An experimental study of when and how speakers use gestures to communicate*

Janet Bavelas, Christine Kenwood, Trudy Johnson
and Bruce Phillips
University of Victoria

This experiment expanded the visual availability paradigm by subsuming it under the broader principle of *recipient design.* We varied recipient design by asking speakers to describe a picture to someone who would see a videotape of their description or only hear an audiotape. Second, speakers described pictures that varied in verbal encodability. Finally, in addition to gestural rate, we analysed the redundancy of gestures with words. The results ($N =$ 40) confirmed our predictions that speakers gesture at a higher rate and use a higher proportion of nonredundant gestures when their recipient would see their videotape; that they also use more nonredundant gestures when describing a picture for which they have a poor vocabulary; and that these two factors interact to produce the strongest effects when vocabulary is limited and the recipient would see the videotape. These effects support the hypothesis that speakers design their gestures to communicate to recipients.

Keywords: gestures, communication, speaker, encoding, recipient design

The recent controversy over whether gestures are communicative (e.g., Kendon, 1994; Krauss, Morrel-Samuels, & Colasante, 1991; Krauss, Chen, & Chawla, 1996) has had the healthy effect of questioning some taken-for-granted assumptions and of introducing new data and methods into the field. We are among those who propose a significant communicative role for gestures, and the present article is the first in a program of research that has the general goal of seeking appropriate experimental evidence for this communicative role and the specific goal of testing hypotheses about when and how gestures communicate.

With the revival of interest in the topic, some limitations of the available data have become apparent, and these have shaped our research designs. The

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proposal that gestures are communicative is actually two distinct hypotheses: that speakers use gestures to communicate (the encoding hypothesis) and that recipients understand the information in the speaker's gestures (the decoding hypothesis). In order to claim that gestures are communicative, it is necessary to provide evidence for both hypotheses, which will often require separate studies. This article addresses the encoding hypothesis, and a later article will address the decoding hypothesis.

Another broad characteristic of the existing literature has been a disagreement about method as well as theory. Many scholars who consider gestures communicative also prefer research that is not experimental, using data gathered outside the lab, whereas critics of this theory favour lab experiments. While our group values both methods, we do primarily experiments and are therefore seeking to add to the existing experimental evidence in support of the communicative hypothesis.

A final problem with the recent debate has been the occasional implicit assumption that gestures have only one primary function (e.g., communication *or* lexical access) so that evidence for one function may be treated as evidence against another. We reject that position and explicitly propose (e.g., Bavelas, 1994; Bavelas & Chovil, 2000) that gestures, like other aspects of language use, can have several functions. For example, a gesture that precedes speech may be self-prompting, but it may also be other-prompting, that is, a request for help with a word search.

Turning specifically to encoding research, there are in retrospect several limitations of the classic paradigm (Cohen, 1977; Cohen & Harrison, 1973; Krauss, Dushay, Chen, & Rauscher, 1995; Rimé, 1982) which tests the effect of the *visual availability* of an addressee (e.g., speaking face-to-face vs. using an intercom or through a barrier) on the speaker's rate of gestures. Although we are seeking here to correct these limitations, by no means do we consider them "errors" in the original designs. Only important and convincing experiments attract enough interest to warrant critical re-appraisal and fine-tuning in future years. Indeed, one of our goals is to show that certain potential interpretive problems do not hold.

Recipient design

First, the assumption that speakers would be less likely to gesture to an addressee who cannot see them is a reasonable one, but the existing manipulations of visual availability inevitably create other differences between conditions as well: Face-to-face dialogue is a more familiar and practiced mode of communication than is speaking on an intercom or through a barrier, so visual availability is potentially confounded with familiarity. In addition, these ways of manipulating the recipient's ability to see the speaker inevitably affect the speaker's ability to see the recipient: In the face-to-face condition, the speaker can see the recipient and thus can monitor reactions to what he or she is saying, but in the intercom or barrier condition, the speaker cannot see the recipient and has only auditory feedback.

