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An International Handbook on Multimodality in Human Interaction

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51. The social interactive nature of gestures: Theory, assumptions, methods, and findings

Abstract

There is a rapidly increasing number of social experiments on gesture use, that is, experiments with at least one condition in which both participants can interact freely. Already this experimental evidence shows that conversational hand gestures serve a variety of social interactive functions in face-to-face dialogues. First, speakers in a dialogue gesture at a higher rate than in a monologue–even when the speaker and addressee cannot see each other (e.g., on the telephone). Moreover, the form and function of speakers' gestures change to fit specific social conditions such as dialogue versus monologue, the presence or absence of mutual visibility, a shared or different visual perspective, and the presence or absence of common ground. Gestures also serve several functions other than conveying information about the topic of the dialogue: They contribute to maintaining the interaction process, and they provide the speaker with information about the gesturer's state of understanding. Altogether, these findings show how gestures communicate in social interaction. They also demonstrate that well-designed and controlled experiments need not reduce dialogue to the study of individuals but can study dialogue itself as an indivisible unit.

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1. Introduction

People use gestures primarily in social interaction, seldom when alone. What we mean here by *social interaction* is a face-to-face dialogue, and *gestures* are the conversational hand movements that people integrate with their words to convey meaning to each other in a dialogue. This chapter addresses both how to study the social nature of gestures experimentally and what such studies reveal about how the participants in a dialogue influence each other's gestures. Why do speakers gesture when talking on the phone? Why do interlocutors describe something to one person with clear, well-formed gestures then use sketchy, poorly formed gestures when describing the same thing to another person? Why do speakers gesture at some times and not others? It turns out that the answer to each of these questions is social, as revealed by experimental studies of gesturing in face-to-face dialogues.

Limiting this review to lab experiments requires some explanation. All gesture researchers find inspiration in the myriad details of everyday conversations. To pursue these compelling observations, it is necessary to videotape similar phenomena for careful study, which leads to a methodological choice: The researcher could either find conversations that are occurring naturally (e.g., at a party, a family dinner, or a playground) or elicit controlled experimental dialogues in the lab. Either context advances gesture research in its own way, and each method has its problematic aspects. Experimental researchers must achieve a balance between control and spontaneity. Some experimentalists believe that spontaneous dialogue inherently precludes experimental control, so they replace one of the participants with a confederate or themselves. We consider this "dialogicide" to be unnecessary, and our review will show that an increasing number of studies are achieving the desired experimental control without depriving the dialogue of its essential features. Indeed, one of our objectives here is to promote the use of face-to-face dialogue when collecting experimental data for investigations of social gesture use. After outlining the defining features of dialogue, we review the gestural findings from studies that used videotapes of real dialogues in the lab.

2. What is dialogue?

Many scholars have proposed that face-to-face dialogue is the primary site of language use (e.g., Bavelas 1990; Bavelas et al. 1997; Chafe 1994; Clark 1996; Fillmore 1981; Goodwin 1981; Levinson 1983; Linell 1982). Clark's (1996) outline of 10 essential features of face-to-face dialogue (see Tab. 51.1) provides a practical checklist for researchers who want to ensure that the gestural phenomena they elicit in the lab arise in real dialogues. Perhaps most germane is what is not a dialogue. Obviously, a speaker who is alone in the lab, describing something to a camera, is not in a dialogue; there is no addressee. But simply placing an addressee in front of the speaker is not sufficient. Both participants must be able to formulate their own actions spontaneously, be self-determined, and act as themselves.

Tab. 51.1: Ten unique features of spontaneous face-to-face dialogues

1. *Co-presence*: Both participants are in the same physical environment.
2. *Visibility*: They can see each other.

