J Nonverbal Behav
DOI 10.1007/s10919-006-0014-2

ORIGINAL PAPER

Seeing and Hearing Double: The Influence of Mimicry in Speech and Gesture on Observers

Fey Parrill · Irene Kimbara

Abstract How sensitive are we to mimicry in speech and gesture, and to what extent does observing mimicry affect our behavior? We addressed this question by asking whether participants who watched a video stimulus containing subtle instances of mimicry would adopt the mimicked features when describing the stimulus. Our participants watched one of four different video clips. The clips showed two people interacting, and contained varying degrees of verbal and gestural mimicry. Participants then described the stimulus, and their speech and gesture were analyzed. Participants who observed more mimicry reproduced more of the mimicked features in their descriptions—despite the fact that these cases of mimicry were quite subtle—indicating a high degree of sensitivity to mimicry.

Keywords Gesture · Mimicry · Syntactic Priming

Mimicry in Speech and Gesture

As researchers who study the way humans communicate, we regularly see cases where one participant in a conversation adopts her interlocutor's speech or gesture. We are

F. Parrill(✉)
Departments of Psychology and Linguistics, University of Chicago, Chicago, USA
e-mail: fey.parrill@case.edu

Present Address:
F. Parrill
Department of Cognitive Science, Case Western Reserve University, Cleveland
OH 44106-7063, USA

I. Kimbara
Department of Linguistics, University of Chicago, Chicago, USA

Present Address:
I. Kimbara
Kushiro Public University, Kushiro, Hokkaido, Japan

not the first to observe this pattern, of course. There is a large body of research on the convergence of verbal and nonverbal behavior across speakers, or *mimicry*. Mimicry is intended as a general term for one person's repetition of another's behavior. It can be seen as a special case of repetition, wherein the repetition occurs across speakers. Other terms describing this behavior include *mirroring* and *synchrony*. Mimicry need not be intentional or deliberate, and may arise from very basic priming mechanisms (Bock, 1986). It may happen in periods of overlap (where both parties engage in a behavior simultaneously) or sequentially (where one party's behavior is repeated by the second party). Verbal behaviors which are frequently mimicked include accent, intonation, word choice, and sentence structure (Levelt & Kelter, 1982; Weiner & Labov, 1983). In the nonverbal realm, mimicked behaviors include facial expressions, posture, and gestures (Bernieri, Davis, Rosenthal & Knee, 1994; Cappella & Palmer, 1990; Gilbert, 1993; Hale & Burgoon, 1984; LaFrance, & Broadbent, 1976; see also Tickle-Degnen & Rosenthal, 1987).

Mimicry in both modalities (verbal and nonverbal) occurs naturally in multi-party interactions. Indeed, in speech, we have a general tendency to reuse things we have just heard (Bock, 1986). In the following exchange, for example, A's question is reused in B's response. A: *What do you like about the city*? B: *What I like about the city is the museums*. Different mechanisms and functions have been proposed for verbal mimicry. Some researchers focus on the processing benefits which repetition might confer on language users (e.g., Bock, 1986; Pickering & Garrod, 2004). For example, hearing a sentence may prime that structure in one's memory, making it easier to formulate one's own speech. Other researchers have suggested that mimicry serves to signal comprehension: by reusing someone's speech you can indicate that your representation of the conversation is the same as your interloctutor's (Halliday & Hasan, 1976; Weiner & Labov, 1983).

Mimicry in nonverbal behavior also arises naturally in communicative situations. Some of the behaviors mimicked across participants do not have a close link to speech, such as posture (LaFrance & Broadbent, 1976) and so-called *self-adaptors* (Chartrand & Bargh, 1999). Self-adaptors (Ekman & Friesen, 1969) are actions such as moistening the lips, scratching the head and face, or tapping the foot. While such behaviors are meaningful in the sense that they may indicate nervousness (Ekman & Friesen, 1969), their meaning is not related to the accompanying speech (and they can, in fact, occur in the absence of speech). de Fornel (1992) and Tabensky (2001), however, have shown that mimicry also occurs for Ekman and Friesen's (1969) category of *illustrators*. Illustrators are gestures where the information represented in the hand movements is related to the message conveyed in speech (McNeill, 1992). For example, a speaker who is talking about a baseball might produce a gesture in which her hand forms a fist. Such a gesture illustrates geometric properties (roundness, internal solidity) of the object, hence the term *illustrator*. In this paper, we will focus on this type of speech-linked gesture. Like mimicry in speech, mimicry in gesture describes the recurrence of features of a gesture (the shape of the hand, its motion, etc.) across speakers (Kimbara, 2006).