One solution to these potential confounds (and perhaps a useful theoretical step as well) is to move beyond the physical manipulations of visual availability to its conceptual basis, which we assume is the concept of *recipient design* (Garfinkel, 1967):

> By "recipient design" we refer to a multitude of respects in which the talk by a party in a conversation is constructed or designed in ways which display an orientation and sensitivity to the particular other(s) who are the co-participants. (Sacks, Schegloff, & Jefferson, 1974, p. 727)

We propose that the concept underlying the physical manipulation of face-to-face vs. intercom (or barrier) is the assumption that speakers will orient and be sensitive to whether their recipient can see them or not and will design their communication accordingly, by using or not using gestures. As Cohen (1977, p. 56) expressed it, "The rationale is that the encoder will use more illustrators *in order to help the decoder*" (emphasis original).

In other words, visual availability is one way to operationalize and vary recipient design. If this is so, there may be other ways to vary the speaker's recipient design than by physical limitations, which may avoid some of the confounds described above. We asked participants, who were alone, to describe pictures to a partner who would either see their videotape or only hear their audiotape. By the principle of recipient design, this expectation should make the speakers sensitive to whether the recipient would see their gestures or not, just as the physical manipulations did but without the potential confounds: The situations are equally unfamiliar, and speakers in neither condition can see their recipient. Of course, the price of this experimental control is that the situations are even less typical of most everyday conversations than in previous experiments. However, if our results replicate the earlier work, we will gain back some generalizability and show that the earlier effects were not due to the potential confounds.

A second way of testing the principle of recipient design is to use a more precise outcome measure. If speakers are sensitive to whether the recipient will see their gestures or not, they may change not only the rate but the kind of gestures they use. For example, Bavelas, Chovil, Lawrie, and Wade (1992) were seeking to establish a distinction between speakers' gestures that are directly related to the topic of conversation (*topic* gestures) and a much smaller group that are unrelated to topic and focussed instead on the recipient and on the dyad's status as conversational partners (*interactive* gestures). Experiment 1 compared speakers in a face-to-face dyad with speakers who were alone; Experiment 2 compared dyads who were face-to-face with dyads speaking through a barrier. In both cases, the face-to-face dyads made significantly more interactive gestures, as predicted. In contrast, there were no reliable differences for topic gestures (an almost significant decrease for face-to-face dyads in Experiment 1 and a nonsignificant increase for face-to-face dyads in Experiment 2). It appears that the effect of visual availability may depend on the nature of the gesture.

In the present study, we added a new dependent variable that should be sensitive to recipient design. If speakers orient to their recipient's ability to see (or only hear) them, they should design the relationship between their words and gestures accordingly. If the recipient is going to see the videotape, speakers can use more *nonredundant* gestures, that is, gestures whose full meaning does not appear in words (which Slama-Cazacu, 1976, called "mixed syntax"). If the recipient is only going to hear the audiotape, speakers should use more gestures that are not redundant with their words. Thus, we predicted that speakers would divide their information between words and gestures differently depending on what the recipient would be able to use.

Verbal encodability

A final limitation of the classic encoding paradigm has been a virtually exclusive focus on visual availability (or recipient design) as the sole factor affecting the speaker's use of gestures. Common sense and some experimental data suggest that the nature of the material being described (e.g., how visual it is or how easily encoded into gestures vs. words) might also affect the speaker's rate or kind of gestures. Most studies have used a single task, one that facilitated gesturing (such as giving directions; Cohen & Harrison, 1973; Cohen, 1977). However, Krauss, Dushay, Chen, and Rauscher (1995) found an effect of task on the speakers' rate of gesturing. The rate was significantly lower for descriptions of synthesized sounds than for descriptions of graphic designs, and seven of their 12 speakers who were describing the tastes of various teas used no

gestures at all. Sounds and tastes are arguably less amenable to encoding into a visual medium such as gestures. Similarly, Graham and Argyle (1975) varied the *verbal* codability of sets of geometric figures and found significant effects on decoders' performance.

