

The Effect of Immediate Communicative Function on the
Physical Form of
Conversational Hand Gestures

by

Jennifer Jay Gerwing
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We accept this thesis as conforming
to the required standard

Dr. J. B. Bavelas, Supervisor (Department of Psychology)

Dr. R. Hoppe, Departmental Member (Department of Psychology)

Dr. J. F. Kess, Outside Member (Department of Linguistics)

Dr. J. Esling, External Examiner (Department of Linguistics)

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University of Victoria

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Supervisor: Dr. Janet B. Bavelas

ABSTRACT

Hand gestures in face-to-face dialogue are symbolic acts, integrated with speech. This thesis investigated factors that determine the physical form of these gestures. When the gesture depicts a previous (nonsymbolic) action, it obviously resembles this action; however, such gestures are not only noticeably different from the original action but, when they occur in a series, are different from each other. This thesis presents an experiment with two separate analyses (one quantitative, one qualitative) testing the hypothesis that the immediate communicative function is a determinant of the (symbolic) form of the gesture. First, I manipulated whether the speaker was describing the previous action to an addressee who had not done the same actions (No Common Ground condition) or one who had (Common Ground condition). The former gestures were more precise and informative than the latter, which were less complex and "sloppier," a finding similar to the effects of common ground on words. In the qualitative analysis, I used the given/new principle to analyze a series of gestures about the same actions by the same speaker. The new information in each gesture was larger, clearer, or otherwise emphasized. When this information became given, a gesture for the same action became smaller or sloppier, which is similar to findings for given versus new information with words. Thus these immediate communicative functions played a major role in determining the physical forms of the gestures.

Examiners:

Dr. J. B. Bavelas, Supervisor (Department of Psychology)

Dr. R. Hoppe, Departmental Member (Department of Psychology)

Dr. J. F. Kess, Outside Member (Department of Linguistics)

Dr. J. Esling, External Examiner (Department of Linguistics)

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Dedication

I dedicate this work to the memory of my mother, a magnificent woman who is never far from my thoughts.

The Effect of Immediate Communicative Function on the Physical Form of Conversational Hand Gestures

In the last few years, gesture research has undergone a surge of academic and scientific interest. Researchers are recognizing that an understanding of gesture use can provide insight into cognition, communication, and culture and that gesture research is not the exclusive domain of any particular academic field. For example, attendees at the 2002 Gesture conference in Austin, Texas, were researchers from fields as diverse as psychology, linguistics, psycholinguistics, anthropology, and the arts, who presented studies that varied from observational field studies to experiments, with analyses that were both qualitative and quantitative. McNeill's (2000b) *Language and Gesture* is a collection of much of the latest research in this area. It reflects a similar diversity of theory, methods, and research interests, from an analysis of an aphasic man's communicative success using a limited repertoire of gestures (Goodwin, 2000) to a longitudinal study of six children, while they made the transition from one- to two-word speech, examining when gesture and speech become integrated into one system (Butcher & Goldin-Meadow, 2000). Further evidence for increasing academic interest in gestures is that the International Society for Gesture Studies (ISGS) formed in 2002, and a new journal, *Gesture*, had its first issue in 2002.

What are gestures? Kendon (2000) defined gestures as "the range of visible bodily actions that are, more or less, generally regarded as part of a person's willing expression" (p. 49). In other words, they are intentional and

communicative motions of the body. McNeill (1992) added that the movements of *conversational gestures* (which are the major topic of research) are idiosyncratic and spontaneous and that a gesture's meaning is determined by the context (such as the linguistic segment) in which the gesture occurs.

Contemporary gesture research encompasses several areas of focus, including how the study of gesture can inform our understanding of thought, social interaction, language acquisition, and language use. If there were a continuum between cognitive (often individualistic) and communicative (or social) approaches, one way to divide the field would be to place any particular research interest somewhere between the two. An example of gesture analysis on the outermost cognitive end of the continuum is the fundamentally asocial view that hand gestures accompanying speech function exclusively (or at least primarily) as a means of lexical access (e.g., Krauss, Chen, & Chawla, 1996; Krauss, Chen, & Gottesman, 2000; Krauss, Dushay, Chen, & Rauscher, 1995). According to this theory, individuals use gestures as a means of prompting themselves when they are having problems finding a word. For example, Krauss et al. (2000) seem to suggest that: (1) Gestures are associated with specific lexical affiliates (i.e., one gesture stands for one particular word), and (2) the kinesthetic experience of the gesture enhances the speaker's ability to find and articulate the sought-after word. This research interest is based on an assumption that gestures serve primarily the internal processes of individuals and that any communicative outcomes of gesture use are subordinate to the process of lexical retrieval.

Other cognitive researchers prefer to study speech-synchronized (conversational) gestures as a means of deriving and supporting cognitive models of language use (e.g., Kita & Ozyurek, 2003; LeBaron & Streeck, 2000; McNeill, 2000a; Roth, 2000, 2002). These researchers are primarily interested in how studying gestures can shed light on the mental processes of speakers and listeners, such how spontaneous speech-synchronized gestures representing the same events reveal motion event encoding (McNeill, 2000a), how gestures are generated from spatio-motoric processes that interact on-line with the speech production process thereby helping the speaker organize information for linguistic expression (Kita & Ozyurek, 2003), or how students' gestural representations of scientific concepts scaffold their mastery of scientifically appropriate discourse (Roth, 2000). Most cognitively focused researchers do not propose that these internal functions of gestures preclude the function of gestures externally, that is, in social interaction (McNeill, 2000b). For example, Roth (2000) pointed out that the use of gestures in discussions of scientific concepts "allows for additional modes of coordinating meaning (common ground) in groups" (p. 1708).