(*Continued*)

Tab. 51.1: *Continued*

3. A*udibility*: They can hear each other.
4. *Instantaneity*: They see and hear each other with no perceptible delay.
5. *Evanescence*: The medium does not preserve their signals, which fade rapidly.
6. *Recordlessness*: Their actions leave no record or artifact.
7. *Simultaneity*: Both participants can produce and receive at once and simultaneously.
8. *Extemporaneity*: They formulate and carry out their actions spontaneously, in real time.
9. *Self-determination*: Each participant determines his or her own actions (vs. scripted).
10. *Self-expression*: The participants engage in actions as themselves (vs. roles).

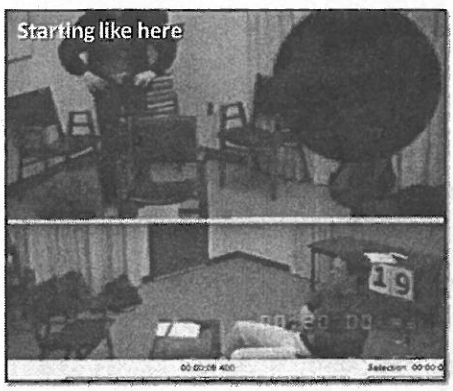
Note. Adapted from Clark 1996, pp. 9–10 Table 3.

The following 12-second excerpt of interaction (from Bavelas et al. 2008) illustrates a controlled experimental task in the laboratory that also fulfills all of Clark's criteria. The two participants, sitting across from each other, interacted spontaneously within their assigned task. A female speaker was describing a drawing of an unusual 18th century dress (shown in Fig. 51.1) to a male addressee who would later have to select a picture of this dress from an array of similar dresses. In this excerpt, the speaker was describing the large design on the front of the very wide skirt. The transcript below includes subscripts and underlining that indicate where each gesture occurred in relation to words, with the description of gestures and other actions in italics and square brackets below. Fig. 51.1 shows still photos of most of the gestures.

(Continued)


Kay so it goes out like that?


Starting where?


Starting like here

(*Continued*)

Fig. 51.1: Screen shots of the gestures made during the speaker's description of the large design on the center of the skirt in the picture above. The video is a three-camera split, with a side view of the speaker and addressee in the lower screen, a front view of the speaker in the upper screen, and a head shot of the addressee superimposed on the upper screen (except when the speaker stands and blocks that camera).

Speaker: $_1$*'Kay, so it goes out like that?*
[Starts to trace a symmetrical **W** *with both hands; holds end position of gesture in the air]*

Addressee: $_2$*starting where?*
[spreads hands in front of himself like hers and holds in position until gesture 3, below]

Speaker: Starting like- - -
[places hands in two new, different starting positions, but abandons both and looks perplexed]

'Kay, am I allowed to stand up? Probably. 'Kay,
[.....stands up.....] [shifts position and pushes her hair back]

$_3$*starting like here*
[Places hands at waist with fingers pointing inwards; holds]

Addressee: $_4$*on her waist?*
[moves hands to his waist and holds in same position as hers]

Speaker: $_5$_____ on her dress, $_6$*like a bit under her waist*
[keeps hands at waist, but rotates so thumbs inwards, holds] *[moves hands down about 2 inches]*

Addressee: Okay

The addressee asked two questions about the location of the design on the dress ("starting where?" and "on her waist?"), each time suspending his own hands as if waiting for the speaker to specify her description. The speaker worked hard to answer his questions, ultimately standing up to demonstrate the location of the design on her own body. Meanwhile, he was simultaneously using his own body as a reference point for his questions. At the end of the excerpt, the addressee's feedback ("Okay") signaled to the speaker that they had established common ground about where the design was located. At every moment, his questions and actions were influencing her gestures. The fluidity, spontaneity, and responsiveness to the addressee of her gestures was striking and, we propose, similar to gestures she might use in typical, everyday social interactions, such as describing something with unusual spatial characteristics to an addressee.

