different Gesture Axes When the Addressee Location Varies versus Remains Constant (Experiment 2)

			Gesture axes		
Group	Addressee configuration	N	Sagittal	Lateral	Vertical
Experimental (variable addressee location)	To-the-side	103	0.17 (0.04)	0.58 (0.06)	0.25 (0.04)
	Face-to-face	105	0.38 (0.05)	0.36 (0.03)	0.26 (0.05)
Control (constant addressee location)	To-the-side A	102	0.15 (0.04)	0.50 (0.05)	0.29 (0.05)
	To-the-side B	103	0.17 (0.04)	0.44 (0.06)	0.32 (0.06)

Note. Standard errors are in parentheses.

bal descriptions across narratives more frequently when the addressee location changed than when it remained constant. There were 102 speech pairs in the experimental group and 104 pairs in the control group. A 2 × 2 ANOVA with group (experimental vs. control) and order of telling (to-the-side first vs. face-to-face first) as factors revealed no significant effect of group ($F < 1$). The changes that occurred in speech were not systematic and did not reveal differences in conceptualization of the direction of movement.

Changes in Gesture in Relation to Speech

The next analysis showed that changes in gesture axes were specific to the encoding of motion INTO and OUT but not to ACROSS. The proportion of sagittal gestures used to depict motion INTO and OUT was compared with that used for motion ACROSS in the experimental group. A repeated measures 2 × 3 ANOVA was conducted on the proportion of total gestures with sagittal axes with configuration (to-the-side vs. face-to-face) and motion event type (INTO vs. OUT vs. ACROSS) as factors. There was an interaction between configuration and motion event type ($F(2, 10) = 4.95$, $p < .05$). Posthoc tests using Fisher's least-significant difference showed that narrators used more sagittal gestures to depict motion INTO and OUT in the face-to-face configuration (INTO, $M = 0.79$, $SE = 0.13$; and OUT, $M = 0.84$, $SE = 0.06$) than in the to-the-side configuration (INTO, $M = 0.25$, $SE = 0.11$; and OUT, $M = 0.54$, $SE = 0.12$). However, there was no difference in sagittal gestures used to represent motion ACROSS in different addressee configurations (face-to-face, $M = 0.49$, $SE = 0.11$; and to-the-side, $M = 0.46$, $SE = 0.10$). These findings parallel those of Experiment 1.

If the face-to-face configuration created the same shared space as the two-addressee condition in Experiment 1, then changes in gesture direction are also expected to be related to changes in the location of the shared space. In the face-to-face configuration, the shared space is expected to be located in front of the narrator, as it was in the two-addressee configuration in Experiment 1. In the face-to-face configuration, 95% of all the sagittal gestures in descriptions of motion OUT moved backward and away rather than forward and toward the addressee. Further, 100% of all the gestures that represented motion INTO moved forward and toward the addressee, that is, toward the shared space in front of the narrator. Thus, in the face-to-face configuration narrators moved their gestures forward and toward the shared space in front of them to represent motion INTO and backward and out of the shared space to represent motion OUT.

The shift in the placement of lateral gestures with regard to the location of the shared space when the addressee was to the side also resembled the pattern in Experiment 1. In the one-addressee configuration, the shared space is expected to overlap with either the left or the right gesture space of the narrator. In depictions of motion INTO, when the shared space was to the left, narrators usually moved their hands from their right gesture space to their left gesture space (85% of the lateral gestures used when the addressee was to the left in the experimental group). In contrast, when the shared space was to the right, narrators moved their hands from their peripheral right side toward their right gesture space so that their gestures could move into the shared space(78% of the lateral gestures used when the addressee was to the right in the experimental group). Similarly, in all the scenes of motion OUT, the location of the lateral gestures changed in relation to the narrator's body depending on where the shared space was located. When the shared space was to the left, the narrators moved their hands from their left gesture space to their right gesture space in order to represent motion OUT (82% of the lateral gestures used when the addressee was to the left in the experimental group). In contrast, when the shared space was to the right, narrators moved their hands from the right side of their bodies toward the periphery and further right, moving out of the shared space (80% of the gestures used when the addressee was to the right in the experimental group).