In order to explore other factors that might affect the speakers' use of gestures for communication, we added a second independent variable based on the *verbal encodability* of material being described. In both cases, the material was highly visual and easily described with gestures, but in one condition (comprised of familiar geometric patterns), speakers would be likely to have a good verbal vocabulary available as well, whereas in the other condition (an unusual dress), they would be unlikely to have the necessary vocabulary. We predicted that this variable would interact with recipient design: When describing a picture for which they had a poor vocabulary, speakers addressing a recipient who would see them on videotape should gesture at a higher rate, and more of these gestures should be nonredundant with their words. For them, using gestures to supplement words would be a good communication strategy.

Summary of design

In order to study *when* speakers use gestures to communicate, we manipulated two factors that we hypothesized would be influential. The first was the speakers' assumption about whether their recipient would see their gestures or not. All speakers were alone and knew they were being videotaped, but their task was to describe a picture to a hypothetical partner who would either see the videotape of their description (*video condition*) or only hear an audiotape of their description (*audio condition*).

The second factor was the nature of the picture being described, specifically, whether the speaker would have a good verbal vocabulary available or not. In the *dress condition*, they described an 18th century dress (Blum, 1982, p.14) with many features for which a contemporary individual is unlikely to have vocabulary but which could be depicted gesturally; see Figure 1.

In the *maze condition*, they described a path that included many geometric outlines for which vocabulary is readily available ("circle", "S-shaped", "diamond", etc.); see Figure 2.

In order to study *how* speakers use gestures to communicate, we analysed two major dependent variables: the traditional measure of rate of gestures per minute and also the redundancy/nonredundancy between gesture and the

Figure 1. 18th Century dress described by speakers (low verbal encodability)[1]

accompanying words. Later, we added a third variable, the rate of deictic expressions ("like this", "over here"), which explicitly indicate the use of gestures to communicate.

We predicted that speakers producing a description for a recipient who would see their videotape would use gestures at a higher rate and that their gestures would be less likely to be redundant with their words than speakers who were speaking to someone who would only hear their audiotape. Similar effects should be found for the dress vs. the maze. In particular, we predicted that the audio-video variable would interact with the nature of the picture being described, that is, speakers describing the dress to a viewing recipient should have a higher rate of gestures and of nonredundant gestures than in the other three conditions. These speakers would find gestures necessary and useful for encoding and also knew their recipient would see them.

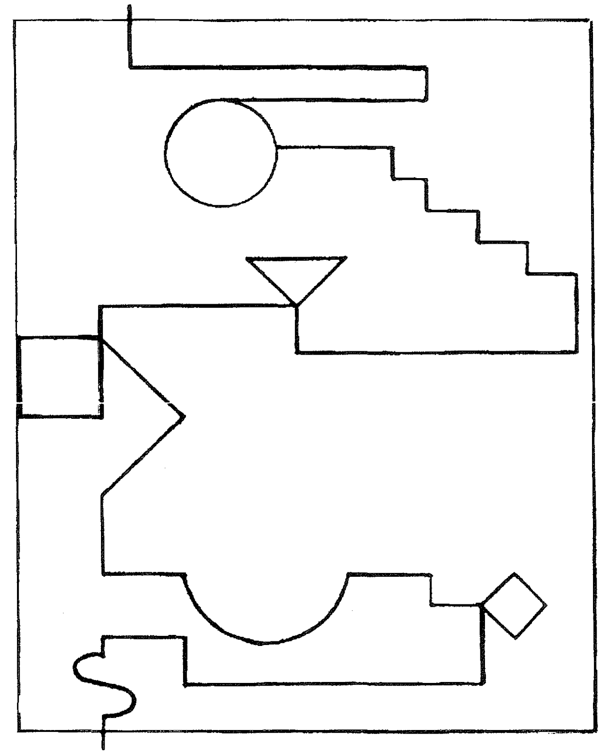

Figure 2. "Maze" described by speakers (high verbal encodability)

Method

Participants

Forty-six students from first-year psychology classes at the University of Victoria participated for course credit. All participants understood that they would be videotaped in our Human Interaction Lab and that they would be able to decide whether and how we could use the tape after viewing it. Data from six participants were replaced: two requested that their videotapes be erased, two did not think that they were allowed to gesture (and therefore deliberately suppressed gestures), one person was given incomplete instructions, and another did not follow the instructions. The final sample consisted of the planned 40 participants (24 women and 16 men).