Researchers on the social end of the continuum investigate the external (communicative) functions of gestures (e.g., Alibali, Heath, & Myers, 2001; Bavelas, Chovil, Lawrie, & Wade, 1992; Bavelas, Gerwing, Prevost, & Sutton, 2002; Clark & Krych, 2002; Furuyama, 2000; Goodwin, 2000; Ozyurek, 2000). The foundation of a social approach is to consider gestures as visible tools that speakers integrate with their words primarily for the purpose of communication (Bavelas & Chovil, 2000). The social view of gestures reflects a drive to

understand precisely how gestures function within and contribute to communication and interaction rather than how they reveal cognitive processes. For example, how interlocutors gesturally interact while one teaches the other how to fold an origami figure (Furuyama, 2000), the different ways speakers use gestures to describe an elaborate 18th-century dress when they are face-to-face with the addressee vs. on the telephone (Bavelas et al., 2002), or the way interlocutors manage dialogue with interactive gestures (Bavelas et al., 1992). Proponents of this approach often videotape two or more individuals in conversation, making it possible to analyze aspects of both their spoken words and their gestures.

A methodological partitioning of the field is also possible, dividing researchers into advocates of either naturalistic observation (e.g., Goodwin, 2000; Haviland, 2000; Kendon, 2000; LeBaron & Koschmann, 2002; LeBaron & Streeck, 2000; Roth, 2000, 2002) or laboratory studies using a more experimental approach (e.g., Alibali et al., 2001; Bavelas et al., 2002; Clark & Krych, 2002; Engle, 2002; Furuyama, 2000; Kita & Ozyurek, 2003; Krauss et al., 1995; Ozyurek, 2000, 2002). Naturally, a thorough understanding of gesture use benefits from both types of inquiry, just as it benefits from studying both cognitive and social aspects.

The research presented in this thesis reflects a communicative, social perspective using experimental studies in the laboratory with both quantitative and qualitative analyses. Specifically, this thesis begins with an investigation of how actions and gestural depictions of those actions differ in physical form, that

is, how actions become symbols. More importantly, the analyses reveal some of the factors determining the observed differences in form. In other words, in this thesis I identify some of the determinants of the physical form of gestures.

Much of previous experimental research on gestures has followed the tradition of Cohen and Harrison (1973) and Cohen (1977), focusing on changes in the *frequency* (relative presence or absence) or *rate* of gestures as a function of visibility between speaker and addressee. Some researchers have looked at more precise effects of visibility on the *types* of gestures produced, rather than simply their rate of production (e.g., Alibali et al., 2001; Bavelas et al., 1992; Bavelas et al., 2002). Still other researchers have observed how gestural representations emerge from the kinesthetic experience of manipulating objects (LeBaron & Streeck, 2000; Roth, 2002). However, even though the lines of inquiry into gesture research have become more refined and more diverse, few researchers have investigated the determinants of the physical form of gestures. In fact, in a discussion of which areas of gesture research are most open (and least addressed), Krauss et al. (2000) proposed that one of the most important questions missing from current research is why different gestures take the particular form they do.

Non-Symbolic vs. Symbolic Acts

Before introducing the recent literature concerning the determinants of gesture form and describing the present studies and analyses, it is necessary to explain the fundamental difference between actions and gestures.

Every day, our hands assume different types of roles. First, our hands help us to carry out material tasks; for example, they could do all the actions involved in making dinner. One of these actions might be cutting some vegetables. In contrast, later we might tell a friend about our brilliant cutting technique. To clarify and expand our verbal explanation, we would probably use our hands to produce gestural depictions of this cutting technique. These conversational hand gestures, or symbolic representations, are the second type of role our hands can assume. Thus, anything we do with our hands can be classified as being non-symbolic (an action) or symbolic (a gesture). The term “symbol” here is intended in the sense of “something that stands for something else” (Quine, 1987). A gesture is a symbol; it is a hand movement that stands for something else. For instance, a gesture referring to cutting carrots is standing for the action we might have used to actually cut carrots. A symbolic representation of cutting, even though it is standing in for the action, will not accomplish any actual cutting.

An underlying assumption of the symbolic, or referential, nature of gestures is apparent in the way they are characterized in the literature. Researchers have described gestures as communicative behaviors that have *referents* (Weiner, Devoe, Rubiow, & Geller, 1972); as *representing* aspects of experience, spatial arrangements, visual appearance, or unique features (Kendon, 1985); as *referential symbols* that exhibit meaning (McNeill, 1985, 1992); as *demonstrations with referents* that can be events, states, processes, or objects (Clark & Gerrig, 1990); as being *symbolic* hand movements that speakers

can use to communicate about actions formerly accomplished or observed (LeBaron & Streeck, 2000); and as visible acts of meaning that are *symbols* with meanings that are deliberately adopted by a speaker for an addressee (Bavelas & Chovil, 2000). Kendon (2000) called gestures a “mode of *symbolic representation*” (p. 50) and, in reference to how representation is achieved, said that gestures have visible forms that can be shaped for use as *representations* of concrete objects.