In sum, variation between the face-to-face and to-the side configuration created the same contextual effect on speakers' representation of direction as did variation between two-addressee and one-addressee configurations. Speakers preferred sagittal gestures in the face-to-face configuration and lateral gestures in the to-the-side configuration. Furthermore, the gestures that accompanied verbal encoding of motion INTO and OUT varied depending on the addressee's positioning; however, those that accompanied verbal encoding of motion ACROSS did not. Thus, the face-to-face configuration created the same shared space as did the two-addressee configuration and also created a similar contrast with the shared space located to the side of the speaker. Therefore, the results of Experiment 2 showed that it is not the number of addressees but the intersection of the spaces created by the location of addressees and the speaker that influences speakers' construal of shared space.

GENERAL DISCUSSION

The findings of this study support the view that speakers use representational gestures accompanying their speech to communicate their intended message to their addressees. Three main findings support this conclusion. First, speakers changed their directional gestures that accompanied spatial prepositions of direction with variations in the position of their addressees. Two experiments showed that speakers prefer to represent direction of motion with gestures along the sagittal (front–back) axis when they speak to either (a) two addressees seated to each side of the speaker or (b) one addressee seated 180° in front of the speaker. The analysis revealed that this was due to the fact that changes in the relative position of the addressees changed the shared space—that is, the intersection of the gesture spaces of the speakers and the addressees. Second, the results showed that changes in the gestures were not derived from changes in speech, since speakers did not change the content of their speech with changes in the shared space. This finding also supports the claim that gestures changed due to changes in the location of addressees. Third, speakers changed their gestures for their addressees only when the changes were relevant to the message conveyed in their speech, thus supporting the composite signal hypothesis. The changes in gesture direction were found to be specific to the spatial prepositions *in*, *into*, *out*, and *out of* that encode a bounded path that has a beginning point and an end point. Speakers change the orientation of their gestures so that they represent the beginning and end point of motion INTO or OUT by moving their gestures into or out of the shared space, wherever it is located. In contrast, speakers did not change their gesture direction for *across* (changing gestures in relation to shared space location is not necessary to convey the meaning of ACROSS since *across* depicts motion along an unbounded path across space).

Do Gestures Communicate?

These results provide evidence for the communicative use of gestures and evidence against claims that the communicative functions of gestures are incidental and that the only function of gestures is to help verbal articulation (Krauss et al., 1998, 2000; Rime & Schiaratura, 1991). However, even though the results of the present study provide support for the communicative use of gestures, they do not disprove the hypothesis that gestures also have internal functions for the speaker (Iverson & Goldin-Meadow,1997; Kita, 2000). It is possible that gestures have both internal and communicative functions and that each gesture is designed by taking both functions into account (Alibali et al., 2001; McNeill, 2000).

This study demonstrates the communicative use of gestures in ways that no other study has done to date. First, rather than being based on observational data (e.g., Goodwin, 2000; Kendon, 1994), it shows experimentally that gestures are designed for addressees. Second, it goes beyond the visibility studies (e.g., Alibali et al., 2001) because it not only shows that speakers gesture in order to be seen by addressees, but it also identifies some of the parameters in the spatial context and the accompanying speech to which gestures are sensitive. Speakers attempt to use common space rather than their own space or the addressee's space in designing their gestures. Choosing to use a common space to convey an intended message with gestures parallels the finding that speakers use common ground (Clark, 1996) to convey an intended message with language. Furthermore, the analysis shows that speakers use shared space as a medium to represent the direction of motion rather than just as a medium in which to make their gestures visible to the addressees. One way to understand why gesture orientations changed with representations of motion INTO and OUT is to think that speakers imagined landmark objects (e.g., building, room) to be located in the shared space. The shared space is imagined as having features of the landmark (e.g., building) such as a front, back, and sides in relation to which the coordinates of motion INTO and OUT can be determined. For example, in descriptions of the motion OUT, when the shared space as an imagined landmark is located in front of the narrator, gestures moved backward and thus out of it, whereas when the shared space was located to the side, the gestures moved laterally out of it. Thus, the results of this study show not only that gestures are communicative, but also that in communicating they are sensitive to features of the spatial context that could be commonly accessible by both speakers and their addressees as well as to the content in the speech.