Any addressee (such as a confederate or the experimenter) who must respond only minimally violates the essential characteristics of dialogue and creates a different, unfamiliar kind of interaction. Without the precise reciprocity and collaboration inherent in a real dialogue, we cannot be sure that the gestures produced in the laboratory have anything in common with the gestures people use in everyday dialogues. There is evidence to suggest that natural behaviors by an addressee are not limited to back channels. They are closely linked, in both timing and meaning, to what the speaker is saying (Bavelas, Coates, and Johnson 2000), and a confederate or experimenter who is trying to respond in a "neutral" or "standard" manner could have unintended effects (Beattie and Aboudan 1994). When experimental researchers are knowledgeable about dialogue and take steps to ensure its essential features in the laboratory, they can be more confident that the conversation is a true dialogue.

3. Experimental investigations of social gestures

The rest of this article reviews experiments with dialogic data that fulfill Clark's checklist of 10 essential features. These studies provide not only a variety of models for social gesture experiments but also evidence that spontaneous interaction in the lab does not eradicate experimental control. Each study had sufficient control of variability to reveal informative gestural differences between conditions.

The review begins with evidence that participants in a dialogue actually gesture more than speakers who are alone or with a constrained addressee. Beyond that, the available experimental research demonstrates that

(i) participants in face-to-face dialogues use gestures to manage the interpersonal, interactive aspects of their conversations;
(ii) they collaborate with gestures, using each other's gestures to complete a shared task successfully and efficiently; and
(iii) speakers adapt their gestures to a number of social variables.

3.1. Speakers in dialogues gesture more

A perplexing pattern of results in the gesture literature is that even when their addressees are out of sight (e.g., sitting behind a partition), speakers still gesture, either at a lower rate than when the addressee was visible (Alibali, Heath, and Myers 2001;

Cohen 1977; Cohen and Harrison 1973; Emmorey and Casey 2001; Krauss et al. 1995) or at the same rate (Bavelas et al. 1992, Experiment 2; Rimé 1982). Why would speakers gesture to an addressee who cannot see them? Bavelas et al. (2008) pointed out a confounding variable in this group of studies: These experiments manipulated whether the participants could see each other, but not whether they were participating in a dialogue.

Bavelas et al. (2008) hypothesized that participating in a dialogue might independently elicit gesturing, regardless of whether the gestures were visible. These authors tested their hypothesis by creating three conditions that disentangled visibility and dialogue. Speakers described the 18th century dress in the example above to an addressee in face-to-face dialogue (visibility plus dialogue), to an addressee on the telephone (dialogue only), or alone in the room to a tape recorder (neither visibility nor dialogue). The authors used linear regression to separate the effects of visibility and dialogue on the rate of gesturing, checking first for an effect of visibility, then for an additional, independent effect of dialogue. They found that restricting visibility did suppress gesturing, but participating in a dialogue significantly increased it. For example, speakers gestured at a significantly higher rate in the telephone condition than in the tape recorder condition, which differed only in whether the speakers were participating in a dialogue. Interestingly, although speakers appeared to gesture at a higher rate in the face-to-face condition compared to the telephone condition, this difference was not significant, a finding that replicated two of the earlier visibility experiments. Bavelas et al. (2008) noted that these shared a methodological feature:

> In Rimé (1982), Bavelas et al. (1992, Experiment 2), and the present experiment, the speaker and addressee were both participants who could interact freely and spontaneously, when and as they wished. In contrast, the five experiments that found a significant effect of visibility were also the ones that constrained the addressee (who was usually the experimenter or a confederate) to a limited repertoire of responses. (Bavelas et al. 2008: 512)

Comparing the three dialogic studies to the other five (cited above) provided additional evidence that being in a real dialogue increases gesturing, even if the participants cannot see each other.