An understanding of the symbolic nature of gestures is not limited to the sphere of academics. In everyday interactions, people use and see gestures, which they must recognize as symbolic in order to produce and interpret them. LeBaron and Streeck (2000) pointed out that, when a speaker uses gestures to describe an action, the addressee sees only motions of the hands but is able to infer actions and, simultaneously, implied objects being acted upon. To continue with the carrot-cutting example, when we use a gesture to represent cutting, our addressee sees only our empty hands moving around but infers chopping (actions) and carrots being chopped (implied objects being acted upon). Viewers naturally recognize that the gestures are symbols for something and not just random hand motions. Bavelas and Chovil (2000) noted a quality of gestures that facilitates the ease with which individuals understand them: gestures are symbols that are encoded analogically, that is, they resemble their referents. For example, a gesture representing chopping will resemble the actual chopping action. When gestures are depictions of actions, we would expect the hand movements of the

action and the gesture to be similar. However, even though a gesture is like what it represents, it is not *equal* to what it represents.

McNeill (1985, 1992) discussed the degree of relation, or the level of abstraction, between a gesture and its referent. The previous example, that of hands holding an imaginary knife and making dicing motions, represents the least abstract form of representation we can use: our hands are depicting an action hands could be doing. In other words, we use our hands in the gesture to represent hands doing an action. A further degree of abstraction is using our hands to represent some other object. For instance, our hand could be held flat to represent a cutting board or our fingers could stand for carrots on the cutting board.

Our hands, in both of the above examples, are representing physical referents, either hands themselves or other objects. McNeill (1985) called both types *iconic* gestures. Iconic gestures depict the tangible, concrete, or material aspects of what we are communicating. McNeill drew a distinction between these two levels of symbolic abstraction (hands depicting either hands or other objects) in iconic gestures: Gestures in which speakers use hands to “recreate and manipulate a virtual object”, such as holding a knife McNeill labeled *iconix₁* gestures. Those in which speakers use their hands to “depict an entity other than hands”, such as some other tangible object (perhaps a carrot), McNeill called *iconix₂*.

Not all gestures represent concrete items or actions. Others represent instead “an image of abstraction” or a “metaphor for a concept” (McNeill, 1992).

These gestures represent concepts that are not concrete (such as a feeling, knowledge, or the notion of yesterday) with gestural metaphors. McNeill called these more abstract gestures *metaphoric*. One example would be to rotate our hands so that they are palms up while shrugging our shoulders (perhaps creating the image of a weighing scale in perfect balance) as a metaphor for uncertainty. Another metaphoric gesture, returning to the dinner preparation example, is if we said, “Don’t get dicing confused with chopping”, while pointing to the left when saying “dicing” and to the right when saying “chopping”. The pointing gesture, which indicates separate locations in front of us, emphasizes the distinctness of the two cutting techniques. It is a metaphorical gesture because it is as though we have bundled the two techniques into distinct objects located at different points in space. Of course they are not really objects we can point to, they are cutting techniques. But by using the metaphor of distinct objects we emphasize the difference between the two. A third example of a metaphorical gesture would be if we were to say to someone who is complaining about sitting in front of a computer all day, “Maybe you should consider cutting up your day a bit by taking a few walks.” We accompany our words with a gesture similar to the previous chopping gestures, now using the chopping motion as a metaphor for separating computer time from walking time. Even though the gesture looks the same as an iconix₁ chopping gesture, the meaning is instead metaphorical. The gesture’s function within the context of the spoken words is different.

The distinction between iconic and metaphoric gestures is important for understanding the types of gestures of interest in the analyses presented later.

Recall that one of the purposes of this project is to compare actions and gestural depictions of those actions. Therefore the analyses are focused on the first two levels of abstraction, iconix_1 and iconix_2 , when the gestures were representing actions or tangible objects. Metaphorical gestures were excluded from analysis.

How Actions and Gestures Differ

Recall the least abstract type of gesture, iconix_1 , when hands in the gesture represent hands doing an action. Although we would expect the hand form and motions of the two to be similar, they would not be exactly the same. The fundamental difference between the two stems from what each accomplishes. Instead of accomplishing something material in the world, as actions do, gestures accomplish something communicative within a particular social interaction. Although the gesture could appear to be a re-enactment of the original action, it is functionally different. A gesture standing for cutting carrots will not actually cut carrots: actions do, gestures communicate. This functional difference is crucial in the way that it influences the physical forms of the two types of hand movements. The function of a particular hand movement imposes a constraint on its form. An action that is intended to cut carrots is constrained by the need to end up with cut carrots. Certain movements are necessary. For instance, the fingers must grip the knife and hold it at the correct angle in relation to both the carrot and the countertop, the action must cause the blade to cut through the carrots, and a particular number of up and down motions are required to cut the carrots to desired specifications. The physical form and movement of an action are dictated by the material purpose of that action.

Similarly, a communicative function creates constraints on the hand form and movement of gestures. We want our addressee to recognize whatever our gesture is symbolizing. Therefore, first, when we use gestures to demonstrate an action, we must be *selective* in our choice of movements. Rather than depicting every aspect of the previous action, we must select the features necessary and sufficient to fulfill the communicative function of our gesture. We will select features of the previous action that will make our reference to that particular action clear. If we are being selective, the gestures will look different from the referent actions (which necessarily had all of the features). Clark and Gerrig (1990) called the selective feature of gestures the *depictive* aspect: the parts that distinguish the intended referent (in our previous example, “holding the knife”) from other possible referents (perhaps “positioning the cutting board” or “holding the carrot”). In gestural depictions, we will select what we consider the action’s most salient features (perhaps the grip and angle of holding) in order to ensure that the gesture’s referent will be unambiguous. Selectivity is more than simply economical; its key importance is to eliminate the extraneous actions that could obscure the gesture’s communicative purpose.