The phenomenon of mimicry has attracted the interest of cognitive psychologists and linguists because it is informative about the processes involved in producing and understanding speech and gesture. In addition, the phenomenon has attracted the interest of social psychologists because it seems to offer a route to understanding a variety of high-level interpersonal phenomena, particularly the development of a sense of rapport between interactants. Chartrand and Bargh (1999), for example,

have shown that mimicry of particular types of self-adaptors (e.g., foot tapping and face scratching) can cause the mimicked person to perceive an interaction as more positive. It also appears that non-participating observers associate mimicry with positive interactions. In the studies of Bernieri and his colleagues (Bernieri, Gillis, Davis, & Grahe, 1996), observers asked to rate interactions with varying degrees of verbal and nonverbal mimicry viewed those exchanges with greater mimicry as more positive. In short, mimicry seems to have consequences for our communicative behaviors and social interactions.

Gesture is often cited as a behavior in which mimicry appears. Previous research on mimicry in the nonverbal modality, however, tends to use the word *gesture* as a cover term for any kind of hand movement. That is, *gesture* often includes both self-adaptors and illustrators. For example, Bernieri and colleagues list gesture as a dimension of variation in the interactions they showed to their participants, but they do not make any distinction between different kinds of hand movements (Bernieri et al., 1996). As noted above, different categories of hand movements can have very different functions, and are thought to be generated by very different cognitive systems (McNeill, 2005). In this study, we consider only gestures that have a meaningful link to the speech with which they are produced. The term *gesture*, as used here, will thus refer exclusively to illustrators.

In considering only this kind of hand movement, we are attempting to address several questions that have not been thoroughly explored in previous research. Because many researchers studying mimicry are social psychologists rather than linguists or psycholinguists, gesture and speech are often treated as separate channels. In reality they are very closely linked. Our study treats the two modalities as a unified whole. Ideally, mimicry should be assessed by looking at naturalistic interactions. When considering the relationship between speech and gesture, however, it becomes very difficult to control for the content of speech, and the form, content, and timing of gestures. For this reason, we elected to explore *observers*' sensitivity to mimicry, following Bernieri and colleagues (Bernieri et al., 1996). We examined sensitivity to mimicry by looking at the speech and gesture participants produced when they described a video stimulus. We ask the following questions: How sensitive are observers to mimicry in speech and gesture? To what extent does observing mimicry affect people's behavior? Are people equally sensitive to mimicry in speech and in gesture?

Notice that this measure is somewhat indirect, relative to, for example, asking an observer to identify cases of mimicry in a stimulus. This measure was selected because it allowed us to assess participants' sensitivity to mimicry without explicitly directing attention to it. A major reason to avoid explicitly asking observers to detect mimicry is that, in most contexts, gestures which occur with speech are not consciously monitored (McNeill, 1992). That is, neither the speakers producing them nor the addressees observing them are typically aware of their presence. A more direct measure, therefore, might result in an unnatural attentiveness to gesture which would ultimately be uninformative. In addition, asking observers to identify cases of mimicry might encourage them to treat speech and gesture as separate channels. We were particularly interested in a measure in which the content of the two could function as a unified whole, as it does in natural interactions.

In the study presented here, each participant watched one of four different video stimuli. In these stimuli, two people discuss their plans for carrying out a task. These stimuli were created, rather than being taken from naturally occurring interactions.

Two factors varied across the stimuli: the extent to which speech was repeated across the two speakers, and the degree of similarity in the gestures produced by the two speakers. We predicted that participants who observed more mimicry in the stimulus would reproduce more of the mimicked features in their descriptions.

Two comments are necessary at this point. First, although the stimuli were scripted, our participants did not find them unnatural. (Our procedure for creating the stimuli and assessing their naturalness is described in the methods section.) Second, the cases of mimicry in our stimuli were subtle, and were never exact copies. Because mimicry is a kind of repetition, an experiment using mimicry as an independent variable conflates mimicry (repetition across speakers) with the number of times a participant observes some element in speech or gesture (repetition).[1] By making the instances of mimicry in our stimulus as covert as possible, we hoped to mitigate this problematic aspect of the study design.