Equipment

We used one unhidden, remotely controlled Panasonic WD-D5000 colour camera to film participants from an angle that was a few degrees to the left of face-on. Analysts used a JVC BR-S605-UB VCR and a 19-inch colour Sony monitor.

Materials

The two stimuli were 8.5 x 11 inch black-and-white laminated versions of the pictures shown in Figures 1 and 2. Pilot work had shown that individuals usually described up to 8 features of the dress, so we sought to design a comparison figure of equal complexity that had features for which there were familiar words. (As the figures show, however, the differences in verbal encodabilty do not apply to every feature in each picture.) The picture was in a clear plexiglass stand on a coffee table in front of the speaker.

In order to verify the intended differences between the pictures, we conducted a small study with the help of 39 volunteers in a first-year psychology class (as were the main participants). They saw seven successive overheads of the maze, each with a different salient feature highlighted, then seven of the dress with seven of its salient features highlighted. For each overhead, they were to write down a term that would identify the feature for another person; if they could not think of one, they could write "?". When they had finished, they rated (a) which picture they thought had more features that were difficult to find labels for and then (b) how much more difficult it was. Thirty-five of the raters said the dress features were harder to describe (mean = 6.8 on a 10-point scale), three said the maze, and one said no difference. There were significantly more "?" responses for the dress than the maze. We did not analyze their descriptions quantitatively, but the maze terms were mostly standardized and familiar terms (e.g., "circle"), while those for the dress were usually idiosyncratic and often vague or too general (e.g., "decoration").

Design

We were interested in the effects of two factors. The first was whether the speaker was describing the picture to a partner who would see a videotape of his or her description or to a partner who would only hear the audiotape. The second factor was the picture (dress or maze). Participants actually described both pictures in both media. We analyzed only their second description (in boldface below), when they would be more relaxed and accustomed to the situation. Thus, participants were randomly assigned to one of four groups:

	First description	**Second description**
1.	video/maze	**audio/dress**
2.	audio/maze	**video/dress**
3.	video/dress	**audio/maze**
4.	audio/dress	**video/maze**

Procedure

The experimenter began with an overview of what they would be doing and also explained that they would be able to see their videotape afterwards and decide who, if anyone, could see it, then gave the following instructions:

> We're interested in how people talk and how they describe different kinds of stimuli. What I'm going to ask you to do may seem a little silly, but it's not difficult. There are two parts to the task, and for each part I'd like you to describe a picture that I'll be giving you. What makes this task a little strange is that you'll be sitting here talking and there won't be anyone else in the room. We figured that it would make it easier if you imagined you are speaking to another person and try to focus on him or her. To help you focus on an imaginary person, we came up with a kind of scenario for you to role-play in.
>
> Here's the scenario: You are a participant on a TV game show. The object of the game is for you to describe a picture to your game-show partner. However, your partner is not present while you do this. They will only have access to your descriptions. The challenge is to describe the item as completely and accurately as possible so that your partner will be able to pick the same picture from a number of similar pictures.[2] Your partner has not seen the item before and will only have your description to make the decision. So try to describe as much of the detail as you can, in any way that you think will get the message across. You can take as long as you like; there are no time constraints. Any questions so far?

In the video condition, the experimenter went on to say:

> For this part of the task, I'd like you to describe a picture of an 18th century dress [*or*: an abstract figure; it looks kind of like a maze]. Your partner will get both the video and audio of your description and use that to make his or her decision. Talk directly to the camera as much as you can. Pretend that the camera is actually your partner. That's the view that they will be getting, so if you seem to be looking directly at them, it will help them to understand what

> you are trying to get across. Remember that the videotape will be the only information your partner will have, and they will have to choose this picture from a number of similar ones, so try to be as thorough as you can and look at the camera.