A second way in which a communicative function constrains the form and movement of gestures is the degree of *transformation* that gestures require. As mentioned previously, a gesture and an action accomplish different things because each is fulfilling a different purpose. We design and perform actions to accomplish what it is that we want to do. Therefore, if we want a few cut-up carrots in our soup we will design our actions accordingly. When producing

gestural depictions in communication, we transform the form and movement of the previous action. We design and carry out gestures so that they will convey information effectively in the particular interaction in which they are produced. When gesturing the cutting action, we first have to consider our addressee. We might therefore make a gripping hand shape that appears similar to our previous action but which is this time in a different orientation (between us and the addressee) and a different location (high enough for the addressee to see). Besides our addressee, we must also consider what particular facet of “cutting” we are demonstrating. If the gesture is a demonstration of a precise up-and-down motion, we might transform the original action by exaggerating the up-and-down movement. Thus the gesture is a transformed version of the original action. Its form is contingent on what we are saying about cutting at that moment. In summary, gestures that represent previously performed actions are physical transformations of selected features of those actions.

I have outlined a number of reasons why gestures should be different from the actions they represent, but a direct empirical comparison is necessary in order to discover the actual differences. In other words, a comparison will reveal how these differences in functional requirements manifest in form. To compare a gesture and referent action we must know precisely what the gesture is symbolizing and have a record of both that action and the gesture. A comparison of the two allows us to identify more clearly what speakers select when gesturing an action, and how they transform the hand movement. By identifying what speakers select and transform, we can begin to understand what factors

influence the gesture's physical form. That is, we can ascertain not only *what* features speakers choose to select and transform, but perhaps *why* they choose to transform those particular features. An understanding of some of the determinants of the physical form of gestures can ultimately inform us about the process of transformation from a non-symbolic action to a symbolic, communicative gesture.

Determinants of a Gesture's Form

The Initial Action

As discussed earlier, a gesture's form is somewhat determined by what it is depicting. A gesture must portray the salient features of its referent if the addressee is to successfully identify what the gesture is symbolizing. However, recall that a gesture depicting an action is not simply a reenactment of that action. Thus the original action is, although an obvious and strong influence, not the exclusive determinant of the gesture's physical form.

The Conversation

Besides the instrumental influence of the previously performed action on its gestural depiction, there is also a social influence. The following statement reminds us that conversational hand gestures are produced within social interaction:

the formation of a [gestural] symbol is a defining moment in the fabrication of shared knowledge because it allows the participants to focus upon and reinvolve previously shared experiences and to plan and conduct shared

activities in their wake. (LeBaron & Streeck, 2000 p. 118, emphasis added)

In other words, when a speaker transforms an action into a communicative gesture he is forming a symbol, and both the speaker and addressee must agree on what the gesture is standing for. Once interlocutors mutually agree on the meaning of the symbol, they can then use it to communicate. The gesture occurs within the interaction, and it influences both the content and the course of the conversation. These spontaneously improvised gestures become a new vocabulary, one that the interlocutors tailor for that particular time and place. The above quotation reminds us that gestures occur in interaction, but it does not suggest *how* the conversation influences the form of gestures. The focus of this thesis is to define more precisely how and why gestures get tailored for the particular interaction in which they occur.

McNeill (2000) suggested a reciprocal relationship between the physical form of gestures and conversation:

In a social interaction, the gestures are among the active participants.

They play a part in the interaction and help to shape it, and *the interaction, in turn, helps to shape them.* (p. 11, emphasis added)

McNeill's statement asserts the interaction's influence on gestures' form, but again it does not explicate exactly how the interaction shapes the gestures.

To my knowledge, there are four empirical studies indicating how the physical form of gestures can be shaped by interpersonal factors such as aspects of the conversation in which the gestures occur. The following is a brief

summary of each of the three published studies as well as a description of an unpublished pilot study that led to this thesis.

An experiment by Furuyama (2000) illustrated one way in which a conversation shapes gestures. In his study, student “instructors” were asked to teach student “learners” how to make an origami figure, but they were not given any paper. Both instructors and learners were thus obliged to use gestures as well as words to demonstrate how to make the figure. Furuyama was able to study how people gesturally interacted with each other and how the pair influenced each other’s gestures. Often the learners’ gestures interacted with the instructors’ gestures, producing collaborative gestures. For example, the instructor might make an imaginary fold, and subsequently the learner might point to, move, or manipulate the folded part of the location of the instructor’s gesture as though the gesture were actually an object in space. Furuyama found that learners produced these collaborative gestures only when the instructors placed the focal, or most salient, part of the gestures (such as the imaginary fold or edge) facing the learner. No collaborative gestures occurred when the focal part of the instructors’ gestures faced away from the learner. Thus the physical form of the learners’ gestures was sensitive to interpersonal factors.

In an experimental study, Ozyurek (2000; 2002) manipulated conversational space. The speaker first viewed a cartoon story that included a scene where a “Granny” threw a cat out into the street; then the speaker described the cartoon to either one or two addressees. When the speaker described the cartoon to one addressee, the addressee sat across from the

speaker. When there were two addressees, they sat to the left and to the right of the speaker, forming a triangle. The speaker's directional gestures (for example, the ones representing the cat's trajectory into the street) changed as a function of addressee location. For instance, when gesturing "she throws him out" within the triangular seating arrangement, the speaker's gestures would depict the direction with a backward motion. However, when the same speaker described the same sequence (even with the same words) while sitting across from only one addressee, he used a right-to-left gesture. The physical form of the gestures depended in part on the interpersonal context (that is, whether to one addressee or two) in which they were produced. Ozyurek concluded that speakers shaped representational gestures of direction in response to the extralinguistic space of the conversation rather than in response to the way the speakers had originally seen the direction in the cartoon.