One open question is whether these changes in gesture direction had different communicative effects on addressees seated in different locations. For example, did an addressee located in front of the narrator have better comprehension of motion INTO when the gesture was sagittal rather than lateral? The findings of this study can not provide definitive conclusions about this aspect of the communicative functions of gestures. Further study is needed to assess addressees' comprehension of gesture orientation in relation to what is expressed in speech and shared space.

It is important to note that the results obtained in this study might be specific to English speakers who use relative frame of reference in their gestures. For example, Guugu Yimithirr speakers of Queensland, Australia, most often do not use a relative but an absolute frame of reference to represent direction in both their spatial language and gestures. That is, they orient their gestures in the “correct” compass directions (Haviland, 1993). It is possible that in such communities the effects of addressee location and shared space might not be observed in the way demonstrated here. The effects of addressee location on gestures should be investigated differently in each linguistic and cultural community.

Implications and Conclusions

If gestures are designed to communicate and if they change with addressee location, the findings have important implications for investigators who use gestures as a source of information about mental processes in educational settings (e.g., Goldin-Meadow, Wein, & Chang, 1992; Goldin-Meadow, Alibali, & Church, 1993). In interpreting learners' gestures, investigators should take into account the spatial context of the communicative setting such as the seating arrangement in a classroom. This might influence the representations revealed in gesture.

The findings also have implications for current models of speech and gesture production (De Ruiter, 1998, 2000; Krauss et al., 2000). With regard to the debate about where gestures originate, since gestures are found to be communicative, they must originate in the same speech production unit where the verbal message is formulated (De Ruiter, 1998, 2000) or in close interaction with the speech processor. Furthermore, theories of gesture production must account for the effects of different parameters in the spatial context, such as addressee location and the relationship between gesture and speech content.

Last and most importantly, if gestures change depending on the addressee, as the rest of language changes, this supports the claim that gesture is part of language use (Clark, 1996; McNeill, 1992). This study has shown that speakers design their gestures in relation to a common ground such as shared space as they design the rest of their language by taking common ground into account (Clark, Schreuder, & Buttrick, 1983). The fact that gestures are designed together with speech to communicate also supports the composite signal view which claims that the definition of language use has to embrace both linguistic and nonlinguistic signals. Therefore, gestures are not just incidental artifacts of representations that help thinking or speaking, but also are used to communicate.

APPENDIX: MOTION EVENT SCENES SELECTED FROM THE CARTOON FOR ANALYSIS

Motion events	Direction of the moving figure from the observer's viewpoint of the TV screen
Episode 1	
*1.1. Sylvester runs across the street from his building to Tweety's building.	Right to left
*1.2. Sylvester runs into Tweety's building.	Right to left
*1.3. Sylvester flies out of Tweety's building.	Left to right
Episode 2	
2.1. Sylvester climbs up the drainpipe.	Up–down
*2.2. Tweety flies in the window.	Right to left
*2.3. Sylvester flies in the window after Tweety.	Right to left
*2.4. Granny throws Sylvester out of the window.	Left to right
Episode 3	
3.1. Sylvester climbs up inside the drainpipe.	Up–down
3.2. Sylvester falls down the drainpipe with a bowling ball inside.	Up–down
3.3. Sylvester rolls down the street.	Left to right
Episode 6	
*6.1. Sylvester swings across from his building to Tweety's building with a rope	Right to left
Episode 8	
*8.1. Sylvester runs across the wires from one building to another	Right to left

*Motion events selected for the motion IN, OUT, and ACROSS analysis.