In the audio condition, the experimenter said instead:

> For this part of the task, I'd like you to describe a picture of an 18th century dress [*or*: an abstract figure; it looks kind of like a maze]. Here's the catch — your partner will only get the audio part of the tape. So remember that your partner will be looking at a number of similar pictures and will only be getting the audio part of the tape, so try to be thorough and accurate.

Before leaving for the adjacent control room, the experimenter added:

> Take a little time to look over the picture, and you can start whenever you're ready. Please leave the picture in the stand. Let me know when you're done and I'll come back in.

Then the instructions and picture were reversed for the second task. Afterwards, the participant came into the control room to hear a full explanation of the study, see his or her videotape, and sign a permission form controlling its use.

Analysis

We transcribed the second description for each participant, beginning with the first words that included any information about the dress or maze and ending when the participant indicated that he or she was finished.

Rate of gestures per minute

Four analysts worked on locating each gesture, separating contiguous gestures, and marking each occurrence in relation to the words on the transcript.[3] Their average inter-analyst agreement on a total of five transcripts ranged from 80.7% to 85.5%. The number of gestures in each description was divided by the length of that description (in seconds) and multiplied by 60 to yield the rate of gestures per minute.

Proportion of nonredundant gestures

The first step in assessing the redundancy/nonredundancy of gesture with words was to divide the transcripts into description units. Each description unit was a coherent unit of meaning describing a distinctive feature of the dress or maze. We attended closely to how the participant chose to deliver the information, for example, a discourse marker such as "next" or "and then" would indicate a new description unit. Depending on the speaker, the dress features could include the hat with feather (sometimes described jointly, sometimes as separate features); the V-shaped neckline or bodice; the sleeves and jacket on her upper torso (jointly or separately); the fan, including the angle of the arm and hand holding it; and so forth. Excluded were description units that did not pertain to specific features of the hat or dress, such as the floor pattern, her hair style, or the dress as a whole ("It looks like a ball gown"). The maze features usually included the circle; the stairs; the triangle; the square; and so forth. Descriptions of the lines leading up to a feature were included with the feature unless the speaker treated them as separate elements.

For both pictures, we then excluded description units in which no gestures occurred. The remaining units all included words and gesture(s) describing a particular feature of the dress and hat, or the maze. Then each gesture-word unit was rated as:

> 0 = the gesture is completely redundant with words
> 1 = the gesture has information that is not in the words[2]

One speaker's description of the line at the top of the maze illustrates a completely redundant gesture (in brackets above the words it accompanied):

(1) [depicts 90° angle]
"... has a one, two, three bends in it, three RIGHT ang– tri– , uh, three right angle, angles."

A nonredundant gesture occurred in this description of the hat:

(2) "and, like a big hat, like a turban-type thing around her head,"
[shows feather shape]
"with this feather coming down the back."

In order to maintain acceptable reliability, we did not distinguish among different degrees of nonredundancy for this part of the project. Two pairs of analysts independently assessed redundancy/nonredundancy for each description unit of the 40 speakers, with 87% agreement overall. The sum of the 0/1 values divided by the total number of gesture-word units represents the proportion of gestures that were nonredundant.

Use of deictic expressions

Early in the analysis, we became curious about how gestures (especially nonredundant gestures) were connected to the words they complement, whether explicitly or by timing alone. When the speaker uses an deictic expression such as "like this," "this long," or "down here," he or she is explicitly directing the recipient to look at and decode the gesture. These expressions thus constitute clear evidence of a speaker's deliberate use of a gesture to communicate information. An example from the present data was

(3) [depicts, then holds position]
"she's holding her arm *like this* with the fan in it"

The speaker bent her arm at an angle with a closed holding an imaginary fan in front of the speaker's chest.