LeBaron and Streeck (2000) investigated the influence of non-symbolic exploratory and instrumental actions on later gestural depictions. They concluded that gestural representation emerges from the knowledge our hands acquire through their experience with objects. For instance, a professor teaching an architectural design course used his hands both to explore student models of miniature buildings (actions) and to manually describe aspects of the models (gestures). LeBaron and Streeck were able to compare the instructor's original instrumental actions to his later very similar gestures and also to those produced later by the students, showing that the gestures he used originated from his initial explorations of the architectural models.

In an unpublished pilot study, I videotaped pairs of participants doing actions (specifically, individually playing with toys) and then describing the toys to each other (often using gestural depictions). The physical form of the gestures differed from the original actions. First, speakers selected particular aspects of the actions they used previously, eliminating peripheral actions such as picking up the toy from the table, holding it while reading the instructions, or putting the toy away. Second, they transformed the features that they did select. In short, gestural depictions often differed from the original action, both temporally (they were faster or slower than the original action) and spatially (they were larger, smaller, or less precise versions).

Finding differences between the actions and the gesture was not unexpected. However, an unanticipated finding was that when a speaker described different aspects of the previously performed action, not only were the gestures different from the original actions, they were also *different from each other*. That is, multiple successive depictions portrayed by the same person and with the same referent took on various physical forms. The following example is typical of the data I obtained in the pilot study. In the example, a participant is describing a whirlygig, which is a narrow rod with a propeller attached perpendicularly to one end. To play with the whirlygig, the participant had to hold the rod vertically between her palms, rub one palm away from the other, and let go of the toy. This launching action would send the whirlygig spinning up in the air.

The Participant's Original Actions

The participant's first actions with the whirlygig were to pick it up and tuck it between her palms. Then, while she helped her fellow participant with a question about her own task, she twirled the whirlygig a few times in one hand. The participant then held the toy motionless between her palms while she leaned over the table to read the toy's instructions.

Once she was ready to try the toy for the first time, she sat up taller, leaned her elbows on the table, and slowly rolled the whirlygig back and forth a few times between her palms. Then, with her elbows still on the table, she pushed her right palm forward while keeping her left stationary. At the end of the action her hands maintained contact with each other. This motion sent the whirlygig on a short flight path, barely skimming over the top of the table before landing on the floor. She retrieved the whirlygig and returned to her seat to try it again.

The second time she sat up even taller with her elbows a few inches above the table. She did a few more back-and-forth warm-up motions, then pushed her right palm forward very quickly and let go of the whirlygig with a flourish. This time her right hand followed through, continued first forward and then swept around to her right side. The second launching action, probably due to the dramatic follow-through, sent the toy up high into the air. She held her right arm out to the side and her left arm forward while she exclaimed "Woo-hoo! Look at that!".

The Speaker's Gestural Depictions

The participant described her experience with the whirlygig with the following words and gestures. (The addressee's contributions are in square brackets.) The underlined sections indicate the locations of all gestures, and the numbered underlined portions indicate her 11 gestural depictions of the whirlygig launching action.

"My last one was a, a little 1... 2... flying thing. [Yeah?] 3And you had to hold your hand, stationary and 4then, with this 5hand, push it, 6away and you 7have to do it away cause otherwise it will spin this way... [smack you in the face!] Surprised I didn't do it actually. So anyways, so then, so you 8go like that. And, and the first time I kinda 9did it like, 10weakly... (laughs)... and it just kinda fell down here, and then, from then I got into it and if you 11did it really fast and it would take off."

First, the participant included 11 depictions of the whirlygig launching action even though she had actually done the action only twice. Only at depictions 9 and 10 did the participant overtly portray her actual whirlygig launching action. Rather than describing all 11 depictions in detail, I have summarized (in Table 1) some of the ways in which they were different from the two original launching actions and from each other. (In a later section of this chapter, I will present a more detailed analysis of the eleven gestural depictions.)

It is clear that there are many differences between her actions and her gestural depictions of those actions. The participant selected and transformed particular features of the launching action for her portrayals. For instance, in

Table 1

How gestures were different from original actions and from other gestures:

Gesture	Comparison		
	First action	Second action	Previous gesture
1	Faster, fingers straighter, longer motion	No big follow through, straighter and shorter motion	-
2	Faster, fingers straighter, longer motion	No arms to the side follow through, straighter and shorter motion	same
3	One hand only	One hand only	One hand only
4	Other hand only	Other hand only	Other hand
5	Faster, much longer motion	No follow through, slower, longer and more forward motion	Both hands straight with longer motion
6	Faster, slightly longer motion	No follow through, slower, longer and more forward motion	Shorter motion with hands not as parallel
7	Faster, slightly longer motion, hands less parallel	No follow through, slower, longer and more forward motion, left hand rubbing up instead of forward	Even shorter motion with hands less parallel
8	Faster, much longer motion, fingers straighter	No follow through, fingers and thumb straighter (not arching out)	Much longer motion with hands more parallel
9	Marked as a depiction of 1 st action: Slower, much longer motion, fingers more spread out	Marked as a depiction of the 1 st action not the 2 nd	Slower motion, pushing hand goes downwards, hands less parallel

10	Marked as a depiction of 1 st action: Slower, much longer motion, fingers more crooked, hands less parallel	Marked as a depiction of the 1 st action not the 2 nd	Even slower, hands even less parallel, fingers and hands curved
11	Faster, slightly longer motion, fingers straighter	No follow through, fingers and thumb straighter (not arching out).	Much faster, longer, hands and fingers straight

most of her gestural depictions she allowed her right hand to follow through straight ahead of her, which was different than either of her two original actions. In the first action her right hand had remained in contact with her left hand, and in the second action her right hand had followed through by sweeping around to her right side.