Beattie and Aboudan (1994) focused specifically on how sensitive gesturing was to how closely the speaker's context resembled a real dialogue. They asked speakers to describe a cartoon narrative three times, once alone in a room (nonsocial/monologue), once to a confederate addressee who was present but unresponsive (social/monologue), and once to a confederate addressee who interacted freely (social/dialogue). There was a stepwise pattern of results: Participants gestured least in the nonsocial setting, slightly more in the social/monologue setting, and most in the social/dialogue setting. Strikingly, the difference between having a nonresponsive addressee and no addressee at all was not significant: Speakers talking to an unresponsive addressee did not gesture much more than when there was no addressee at all. However, the difference between the social/monologue and social/dialogue conditions was significant. Participants gestured almost three times more when talking to a freely responding addressee than to an unresponsive addressee. This effect of what Clark (1996) called *extemporaneity* has obvious implications for investigations of social gesture use. The authors had even broader conclusions, asserting that "in future, those theorists who wish to use gesture as an

important window on the computational stages of the human mind might find it necessary to pay more attention to the social contexts from which their data is extracted" (Beattie and Aboudan 1994: 260).

3.2. Some gestures are specialized for dialogue

The vast majority of gestures illustrate the topic of discussion, but some appear to have a different function. Bavelas and colleagues (Bavelas et al. 1995; Bavelas et al. 1992) investigated these non-topical gestures using a variety of videotaped, task-oriented dialogues, including retelling a cartoon narrative, explaining how to get a book out of the library, and telling a close-call story. They began by locating all of the gestures in these face-to-face dialogues, then excluding gestures that depicted any aspect of the topic of the dialogue. Approximately 15% of the gestures remained, all of which shared two common features. First, the gesturer's hand was oriented toward the addressee (e.g., quickly pointing one or more fingers at the addressee or displaying an open palm to the addressee). Second, the gesture referred directly to the addressee; a paraphrase of the gesture would include the word "you." For example, while discussing how to use the library's card catalogue, one student had made suggestions about how to look up books. Later, the other student referred to this suggestion, saying "then look it up under the appropriate thing." As he said "appropriate," the speaker flicked his finger toward the addressee. This gesture did not refer to using a card catalogue; it cited the other person as the original source of the information – the gestural equivalent of "as you said" (Bavelas et al. 1992: 475–476). The authors proposed that participants used these gestures to serve a variety of interactive purposes, such as requesting help with a word search (e.g., by holding the palm out as if to receive something from the addressee) or referring to something that the participants had discussed earlier and was now common ground (e.g., by flicking the hand toward the addressee, which in this context indicates "as you know"). These gestures appeared to be related to the social interaction independently of topic, so Bavelas et al. (1992) proposed that they had *interactive* rather than *topical* functions.

Bavelas et al. (1992; 1995) embarked on a series of experiments to confirm that these gestures with interactive functions were indeed linked to dialogue, while the other gestures were linked to topic. In the first study (Bavelas et al. 1992: Experiment 1), participants described the same material under two different conditions: the speaker was talking to an addressee or was alone in the room. The latter group talked to the camera, although they knew the experimenters were watching from the control room. As predicted, there were more interactive gestures when the speakers were in dialogue than when alone; the topic gestures showed the opposite trend. In the next study, Bavelas et al. (1992: Experiment 2) tested the hypothesis that, if speakers made interactive gestures solely for interactive purposes, these should be less likely to occur if the addressee could not see them. As predicted, the rate of interactive gestures was significantly higher for participants who were speaking face to face compared to those speaking through a partition. The same variable did not significantly affect the rate of topic gestures. To test their hypothesis that gestures with interactive functions were an efficient way for the speaker to include and refer to the addressee without interrupting the topic of the dialogue, the authors developed a reliable redundancy analysis for the gestures in

both of these experiments. The analysis revealed that interactive gestures were significantly less likely to be redundant with words than topic gestures were. Whereas the modal topic gesture added no information to the phonemic clause it accompanied, the modal interactive gesture was completely non-redundant with the words.