Three analysts first examined the transcripts to locate and highlight each deictic expression, then each expression was checked against the videotape to verify that the speaker made an accompanying gesture. These decisions are straightforward and did not require formal reliability, although each transcript was checked by at least two individuals.

Apparently, speakers link their gestures and words primarily by timing and meaning, because relatively few deictic expressions occurred (53, or less than 3% of the 1,987 gestures in our data). They were so dramatically affected by audio/video condition that statistical tests were not possible. However, we will report their frequencies below.

Results

We conducted three planned comparisons on the two major dependent variables. First, we tested our prediction that, compared to the audio condition, the video condition would have a higher rate of gestures per minute and a higher proportion of nonredundant gestures. As shown in Table 1, both of these differences were significant. Also, both the number of individuals using deictic expressions and the total frequency was much higher in the video condition than the audio condition; they virtually did not occur in the latter.

Second, we tested the effect of the maze vs. the dress. As shown in Table 2, there was no difference in the rate of gestures per minute, but there was a significantly higher proportion of nonredundant gestures in dress condition. Deictic expressions were also more frequent.

Table 1. Mean effects of audio vs. video condition (planned comparisons)

	Video (n = 20)		Audio (n = 20)		Significance			Adjusted R^2
Measure	M	(SD)	M	(SD)	t	df	p	
Rate of gestures per minute	20.75	(9.52)	11.01	(8.10)	3.46	28.01[a]	.002	.22
Proportion of non-redundant gestures	0.66	(0.30)	0.34	(0.32)	3.51	36	.001	.20
Deictic expressions:								
Number of users	11		3					
Frequency	49		4					

[a] Equal variances not assumed.

Table 2. Mean effects of dress vs. maze condition (planned comparisons)

	Dress (n = 20)		Maze (n = 20)		Significance			Adjusted R^2
Measure	M	(SD)	M	(SD)	t	df	p	
Rate of gestures per minute	15.25	(9.53)	16.51	(10.70)	0.45	28.01[a]	ns	.02
Proportion of non-redundant gestures	0.63	(0.32)	0.37	(0.33)	2.88	36	.007	.12
Deictic expressions:								
Number of users	8		6					
Frequency	38		15					

[a] Equal variances not assumed.

Third, we tested the predicted interaction between factors and confirmed that the video/dress condition had a significantly higher rate of gestures per minute and also a significantly higher proportion of nonredundant gestures than did the other three conditions combined. Again, deictic expressions were also proportionately more frequent. See Table 3.

Finally, we confirmed that there were no significant differences in two extraneous variables: the total length of descriptions in the four conditions (see Table 4) or the speaker's gender.

Table 3. Mean effects of video/dress vs. all other conditions (planned comparisons)

Measure	Video ($n = 10$)		Other conditions ($n = 30$)		Significance			Adjusted R^2
	M	(*SD*)	*M*	(*SD*)	*t*	*df*	*p*	
Rate of gestures per minute	21.68	(6.24)	13.95	(10.36)	2.93	23.16[a]	.008	.09
Proportion of non-redundant gestures	0.80	(0.21)	0.40	(0.33)	3.76	36	.001	.23
Deictic expressions:								
Number of users	6 (of 10)		8 (of 30)					
Frequency	35		18					

[a] Equal variances not assumed.

Table 4. Length of description by condition

Condition	Time (min:sec)	
	M	*SD*
Video/Dress	3:34	1:45
Video/Maze	3:51	2:17
Audio/Dress	3:36	1:57
Audio/Maze	3:04	1:31
All conditions	3:22	1:51

Discussion

Our alternative manipulation of recipient design replicated earlier results, without their potential confounds. Speakers who expected their recipient to see a video of their description made gestures at a higher rate than speakers whose recipient would only hear an audio version. The addition of the nonredundancy measure also confirmed another effect of recipient design. Speakers addressing video recipients tended to shift more information from words to gestures, whereas speakers to audio recipients tended to use redundant gestures. Both effects suggest strategic decisions by the speakers, as does the disproportionate difference in the use of deictic expressions.