What was more interesting than the difference between the actions and the gestures was that the depictions were often different from each other. The differences between the depictions did not look like random variation, they appeared to be systematic. I will propose that there was another influence on the form of the gestures besides the initial action, an influence that appeared to change across very short periods of time. In other words, although there seemed to be a conversational influence, it did not seem to be exerting itself globally on all of the 11 whirlygig depictions in the same way.

I have described four studies that demonstrated conversational influences on gestures' physical form, but there are methodological differences. Furuyama (2000) and Ozyurek (2000) controlled the task and setting experimentally in order to study specific determinants of gestures' form. But neither of these studies explored the difference between actions and gestures: Furuyama had no original actions with which to compare the gestures, and Ozyurek compared the gestures to various trajectories that the speaker had viewed in a cartoon. LeBaron and Streeck (2000) and my unpublished pilot data examined hands doing actions and then the same hands performing gestural depictions of those actions. Thus both studies present comparisons of actions and the later representative gesture,

albeit without experimental manipulation. Without experimental manipulation, it is difficult to say precisely what is determining the form of the gestures. It should be possible to combine (1) a direct comparison of gestures and the actions they represent with (2) an experimental manipulation that sheds light on the determinants of the physical form of the gestures.

This thesis presents such an experiment on the symbolic formation of gestures. I recorded both the actions and the gestures, then conducted both a quantitative and a qualitative analysis to discover some influences on the gestures' form.

Recall that the pilot data indicated that the actions and gestures were in fact different. The gestures were selective and transformed versions of the former action. Recall also that when participants depicted an action several times, the depictions were different from each other. Thus the influences on the physical form of the gestures depended not only on the constraints imposed by the general communicative context, but also on specific, moment-by-moment changes within that context over time.

Conversational Context

I propose that the determinant of the form of a gesture is the communicative function the gesture is serving at the precise moment it occurs. In other words, in the pilot data, each gesture appeared to be shaped by its *immediate communicative function* within a particular conversational context. The reason why depictions of the same action were different was because the form of each gestural depiction was constrained by the gesture's particular

communicative function at the precise moment it occurred. In the whirlygig example above, portrayals 9 and 10 served to communicate how the speaker had done the action too weakly, therefore both portrayals exaggerate the “weakness” of her action. Portrayal 11 depicts a fast action that would make the whirlygig “take off”, thus it is fast, straight, and precise. The physical form of this last portrayal is quite different than that of portrayals 9 and 10, reflecting the fact that its communicative function is different.

Although a gesture’s form is influenced by its immediate communicative function, the gesture and its function also exist within the broader context of the interaction, the current topic of conversation, and what the speaker contributes to that topic. In other words, a gesture occurs within an utterance, which is part of a broader topic of conversation, which is itself occurring within a particular framework that includes the people talking, where they are, and what they are discussing. Thus, a gesture is embedded in several levels of *conversational context*, which shape many aspects of both the audible (i.e., words) and visible (i.e., gestures) components of interlocutors’ communication.

As noted, a conversational context consists of several levels nested within each other. The broadest, overarching level is the dialogue as a whole: who is talking and where they are. This level includes what interlocutors have in common (such as an experience, knowledge, or location), and it will affect both the content and delivery of their messages. If the interlocutors share a space, they can refer to objects in that space with their words (“that table over there”) and gestures (pointing to a table that both can see). The interlocutors’ knowledge

of what they share will affect the way they speak and gesture to each other. I will illustrate this level of conversational context (and all subsequent ones) with excerpts from my pilot data: a dialogue that occurred in a laboratory between two previously unacquainted students who were being videotaped as part of a psychology experiment. Relevant to this broadest context is any previous experience that they know they have in common, which in this case is that they had both had played with some toys immediately before the dialogue began. These aspects of the context will affect both what each of them says and how they say it.

Nested within the overarching context of the dialogue as a whole is the overall purpose the interlocutors share; this conversational context is the purpose that is driving the course of their dialogue. People in conversation generally try to establish collective purposes (Grice, 1975). The purpose may be to discuss a particular situation, to solve a problem, or even just to pass time together amiably. In the pilot study, the level of conversational context was my instruction to discuss the toys each of them had previously played with. Thus, although their conversation was spontaneous and improvised, its topic was imposed. The dialogue's topic influenced the participants' choice of spoken words (their words included descriptions of the toys and what the toys had done) and their gestures (they often depicted aspects of their previous actions with the toys).

A third, narrower, embedded context is what the interlocutors choose to say within the overall purpose of the conversation. In the pilot study, this context was what each speaker chose to communicate about the previously performed

actions. It was each speaker's spontaneously chosen contribution to the conversation. Recall the earlier description of a participant discussing her experience with the whirlygig. She chose to contribute not only the identification of the toy, but also how she had been instructed to do the launching action and what had happened when she tried the first time. Some speakers chose to simply list what the toys were, others told of humorous outcomes or even how they felt about the task itself.

Finally, even within the speaker's chosen contribution to the conversation, every gesture occurs at a *precise* moment. The exact timing of each gesture forms the most narrow context influencing the gesture's physical form. It determines the gesture's immediate communicative function. As noted in the pilot study, a person may gesture various versions of the same action several times within the same conversational contribution, and each rendition may be quite different. I propose that the physical differences are a result of each gesture's particular communicative purpose at the precise moment it occurs. For example, a participant may gesture two successive versions of an action. The function of the first may be to identify what the action was, and the function of the second may be to draw attention to a particular feature of that action. The immediate communicative function of each is different, so even though the gestures are both symbolizing the same action, their form is influenced by subtle differences in their function at that moment.