Together, these results confirmed that gestures with interactive functions responded to the availability of a visible addressee, but what if the visible addressee was not engaged in interaction with the speaker? The next experiment (Bavelas et al. 1995: Study 1) addressed this question with two conditions that were both face-to-face dyads. In one condition, the dyads retold a cartoon together in a full dialogue. In the other condition, one participant retold the first half of the cartoon, then the other participant retold the second half; they could not help each other, so they were in sequential monologues. The results showed that, even though there was a visible addressee in both conditions, the dyads in the full dialogue condition made interactive gestures at significantly higher rate than those in the sequential monologues. Finally, they tested whether addressees understood and responded to the various functions of the interactive gestures. For example, when the speaker made a word-searching interactive gesture, would the addressee provide a word, even though the speaker had not asked for assistance verbally? One set of analysts identified the specific function of a large random sample of the interactive gestures in the data, and another set of analysts classified the addressee's response. The predicted effect of interactive gestures on the addressees' immediately subsequent behavior was statistically significant. Altogether, the series of studies showed that this relatively small group of previously unnoticed gestures seem to be an efficient way for interlocutors to manage the social requirement of including and coordinating with each other, moment by moment, in their dialogue.

3.3. Gestures can be collaborative

Furuyama's (2000) study showed how dyads built on and elaborated each other's gestures. In each dyad, Furuyama taught one participant (the Instructor) how to fold an origami figure. Then, he videotaped the Instructor teaching the other participant (the Learner) how to do it. The dyads did not have any origami paper for this task, so they could only use words and gestures. The data revealed what Furuyama called *collaborative gestures*, "which interact with the gestures of the communicative partner (...). The meaning of this type of gesture crucially depends on the interlocutor's gesture, since the interlocutor's gesture is a part of the collaborative gesture as a whole" (Furuyama 2000: 105). For example, an Instructor was gesturally depicting the origami paper as having been folded into an imaginary triangle, and was starting to depict the next fold. The Learner interrupted and took over, saying "and you take this corner" while gesturally picking up and moving the corner of the instructor's triangle – which was, in fact, empty space (Furuyama 2000: 106). The Instructor's gestures had created a virtual origami paper, and both participants' gestures could maintain, manipulate, and even refer to it deictically ("this corner"). Almost 18% of the 400 Learners' gestures analyzed were collaborative gestures (calculated from Furuyama 2000: 108, Table 5.2). The Learners also contradicted the generalization that individuals only gesture with their own speech, because they often timed their collaborative gestures with the Instructor's speech rather than their own. Moreover, whether the Learners made collaborative gestures depended on the form of the Instructor's gestures. In

sum, participants used collaborative gestures in intricate coordination to complete a potentially difficult spatial task with ease.

3.4. Gestures can monitor understanding

Clark and Krych (2004) showed that, when collaborating to accomplish a joint task, the participants can use gestures as a means of providing moment-by-moment feedback about their mutual understanding of instructions. Dyads in this study consisted of Directors, who had models constructed from Lego blocks, and Builders, who could not see the models but who had to build them according to the Director's instructions. Clark and Krych (2004) manipulated whether participants could see each other or not and whether they could interact in dialogue or not. They found that the dyads who completed this task significantly more quickly were the ones in which the Director could see the Builder's workspace and in which the two participants could interact freely. In order to discover the behaviors and processes that led to this advantage, they reliably analysed the details of these particular interactions. They found that the Builders' gestures were central to a dyad's efficiency. Builders often responded to Director's instructions with provisional actions, such as pointing to a particular block, picking it up to exhibit it to the Director, or poising a block over a possible position. These actions, all of which the authors considered to be communicative gestures, provided overt displays of the Builders' current state of understanding, and they had an immediate influence on Director's utterances. For example, when the Builder's gesture indicated a correct understanding, the Director often broke off further instruction about that step – even in midsentence – and moved on to the next one. In contrast, when the Builder's actions proposed a potentially incorrect step, the Director would insert a precisely timed correction to redirect the Builder. Thus, Clark and Krych (2004) demonstrated that one of the advantages of a face-to-face dialogue is the availability of gestures, which the participants can use to monitor (and to correct) their mutual understanding.