Methods

Overview

Each participant watched one of four different 30 s stimulus videos. Participants then described the video to the experimenter.

Participants

Forty University of Chicago undergraduates participated in the study for payment. Participants (26 female, 14 male) were native speakers of English or had been living in the United States for more than 10 years.

Stimulus Materials

In the stimulus videos, two women are seated in front of a model town (shown in Fig. 1) and are conferring on the route they plan to take through the town.[2] The video is shot from behind so that the faces of the speakers are not visible. The exchange lasts 30 s. We created two versions of a basic script. In the first version, the *mimicked* script, portions of the speech and gesture of one speaker were repeated by the other. There were four instances of mimicked speech and three instances of mimicked gesture in this script. The second version of the script, the *non-mimicked* script, was identical to the first version, except that speech and gesture were always different across speakers. In other words, in the places where mimicry occurred in the mimicked script, slightly different speech and gesture were used so that there was no longer any repetition across speakers.

The importance of our results rests on the subtle differences between these two scripts. For that reason, we wish to carefully emphasize two things. First, the

[1] We thank Judith Hall and two anonymous reviewers for pointing this out.

[2] We selected this task because we could use relatively simple gestures (pointing and path-tracing gestures), which would facilitate analysis. The script we created is based on speech produced by participants taking part in a task in which they decide how to get some animals out of a town, which is part of a study of collaborative planning (Quek, Bryll, Arslan, Kirbas, & McNeill, 2002). The script was intended to be humorous and our participants found it so.

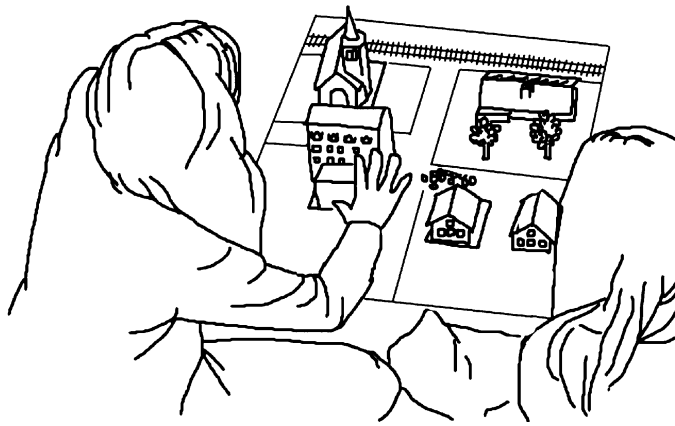

Fig. 1 Representation of the video stimulus

instances of mimicry were not *exact* duplications. A speaker who perfectly repeated the speech or gesture of her interlocutor would seem very unnatural, thus some variation was necessary. In clarifying this point, we will first consider the stimulus speech. Table 1 shows the complete scripts for both the mimicked and non-mimicked stimuli. In the mimicked stimuli, the cases of mimicry are bolded. The speech being mimicked is underlined. In total, there are four instances of mimicked speech. By comparing the bolded and underlined speech, one can quickly note that the amount of repetition (relative to the amount of non-repeated speech) is small.

There are three instances of mimicked gesture, none of which is an exact duplication either. The mimicked gestures can be decomposed into three features: motion, hand shape, and location. In the mimicked gesture script, we varied either one or two features, as shown in Table 2 (y = matched across speakers, n = not matched). Again, our logic was that perfect matches would look unnatural.

The second point we wish to stress is that the bulk of the speech and gesture produced in our two scripts was exactly the same. That is, the difference between the two scripts is a matter of a few words and a few gesture features. The extreme similarity of the gestures produced in the two scripts is represented in Table 3 (the first three columns of which replicate Table 2). Consider the first instance (instance 1). Two features match in the mimicked script. In the non-mimicked script, one feature matches (hand shape). For this first instance, then, the mimicked and non-mimicked gesture scripts differ by only a *single feature* (motion).

In summary, we are not comparing very conspicuous mimicry to a total absence of mimicry. While these details are rather fine-grained, it is important to bear them in mind when considering the results we present. We are concerned with the extent to which observers are sensitive to mimicry, thus we set out to create stimuli which require a good deal of sensitivity (essentially stacking the deck against ourselves).