In summary, I hypothesize that a gesture's form is ultimately influenced by its immediate communicative function, which is embedded in several levels of

conversational contexts. The broader levels of context impose constraints on the more narrow ones. Thus aspects of the broad levels affect the precise function of the gesture when it occurs. For example, if the interlocutors know that they share the experience of playing with a particular toy, the immediate communicative function of any gestural depiction of playing with that toy is constrained by the fact that they know they both played with it. The levels of conversational context join and together influence the physical form of the gesture.

Before illustrating more clearly how a gesture's immediate communicative function shapes its form, I would like to give an example using spoken words. An analogy for gestural transformations within a conversational contribution is the use of verbal synonyms. We might choose one synonym over another at a particular moment due to our changing communicative needs within the conversation. Although our referent stays the same, our choice of word to refer to it may change.

The following (from Clark and Wilkes-Gibbs, 1986) is an example of a speaker choosing different words to refer to the same single referent. In this example, the speaker and addressee both had a series of cards with images of Tangram figures (geometric figures without readily available names) on them. The speaker's cards were in a particular order, and her task was to help the addressee put his cards in exactly the same order. However, they could not see each other's cards, so they had to agree on names for the figures on the cards. The speaker and addressee did six trials of the ordering task with the same set of cards. Statement 1 below is how the speaker referred to and described one of

the cards the first time (trial 1), and the subsequent statements were the way she referred to the same card through successive repetitions of the task (trials 2-6).

1. Okay, the- number 7 looks like, sort of **like an angel flying away or something. It's got two arms.**
2. Okay, the seventh one, um, looks **like someone, looks like the angel flying away**, or that's what I said last time.
3. Fourth one is **the, uh, flying one.**
4. Fifth one is **the one that looks like an angel.**
5. Um, the second one is **the angel one.**
6. Sixth one's **the angel.**

The phrases in bold indicate where the speaker was referring to the same image. Even though each phrase refers to the same image, the term the speaker used to refer to it changed. The referring expressions varied as a function of the interlocutors' repetition of the task and increasing familiarity with their label over time.

The following is another verbal example from our pilot data. The speaker was describing a toy (a finger cuff) that she had played with, and both she and the addressee chose different words to refer to it. Again, the addressee's contributions are in square brackets.

Then I went on to- I had **the one... funny.....toy** like you had **the one with...**[oh the **finger-**] yeah [yeah] **finger-** [yeah] **pull** so I did **that one** [yeah] which was... (laughs) [yeah (laughs)] no big thrill.
[yeah] Pull my... finger out.

The bold words (“the one funny toy”, “the one with”, “the finger”, “finger pull”, and “that one”) all stand for the same referent: the finger cuff. The interlocutors referred to the finger cuff in the way that best suited the immediate conversational context. The first time the speaker referred to the toy, she appeared to be having trouble coming up with a name for it, and she identified it by describing it (“the one funny toy”) instead of naming it. The addressee contributed “the finger”, the speaker built on her contribution by naming the toy the “finger pull”. Once she had named it, and the addressee knew for certain what she was referring to (evident from all the “yeah’s”). To refer to it the next time, she called it “that one”. As in the Clark and Wilkes-Gibbs (1986) study, the referring expressions that the interlocutors used changed over time. However, the span of time shown in the two studies is very different. Whereas the participants in the Clark and Wilkes-Gibbs study used different referring expressions over six trials, the participants in my pilot data example used five different referring expressions, to represent the finger cuff, in the span of approximately 13 seconds. Thus interlocutors choose one synonym over another, within relatively long or short periods of time, in order to meet the changing communicative requirements of the conversation.

As with spoken language, when an individual uses a gesture to represent something, that gesture’s form will depend on the gesture’s communicative function at that moment, in that context. I would like to return to the whirlygig example from the pilot study. Descriptions of each gestural depiction will follow the transcript.

“My last one was a, a little 1... 2... flying thing. [Yeah?] 3And you had to hold your hand, stationary and 4then, with this 5hand, push it, 6away and you 7have to do it away cause otherwise it will spin this way and smack you in the face. So anyways, so then, so you 8go like that. And, and the first time I kinda 9did it like, 10weakly... (laughs)... and it just kinda fell down here, and then, from then I got into it and if you 11did it really fast and it would take off, ...”

Portrayals number 1 and 2 were both quick movements that presented salient features of the whole motion required to launch the whirlygig. Whereas the original action included holding the toy for a few seconds and rolling it back and forth in her palms, the speaker chose to eliminate those actions. Instead, her depiction included only the rub and release. The addressee had actually seen the speaker play with the toy (recall that this is an aspect of the broad conversational context). Thus the two quick gestures were sufficient for her to recognize the toy to which the speaker was referring. Their immediate communicative function was to identify the toy to someone who had seen it; early on, the addressee, by saying “yeah”, indicated that she understood.

Portrayals 3 and 4 showed separate aspects of the action abstracted from the whole motion. For portrayal number 3, the speaker just showed the position of the hand that remained stationary. In portrayal number 4, she maintained the held hand and depicted the starting position of the other hand. Although these gestures still referred to the action required to launch the whirlygig, they served a slightly different communicative function: *how* to launch the toy. It was no longer

necessary to identify the toy. In order to fulfill the function of instructing how to play with the toy, the gestures looked different than those that were serving to identify the toy.