REFERENCES

Alibali, M. W., & Di Russo, A. A. (1999). The function of gesture in learning to count: More than keeping track. *Cognitive Development*, **14,** 37–56.

Alibali, M. W., Flevares, L., & Goldin-Meadow, S. (1997). Assessing knowledge conveyed in gesture: Do teachers have the upper hand? *Journal of Educational Psychology*, **89,** 183–193.

Alibali, M., Heath, D., & Myers, H. (2001). Effects of visibility between speaker and listener on gesture production: Some gestures are meant to be seen. *Journal of Memory and Language*, **44,** 169–188.

Alibali, M. W., Kita, S., & Young, A. (2000). Gesture and the process of speech production: We think, therefore we gesture. *Language and Cognitive Processes,* **15,** 593–613.

Bavelas, J. B., Chovil, N., Lawrie, D. A., & Wade, A. (1992). Interactive gestures. *Discourse Processes,* **15,** 569–489.

Clark, H. (1996). *Using language*. Cambridge: Cambridge Univ. Press.

Clark, H. H., Schreuder, R., & Buttrick, S. (1983). Common ground and the understanding of demonstrative reference. *Journal of Verbal Learning and Verbal Behavior*, **22,** 245–268.

Cohen, A. A. (1977). The communicative functions of hand illustrators. *Journal of Communication*, **27,** 54–63.

De Ruiter, J. P. (1998). *Gestures and speech production*. Nijmegen: MPI Series in Psycholinguistics.

De Ruiter, J. P. (2000). The production of gesture and speech. In D. McNeill (Ed.), *Language and gesture* (pp. 284–311). Cambridge: Cambridge Univ. Press.

Engle, R. A. (1998). Not channels but composite signals: Speech, gesture, diagrams, and object demonstrations are integrated in multimodal explanations. In M. A. Gernsbacher & S.J. Derry (Eds.), *Proceedings of the Twentieth Annual Conference of the Cognitive Science Society*, (pp. 321–326). Mahwah, NJ: Erlbaum.

Emmorey, K., & Casey, S. (in press). Gesture, thought, and spatial language. In P. Olivier (Ed.), *Spatial language: Cognitive and computational perspectives*. Dordrecht, The Netherlands: Kluwer Academic.

Feyereisen, P., Van de Weile, M., & DuBois, F. (1988). The meaning of gestures: What can be understood without speech? *Cahiers de Psychologie Cognitive*, **8,** 3–25.

Goldin-Meadow, S., Alibali, M. W., & Church, B. (1993).Transitions in concept acquisition: Using the hand to read the mind. *Psychological Review*, **100,** 279–297.

Goldin-Meadow, S., Wein, D., & Chang, C. (1992). Assessing knowledge through gesture: Using children's hands to read their minds. *Cognitive Instruction*, **9,** 201–217.

Goodwin, C. (2000). Gesture, aphasia, and interaction. In D. McNeill (Ed.), *Language and gesture* (pp. 84–98). Cambridge: Cambridge Univ. Press.

Haviland, J. (1993). Anchoring, iconicity and orientation in Guugu Yimithirr pointing gestures. *Linguistic Anthropology*, **1,** 3–45.

Haviland, J. (2000). Pointing, gesture spaces, and mental maps. In D. McNeill (Ed.), *Language and gesture* (pp. 13–46). Cambridge: Cambridge Univ. Press.

Iverson, J., & Goldin-Meadow, S. (1997). What's communication got to do with it? Gesture in children blind from birth. *Developmental Psychology*, **33,** 453–467.

Jackendoff, R. (1983). *Semantics and cognition*. Cambridge: MIT Press.

Kelly, S. D., & Church, B. (1998). A comparison between children's and adults' ability to detect conceptual information conveyed through representational gestures. *Child Development*, **69,** 85–93.

Kendon, A. (1994). Do gestures communicate? A review. *Research on Language and Social Interaction*, **27,** 175–200.