After filming the mimicked and non-mimicked scripts, we used digital video editing software to recombine their video and audio tracks to produce two new videos. We were able to do this without arousing suspicion in our participants because the faces of our stimulus speakers were not visible (see Fig. 1). In one of these new videos speech was mimicked, but gesture was not (a recombination of the mimicked speech audio with the non-mimicked gesture video). In the second of these new videos, speech was not mimicked while gesture was (a recombination of

Table 1 Complete scripts for mimicked and non-mimicked stimuli

Mimicked		Non-mimicked	
Speech	Gesture	Speech	Gesture
A: Hey, you can play the flute.	Point to speaker B	A: Hey, you can play the flute	Point to speaker B
B: Yeah, **I can play the flute**. What does that...	Hand moves towards speaker A with palm up	B: Yeah, that's certainly true. What does that...	Hand moves towards speaker A with palm up
A: Like in the fairy tale, where the guy leads all the rats out by playing the flute?	Move straight, open palm, towards station	A: Like in the fairy tale? Where the guy leads all the rats out by playing the flute?	Move straight, open palm, towards station
B: Ah, so **I can lead all the wombats out by playing the flute**...and do I have to lead them all the way to Australia?	**Move straight, open palm, towards church**	B: Ah, so I can get them to follow me...and do I have to lead them all the way to Australia?	Wavy path, open palm, towards houses
A: No, I tell you what: you can go around the theater a few times...	Circles twice, point, over theater	A: No, I tell you what: you can go around the theater a few times...	Circles twice, point, over theater
B: And when they're all following behind me...	**Circles once, point, over theater**	B: And when they're all following behind me...	Move straight, point, towards houses
A: You can lead them over here.	No motion, open palm, over station	A: You can lead them over here.	No motion, open palm, over station
B: No, **I can lead them over here...**	**Move straight, open palm, towards houses**	B: No, I can get them to come this way,	Move straight, point, towards houses
B: And you can be behind the house.	Come down, open palm, behind houses	B: And you can be waiting for us.	Comes down, open palm, behind houses
A: Or **a big crate can be behind the house**.	Comes down, fingers cupped, behind houses	A: Or a big crate can be behind the house.	Comes down, fingers cupped, behind houses
B: And I can lead them into the crate.	Come down, both hands with fingers cupped, behind houses	B: And I can just lead them into it.	Come down, both hands with fingers cupped, behind houses

Note: Cases of mimicry are in bold and behavior being mimicked is underlined

Table 2 Features matched in mimicked gesture script

	Motion	Hand shape	Location
Instance 1	y	y	**n**
Instance 2	**n**	y	y
Instance 3	**n**	y	**n**

Note: y = matched across speakers, n = not matched

Table 3 Comparison of gesture across scripts

	Mimicked gesture script			Non-mimicked gesture script		
	Motion	Hand shape	Location	Motion	Hand shape	Location
Instance 1	y	y	**n**	**n**	y	**n**
Instance 2	**n**	y	y	**n**	y	**n**
Instance 3	**n**	y	**n**	**n**	**n**	**n**

Note: y = matched across speakers, n = not matched

Table 4 Experimental stimuli

	Gesture mimicked	Gesture not mimicked
Speech mimicked	Stimulus 1: mimicry in speech & gesture	Stimulus 2: mimicry in speech only
Speech not mimicked	Stimulus 3: mimicry in gesture only	Stimulus 4: no mimicry

the non-mimicked speech audio with the mimicked gesture video). The four stimuli used for the experiment are shown in Table 4.

Finally, because these stimuli were created, it is important to know whether or not they were perceived as natural. All participants were debriefed after the experiment. Only 3 of our 40 participants reported suspecting that the stimulus had been edited, and even these participants did not suspect that the original was not a natural interaction.

Procedure

Participants watched the video stimulus three times (to ensure that they would retain the content), then were seated in front of a table which held the same model town appearing in the stimulus (see Fig. 1). Participants were asked to describe the stimulus to an experimenter in as much detail as possible. The description was videotaped. The speech and gesture each participant produced during this description task was transcribed and coded.

Analysis

We expected that the speech our participants produced would be similar to the stimulus speech in all four conditions: people are likely to reuse speech they have just heard. For that reason, our analysis of speech focused both on sentence structure and lexical matches (matches for the words used in the stimulus). We first coded participants' speech for the extent to which it matched the sentence structure of the *target utterance* from the stimulus. A target utterance is one of the four instances of

mimicry in speech shown in Table 1. If it was unclear what the appropriate target was for an utterance produced by the participant, the utterance was coded as a non-match. For each utterance which matched the syntactic structure of a stimulus target, we then coded participants' speech for the extent to which the words used in the utterance matched the stimulus words. The proportion of matches produced by each participant was used as our measure of mimicry in speech.