3.5. Social variables shape gestures and their relationship to words

3.5.1. Visibility

This literature review opened with a description of a study by Bavelas et al. (2008) showing that the apparent effect of visibility on the rate of gesturing has been confounded by a strong effect of dialogue. However, the same data set (gestures used when describing the 18th century dress) showed that visibility does have a strong effect on gesture features other than their rate. Gestures in the face-to-face condition were more communicative than gestures in the telephone and tape recorder conditions, in four ways: First, in face-to-face dialogue, speakers made life-sized gestures that depicted the dress in proportion to the size of a human body. These speakers often placed these gestures around their own body, as in the example at the beginning of this chapter. In contrast, speakers on the telephone and tape recorder conditions made small gestures that matched the size of the picture of the dress. Second, in face-to-face dialogue, speakers made interactive gestures at a higher rate than in the conditions where no one would see them. This replicated the results of Bavelas et al. (1992: Experiment 2). Third, in face-to-face dialogue, speakers' gestures were significantly

less likely to be redundant with the concurrent words. That is, the gestures were more likely to contribute unique information, which was not being conveyed verbally. In telephone dialogues and tape recorder monologues, the information in the gestures added little information over and above what the immediately accompanying words conveyed. The fourth, related finding was that speakers in the visibility condition accompanied significantly more of their gestures with verbal deictic expressions (such as "here" or "there"). These deictics drew attention to the gesture, which carried information that was not in the words. Speakers in telephone dialogues and tape recorder monologues rarely marked their gestures with deictic expressions. All four of these effects suggest that the speakers whose addressees could see them drew on their gestures as a communicative resource, while the other speakers did not.

Kimbara (2006, 2008) demonstrated another effect of visibility on gestures, namely, whether interlocutors who can see each other tend to use similar gestures for the same events. Gestures depicting a particular referent can do so in a variety of ways. For example, speakers can demonstrate someone running by moving their own arms as though running, by wiggling two fingers to represent little running legs, or by tracing a path in the air. In the 2006 study, Kimbara showed that interlocutors tended to encode gestures about the same referent in the same way (e.g., they might both wiggle their fingers to show a man running). However, this effect might have nothing to do with seeing each other's gestures. It could emerge solely from participants' shared linguistic context and subsequent convergence on linguistic encoding (i.e., they use similar words in a similar context). Kimbara (2008) tested this possible alternative explanation by varying visibility. Ten dyads watched 10 short excerpts from cartoons. After each excerpt, the dyad retold the excerpt together "in as much detail as possible so that a person who had not seen the clips could understand what was being described" (Kimbara 2008: 126). To test the effect of visibility, Kimbara alternated the retellings between two conditions: the participants could see each other or they had a blind pulled down between them so that they could hear but not see each other. Kimbara located all instances of coreferential gesture pairs and analyzed them for convergence of the gestures' form. The results showed that when participants could see each other, their gesture forms converged significantly more often than when they could not (66% vs. 30%). Thus the similarly in form could not be attributed to shared linguistic context and verbal encoding; it was an effect of visibility, of being able to see each other's gestures.

3.5.2. Addressee location

Özyürek (2000, 2002) examined the effects of participants' spatial relationship to each other on the form of speakers' gestures. The speakers in these experiments had watched a cartoon, which they then narrated to addressees who had not seen it. In the 2000 study, speakers narrated the story twice, once to a pair of addressees who were seated at either side of the speaker in a triangular formation and once to a single addressee who was sitting on one side of the speaker. In the 2002 study, the speakers narrated the story to only one addressee, who sat either directly across from the speaker or off to one side. The cartoon included several situations where characters or objects moved from one place to another (e.g., running into a building or climbing up a drainpipe). In both studies, Özyürek analysed the gestures speakers used to describe these movements. The speakers' gestures that depicted "into" and "out of" differed