The poorer verbal encodability of the dress did not produce a higher rate of gesturing than the more easily described maze. One possible reason is that some parts of the maze (namely, the patterns of the connecting lines) are not necessarily easily encodable, and conversely the dress had some features that were easily named. However, the dress did elicit a higher proportion of nonredundant gestures and more deictic expressions. Speakers seemed to rely on gestures when words were not readily available.

The precision of speakers' decisions is clearest in the unique effect of the dress/video condition. Speakers who were describing the dress, for which they had a poor vocabulary, but who expected their recipients to be able to see them had the highest rate of gestures, the highest proportion of nonredundant gestures, and proportionately more deictic expressions. That is, they were highly attuned both to the usefulness of gestures for this picture and to their recipients' ability to use this information. All of these results support our hypothesis that recipient design is a major factor in the speaker's use of gesture.

Our findings suggest that experimental investigators should attend to more, and more subtle, variables such as the gestural or verbal encodability of the material, the relationship between the meaning of the words and of the gesture (e.g., redundancy/nonredundancy), and explicit markers such as deictic expressions. Our redundancy index is evidence that an important qualitative aspect of gestures can be captured quantitatively for those who prefer this mode of measurement.

Finally, these results raise some interesting questions about the debate over communicative vs. lexical access functions of gestures. Krauss and his collagues (e.g., Krauss, Morrel-Samuels, & Colasante, 1991, p. 744) have proposed that, in spite of significant effects of visual availability in the classic studies, the fact that gestures do not disappear when no recipient would see them undermines the communicative theory. This reasoning would also cite as evidence the gestures that occurred in our audio condition. Alternatively, Clark (1996, pp. 179–180) has proposed that gestures may be so integral to conversation that it is easier to make them than to suppress them. Although we agree with Clark's position, it could be read as saying that these gestures are speakers' errors. Our evidence reveals that, when their gestures would not be seen, speakers are much more likely to make them redundant and therefore not essential to their recipients (and not marked by deictic expressions). These speakers may be gesturing because it is natural to do so as part of speech, but they are also carefully monitoring the information they encode into gestures and words. Speakers' precision in when and how they use gestures definitely exceeds our current theories.

Notes

* Pickering (1991) conducted a pilot version of this design, and Rodney Beuthin, Jeff Hancock, and Tanya Merx assisted the authors with analysis. This work was supported by a research grant to the first author from the Social Sciences and Humanities Research Council of Canada, and Kenwood presented it at the First Congress of the International Society for Gesture Studies (Austin, Texas, June 2002).

1. From Blum (1982, p. 14). Copyright Dover Publications; reprinted with permission.

2. It has been pointed out that speakers did not know the alternatives that their addressees would have to choose from and therefore could not tailor their descriptions accordingly. However, because this was true for all conditions, it cannot provide an alternative explanation for specific effects. The most likely consequence would be increased individual variability, making experimental effects less likely.

3. Procedure available from the first author.

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Authors' address

Janet Bavelas, Christine Kenwood, Trudy Johnson, and Bruce Phillips
Department of Psychology, University of Victoria
P. O. Box 3050
Victoria, B. C.
V8W 3P5
Canada

E-mail: jbb@uvic.ca

About the authors

Janet Bavelas, Ph.D., is a Professor of Psychology who does research on the features of face-to-face dialogue (including gestures) that make it a unique form of language use.

Christine Kenwood, M. A., is a doctoral student in Psychology whose other research interests include discourse analysis, social constructionism, and program evaluation.

Trudy Johnson, M. A., M. P. A., has done research on communication and social processes and is currently a Senior Research Analyst doing applied research and program evaluation at Malatest & Associates, Victoria, B. C.

Bruce Phillips, M. A., is a doctoral candidate in Psychology and a Usability Engineer at Microsoft Corporation. Other research interests include computer-mediated communication and conflict resolution.