To analyze the extent to which participants' gestures mimicked those produced in the stimulus, we first extracted all gestures that corresponded to the target stimulus gestures. Participants' speech provided the basis for determining which stimulus gesture a participant's gesture corresponded to. It should be noted that although participants did not reproduce the speech of the stimulus exactly (they produced complex discourses with interjections, evaluations, and observations of various kinds), it was not problematic to tell which portion of the stimulus they were referring to because the organization of their descriptions closely followed the stimulus. The gestures which corresponded to stimulus gestures were then coded for the features described above (motion, hand shape, and location) in order to determine whether these features matched those of the target stimulus gesture. Gestures were coded as matches only when all three features used by the speaker in the stimulus appeared in the participant's gesture. The proportion of matches produced by each participant was used as our measure of mimicry in gesture.

Results

The total number of utterances and the total number of gestures produced by each speaker was comparable across all four conditions. Means for each condition are shown in Table 5. To determine whether the presence of mimicry in the stimulus video a participant saw had an effect on his or her production during the description task, we carried out a 2×2 analysis of variance (ANOVA) with mimicry in stimulus speech and mimicry in stimulus gesture as factors and the proportion of matches produced as our dependent variable.

The means for the proportion of matches produced in speech and gesture during the description task are presented in Table 6. We found a significant effect of mimicry in stimulus speech on the proportion of matches participants produced in their own speech during the description task: $F(1, 36) = 8.46$, $p = .006$. Participants who saw the stimuli in which speech was mimicked across speakers were more likely to produce the mimicked speech in their descriptions. The presence of mimicry in gesture in the stimulus, on the other hand, did not impact the production of matches in speech ($F(1, 36) = .05$, $p = .81$), nor did the two factors interact ($F(1, 1) = .005$, $p = .94$). We also found a significant effect of mimicry in stimulus gesture on the

Table 5 Mean proportion of utterances and gestures in each condition, standard deviations in parentheses

	Stimulus 1: mimicry in speech & gesture	Stimulus 2: mimicry in speech only	Stimulus 3: mimicry in gesture only	Stimulus 4: no mimicry
Utterances	10.4 (3.9)	10.9 (3.9)	10 (1.9)	11 (3.4)
Gestures	6.1 (1.3)	5.9 (3.2)	6.2 (1.6)	7 (2.7)

Table 6 Mean number of matches produced in speech and gesture during description task, standard deviations in parentheses

	Stimulus 1: mimicry in speech & gesture	Stimulus 2: mimicry in speech only	Stimulus 3: mimicry in gesture only	Stimulus 4: no mimicry
Speech	.71 (.24)	.70 (.27)	.47 (.19)	.45 (.32)
Gesture	.33 (.29)	.15 (.15)	.40 (.23)	.17 (.12)

proportion of matches participants produced in their own gestures during the description task: $F(1, 36) = 9.64$, $p = .003$. Again, participants who saw a stimulus in which gestures were mimicked across speakers produced more of the mimicked gesture features during the description task. Mimicry in speech in the stimulus did not impact the production of matches in gesture: $F(1, 36) = .50$, $p = .48$. The interaction between the two factors was not significant: $F(1, 1) = .15$, $p = .69$. These results confirm our predictions.

One might expect that mimicked gestures would occur as a consequence of mimicked speech. That is, since the two behaviors are related in meaningful ways, mimicking one might naturally result in a higher rate of mimicry in the second. Our results suggest that this is not the case. Post hoc analyses (using Tukeys's HSD test) revealed no significant difference between the means of the two groups who saw a stimulus video with mimicry in speech (mean difference = .01, critical difference = .17), despite the fact that one of these groups also saw mimicry in gesture. Nor is the reverse true: mimicking gesture was not associated with a higher rate of mimicry in speech. The means of the two groups who saw mimicry in gesture were not significantly different (mean difference = .07, critical difference = .13), even though one of these groups also heard mimicry in speech. This pattern is also apparent in the lack of significant interaction between the two factors.