according to the location of the addressee or addressees: Speakers' gestures represented the direction as "into" or "out of" the space that the participants shared, which differed in each experimental condition. That is, speakers accommodated to whether the addressee was sitting to the side rather than facing them, presumably so that the meaning of their gestures would be clear to their addressees. Özyürek also provided evidence that it was specifically the shared physical space between participants that led to the differences in gesture trajectory. First, speakers did not change their verbal descriptions when the shared space changed, so the adjustments in gesture direction and orientation were not due to changes in their speech. Second, there was no change in gestures for the movements that would not be affected by these seating conditions. For example, a gesture indicating "up" looked the same whether participants were sitting face to face or side by side. It was the relationship between the meaning that the speakers were conveying and the configuration of their shared space that determined differences in the speakers' gestural representations of the same movements in the cartoon.

3.5.3. Shared visual perspective

Bangerter (2004) investigated how participants can elect to contribute information either in words or in gestures in order to minimize the collaborative effort required to establish mutual understanding. Pairs of participants did a referential communication task. The Director in each pair had an array of photos of faces that were arranged in a particular order. The Matcher in each pair had to arrange his or her own set of photos in the same order, according to the Director's instructions. Although they couldn't see each other's set of photos, the participants could refer to a larger array of photos that was on a board that both participants could see. Participants were free to use whatever means of communication they chose to refer to the photos, including words (i.e., descriptions of the photos) or gestures (i.e., pointing at the display board). Bangerter manipulated two variables. The first was whether Directors and Matchers could see each other and thus use pointing to refer to the photos. When the participants could not see each other, they used significantly more words to do the task. Presumably, this difference was because they could not use pointing, only words. Second, he manipulated the distance between the board and the participants, which changed their shared visual perspective and therefore the relative utility of words and pointing. At close distances, pointing was an efficient and unambiguous strategy for referring to particular photos, and both participants used pointing to indicate a particular photo rather than verbally describing the location and features of the photo. They often combined pointing with verbal deixis (*this*, *that*, *here*, *there*), which suppressed or replaced full verbal descriptions. At farther distances, where pointing at the closely grouped photos would be more ambiguous, participants used verbal descriptions. These findings strongly suggest that the participants were systematic, flexible, and opportunistic in how they use their words or gestures to establish reference as quickly and accurately as possible, given their shared perspective.

3.5.4. Addressee knowledge

Common ground is another social factor that influences speakers' gestures. Gerwing and Bavelas (2004) manipulated common ground experimentally using several groups

of three participants. One participant was randomly assigned to be the target participant. The experimenter seated all three out of each other's sight and gave each of them some toys (e.g., a "finger trap" or "whirligig"). The target participant had the same toys as one of the participants (creating common ground) but a different set from the other (and therefore no common ground). When they had all finished trying out their set of toys, the experimenter told them which two had had the same set and which one had a different set. The experimenter then asked the three participants to briefly discuss what they had done with their toys, but to do so in assigned pairs with the extra participant waiting out of earshot. In the first two dialogues, the target participant talked to each of the other two participants in counter balanced order, which created a within-subjects comparison. Because the objects did not have well standardized names, the participants depicted what they had done using gestures. When their addressee did not share common ground, the target participants' initial gestures were reliably judged to be more complex, precise, or informative than when the addressee did share common ground. Common ground led to sketchier, "sloppier" gestures, presumably because these were all that this addressee needed. In addition, a qualitative analysis of the pairs without common ground showed that their gradual accumulation of common ground over the course of the dialogue similarly influenced the form of their gestures. Successive gestures referring to the same object showed a given-new effect, that is, gestures for new information about a referent were sharp and clear, and later gestures for the same referent became more schematic.