Kendon, A. (1997). Gesture. *Annual Review of Anthropology*, **26,** 109–28.

Kita, S. (2000). How representational gestures help speaking. In D. McNeill (Ed.), *Language and gesture* (pp. 162–185). Cambridge: Cambridge Univ. Press.

Krauss, R. (1998). Why do we gesture when we speak? *Current Directions in Psychological Science*, **7,** 54–60.

Krauss, R. M., Chen, Y., & Chawla, P. (1996). Nonverbal behavior and nonverbal communication; What do conversational hand gestures tell us? In M. Zanna, (Ed.), *Advances in experimental social psychology* (pp. 389–450). San Diego, CA: Academic Press.

Krauss, R. M., Chen, Y., & Gottesman, R. (2000). Lexical gestures and lexical access: A process model. In D. McNeill (Ed.), *Language and gesture* (pp. 261–284). Cambridge: Cambridge Univ. Press.

Krauss, R. M., Dushay, R. A., Chen, Y., & Rauscher, F. (1995). The communicative value of conversational hand gestures. *Journal of Experimental Social Psychology*, **31,** 533–552.

Krauss, R. M., Morrel-Samuels, P., & Colasante, C. (1991). Do conversational hand gestures communicate? *Journal of Personality and Social Psychology*, **61,** 743–754.

LeBaron, C., & Streeck, J. (2000). Gestures, knowledge, and the world. In D. McNeill (Ed.), *Language and gesture* (pp. 118–140). Cambridge: Cambridge Univ. Press.

Levelt, W. J. M. (1989). *Speaking: From intention to articulation*. Cambridge, MA: MIT Press.

Levinson, S. (1983). *Pragmatics*. Cambridge: Cambridge Univ. Press.

Liddell, S. (1995). Real, surrogate and token space: Grammatical consequences in ASL. In K. Emmorey & J. Reilly (Eds.), *Language, gesture, and space* (pp. 19–43). Hillsdale: Erlbaum.

Liddell, S. (2000). Blended spaces and deixis in sign language discourse. In D. McNeill (Ed.), *Language and gesture* (pp. 331–357). Cambridge: Cambridge Univ. Press.

Lindner, S. (1981). *Upped out*. Paper presented at the Berkeley Cognitive Science Conference on Language and Mental Imagery, Berkeley, CA.

McCullough, K. E. (1993). *Spatial information and cohesion in the gesticulation of English and Chinese speakers*. Paper presented at the Annual Convention of American Psychological Society, Chicago.

McNeill, D. (1985). So you think gestures are nonverbal? *Psychological Review*, **92,** 350–371.

McNeill, D. (1992). *Hand and mind: What gestures reveal about thought*. Chicago: Univ. of Chicago Press.

McNeill, D., & Duncan , S. (2000). Growth points in thinking-for-speaking. In D. McNeill (Ed.), *Language and gesture* (pp. 162–185). Cambridge: Cambridge Univ. Press.

Özyürek, A., & Kita, S. (1999). Expressing manner and path in English and Turkish: Differences in speech, gesture and conceptualization. In M. Hahn & Scott C. Stonnes (Eds.), *Proceedings of the 21st Annual Meeting of the Cognitive Science Society* (pp. 507–512). Mahwah, NJ: Erlbaum.

Rime, B. (1982). The elimination of visible behavior from social interactions: Effects on verbal, nonverbal, and interpersonal behavior. *European Journal of Social Psychology*, **12,** 113–129.

Rime, B., & Schiaratura, L. (1991). Gesture and speech. In R. S. Feldman & B. Rime (Eds.), *Fundamentals of nonverbal behavior* (pp. 239–281). New York: Cambridge Univ. Press.

Schober, M. F. (1993). Spatial perspective taking conversation. *Cognition*, **47,** 1–2.

Wilkins, D., & Hill, D. (1995). When "go" means "come": Questioning the basicness of basic motion verbs. *Cognitive Linguistics*, **6,** 209–259.

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