Discussion and Conclusions

This study was designed to ask the following questions: How sensitive are people to mimicry in speech and gesture? To what extent does observing mimicry affect people's behavior? Are people equally sensitive to mimicry in speech and gesture? We have shown that observing mimicry in a video stimulus can lead to greater production of the mimicked material, in both speech and gesture. This result may not appear particularly dramatic: when there was repetition in the stimulus the repeated features appeared in the production of observers. Repetition should lead to greater retention in memory, the general principle behind rehearsal. These findings become more striking when one considers the subtlety of the manipulation. The variations across our stimuli were quite small, but they resulted in measurable differences in the representations participants formed. This result suggests that observers are quite sensitive to mimicry—that mimicry need not be blatant in order for repetition to have an impact on memory. Furthermore, gesture is generally believed to be a less consciously monitored behavior. That is, speakers are not typically aware that they are gesturing, and observers are not typically aware that they are seeing gesture. Thus, the finding that participants who observed mimicry in gesture produced more of the mimicked features suggests that observers are quite sensitive to this behavior, without necessarily being aware of it.

Participants did not produce word-for-word reports of the stimulus. Their descriptions were complex discourses: they interjected various kinds of digressions and evaluations in addition to describing the actions they observed. Thus, even when synthesizing the event into a cohesive whole, speakers in a naturalistic discourse context were still influenced by mimicry. Our findings thus lend support to the claim that mimicry plays a special role in human communicative behavior.

Acknowledgements We thank Susan Duncan for guidance and for assistance with creation of the stimuli. We also thank David McNeill and Howard Nusbaum for their extensive and thoughtful comments.

References

Bock, J. K. (1986). Syntactic persistence in language production. *Cognitive Psychology, 18*, 355–387.

Bernieri, F. J., Davis, J. M., Rosenthal, R., & Knee, C. R. (1994). Interactional synchrony and rapport: Measuring synchrony in displays devoid of sound and facial affect. *Personality and Social Psychology Bulletin, 20*, 303–311.

Bernieri, F. J., Gillis, J. S., Davis, J. M., & Grahe, J. E. (1996). Dyad rapport and the accuracy of its judgment across situations: A lens model analysis. *Journal of Personality & Social Psychology, 71*, 110–129.

Cappella, J. N., & Palmer, M. T. (1990). Attitude similarity, relational history, and attraction. *Communication Monographs, 57*, 161–183.

Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: The perception–behavior link and social interaction. *Journal of Personality & Social Psychology, 76*, 893–910.

de Fornel, M. (1992). The return gesture. In P. Auer & A. di Luzio (Eds.), *The Contextualization of language* (pp. 159–193). Amsterdam: John Benjamins.

Ekman, P., & Friesen, W. V. (1969). The repertoire of nonverbal behavior: Categories, origins, usage, and coding. *Semiotica, 1*, 49–98.

Gilbert, D. A. (1993). Reciprocity of involvement activities in client–nurse interactions. *Western Journal of Nursing Research, 15*, 674–689.

Hale, J. L., & Burgoon, J. K. (1984). Models of relations to changes in nonverbal immediacy. *Journal of Nonverbal Behavior, 8*, 287–314.

Halliday, M., & Hasan, R. (1976). *Cohesion in English*. London: Longman.

Kimbara, I. (2006). *Interpersonal influences on gesture production*. Unpublished doctoral dissertation, University of Chicago.

LaFrance, M., & Broadbent, M. (1976). Group rapport: Posture sharing as a nonverbal indicator. *Group and Organization Studies, 1*, 328–333.

Levelt, W. J. M., & Kelter, S. (1982). Surface form and memory in question answering. *Cognitive Psychology, 14*, 78–106.

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

McNeill, D. (2005). *Gesture and thought*. Chicago: University of Chicago Press.

Pickering, M. J., & Garrod, S. C. (2004). Toward a mechanistic psychology of dialogue. *Behavioral and Brain Sciences, 27*, 169–226.

Quek, F., Bryll, R., Arslan, H., Kirbas, C., & McNeill, D. (2002). A multimedia database system for temporally situated perceptual psycholinguistic analysis. *Multimedia Tools and Applications, 18*, 91–113.

Tabensky, A. (2001). Gesture and speech rephrasings in conversation. *Gesture, 1*, 213–235.

Tickle-Degnen, L., & Rosenthal, R. (1987). Group rapport and nonverbal behavior. *Review of Personality and Social Psychology, 9*, 113–136.

Weiner, E. J., & Labov, W. (1983). Constraints on the agentless passive. *Journal of Linguistics, 19*, 29–58.