Holler and Stevens (2007) followed up these findings by including both speech and gesture in their analysis so they could investigate how common ground influenced the interplay between the two modalities. They focused on how participants' expression of *size* in speech and gesture was influenced by whether the participants shared common ground. The authors used a referential communication task, specifically, several "Where's Wally" pictures that prominently featured large objects such as a gigantic knots in a pipe or an unusually large, dome-shaped roof on a house. Each speaker described these pictures and the locations of these large objects either to an addressee with whom the speaker had previously looked at the pictures, that is, who had seen the same pictures (common ground condition) or to an addressee who had not seen them (no common ground condition). Holler and Stevens (2007) found that how speakers used words and gestures to refer to the large objects differed significantly according to whether they shared common ground or not. Although speakers in both conditions used verbal size markers (e.g., "big," "huge," "enormous") equally, those in the no common ground condition often accompanied these words with gestures that were large enough to depict the size accurately. Speakers in the common ground condition did not accompany their verbal size markers with gestures as often; when they did, the gestures were significantly smaller than the gestures produced in the no common ground condition. In summary, in the common ground condition, speakers expressed the size of the objects with their words but used their gestures in the no common ground condition. Holler and Stevens (2007) pointed out that researchers should consider both the linguistic and imagistic sides of utterances when deciding whether speakers have become more elliptical. In other words, analyzing only speech or only gesture is not sufficient.

4. Conclusion

The rich group of experiments reviewed here documents the important role that hand gestures play in language as a social process. Moreover, these experiments illustrate the variety of tasks and variables that can be used to elucidate gestures' functions, as well as an equal variety of dependent variables to assess effects of these variables. The findings include evidence that participants in a dialogue gesture at a higher rate than speakers who are in a monologue or with a constrained addressee. In addition, participants in face-to-face dialogues use interactive gestures that function specifically to manage interactive aspects of their conversations. Furthermore, participants can monitor each other's gestures to display and check their mutual understanding in order to complete a task together. Finally, speakers adapt their gestures to a wide variety of social variables, including whether the participants can see each other, where they are sitting in relation to each other, what they can see, and whether the addressee is familiar with what the speaker is describing.

As noted at the outset, our primary theoretical assumption is that the fundamental site of social interaction is face-to-face dialogue – unmediated, spontaneous, and reciprocal conversations between at least two interlocutors. Because face-to-face dialogue is also the primary site of conversational gestures, the understanding of these gestures must draw as much on social interactive processes as on factors attributed to individuals (e.g., cognition, culture, personality, etc.). These two assumptions have strong methodological implications. None of the above findings could have arisen in experiments that used an individual alone, with an experimenter, or with a confederate; they required a real addressee. If, as Lockridge and Brennan (2002) have shown in another area, there are different results for the same experimental procedure when using real versus confederate addressees, then methods that do not include real social interaction in face-to-face dialogue have questionable generalizability to the natural use of conversational gestures.

Fortunately, the number of truly social experiments on gestures has increased rapidly in the past decade, showing that it is possible to do experimental investigations of gestures in full face-to-face dialogues. The variety of published experiments reviewed here have already contributed both substantive results and methodological exemplars. It is therefore possible, fruitful, and necessary to leave the narrow constraints of reductionism in order to continue to advance our knowledge of the social interactive nature of gestures. The neuropsychologist Alexander Luria pointed out that the principle of reduction to the smallest possible element is not a scientific necessity. Indeed,

> there are grounds to suppose that it may be false. To study a phenomenon, or an event, and to explain it, one has to preserve all of its basic features. (...) It can easily be seen that reductionism may very soon conflict with this goal. One can reduce water (H_2O) into H and O, but – as is well known – H (hydrogen) burns and O (oxygen) is necessary for burning; whereas water (H_2O) has neither the first or second quality (...). In order not to lose the basic features of water, one must split it into *units* (H_2O) and not into *elements* (H and O). (Luria 1987: 675, emphasis in original)

We propose that, in order to learn about the social interactive nature of gestures, the indivisible *unit* of study must be a true dialogue. Attempting to learn about dialogue from the study of individuals will lose the basic features of social interaction, just as studying hydrogen and oxygen separately loses the basic features of water.

5. References

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