Portrayals 5, 6, and 7 were all renditions of the whole motion again. The three were almost identical, but they were depicted with shorter motions and less precise hand positions. Portrayal 5 seemed to fulfill the purpose of showing what the two hands were supposed to do together (building on the separate hand depictions earlier), and it was the clearest and most precise of the three. Portrayals 6 and 7 appeared to be only re-iterations of the same movement. Because the communicative function of these last two gestures was not to identify how the hands work together (which was the function of portrayal 5) and was instead simply a repetition of the movement, the physical form of each could afford to be less precise.

Gesture 8 depicted what seemed to be the ideal whirlygig launching action gesture: a quick, palms-together rubbing motion. This gesture was faster, longer and more precise than gestures 5 through 7. Its function appeared to be to make sure that the addressee understood the prototypic launching action. Judging by the gestures that followed this one, gesture 8 contributed a necessary contrast between how one was supposed to launch the whirlygig and how the participant had done it the first time.

Portrayals 9 and 10, which the participant clearly labeled as depicting how she had done the whirlygig launching action the first time, were much slower than portrayal 8. In addition, the participant's fingers were more spread out and bent,

and her posture was crooked and she bent over slightly. The participant appeared to be showing her addressee in her words (“weakly”) and gestures (slow and sloppy) that her first motion caused the whirlygig to spin too slowly, resulting in a flight path that was neither high nor long. Her slow movements, sloppy finger positions, and slouching provided an explanation for the toy’s path: Unlike the ideal, she had not rubbed her palms together sufficiently fast to give it the speed it needed to fly properly. An examination of the previous actions, which the participant was now depicting, revealed that her action had not been quite fast enough. The participant’s gestures depicted her previous slow movement with great exaggeration, adding extra features to make the gesture look unmistakably slow and weak.

The final portrayal, number 11 was fast, the motion was straight and precise. It may have depicted the second time the participant sent the toy spinning, when she said that she “got into it”. She followed this gesture by twirling her right hand up into the air, indicating the whirlygig’s much-improved second flight path.

The 11 gestures were all different depictions of the same referent: the whirlygig launching action. The gestures all seemed to be tailored to fulfill their immediate communicative functions. I propose that the differences in the physical forms of the speaker’s gestures can be accounted for by subtle variations in the immediate communicative functions.

Two determinants of immediate communicative functions.

In order to demonstrate that immediate communicative function shapes the physical form of a gesture, it is necessary to invoke some principles that affect such functions. Clark (1992) outlined three principles of discourse, which came out of his work with Haviland in 1977. These principles (although previously applied exclusively to verbal communication) are relevant to my observations in the pilot data and will provide a useful framework for the formal tests to be presented in the next two chapters. The first principle is:

1. The participants in a conversation work together against a background of shared information (*common ground*) (Clark, 1992);

The level of common ground that already exists between interlocutors affects the broadest conversational context. In my previous example, the participants' level of common ground (that the addressee had seen the speaker play with the whirlygig) influenced the form of the speaker's initial portrayals. For portrayals 1 and 2, the addressee had actually seen the speaker play with the toy, and therefore two quick gestures were sufficient for the addressee to recognize the toy to which the speaker was referring. Chapter Two presents a quantitative analysis of an experiment in which I manipulated the level of common ground that the participants shared and studied the effect on the form of the initial gestures.

Clark's other two principles of discourse are the following:

2. As the discourse proceeds, the participants accumulate shared information by adding to it with each utterance (*given information*);

3. Speakers design their utterances so that their addressees can readily identify what is to be added to that common ground (*new information*) (Clark, 1992).

Given and new information accumulate over the course of the dialogue, as participants accumulate common ground. Recall that for portrayals 5, 6, and 7, the last two portrayals did not have to be as precise as the first because they were re-iterations of portrayal 5; they were now given information. My qualitative analysis, presented in Chapter Three, will show how given and new aspects of the information contained in gestures affect its physical form.

Chapter Two: Experimental Effects of Common Ground

Recall that common ground refers to information that interlocutors share; common ground provides a background for their conversation. Suppose, for example, that a co-worker pops her head into my office and says, "So, are we running tomorrow?" Our mutual understanding of "running" will depend on the common ground that we share; it could refer, for example, to either conducting experiments or exercising, both of which we do together. When interlocutors know that they share certain information, they can presuppose this information when speaking to each other. If my co-worker and I usually go running for exercise on Fridays, and she is asking me the above question on a Thursday, then I would take the word "running" to mean exercising. Furthermore, if we just finished our experiment the week before, I can be quite sure that she is not referring to that activity. The propositions that a speaker takes for granted as part of the background of the conversation are the speaker's *presuppositions* (Stalnaker, 1978):

Presuppositions are what is taken by the speaker to be the *common ground* of the participants in the conversation, what is treated as their common knowledge or mutual knowledge (Stalnaker, 1978, as cited in Clark, 1992, p. 3).

What the speaker takes at the outset to be common ground with the addressee is one aspect of the broadest level of conversational context as I defined it in Chapter One; it influences how the speaker can refer to things. My co-worker can presuppose both our exercise routine and our having finished the experiment as

being part of our common ground. She can therefore take it for granted and need not explain which kind of “running” she means.

If interlocutors know that they share common ground about something, a speaker can refer to it elliptically and expect that the addressee will successfully recognize the reference. If they do not share common ground, the speaker’s reference will have to be more explicit (i.e., more complex or elaborate). The effect of common ground on reference is consistent with two maxims of Grice’s co-operative principle (Grice, 1975). First, it is consistent with the maxim of *manner*. speakers should refer to things in a manner that is clear and unambiguous. That is, speakers should be clear, easily understood, and orderly, and they should avoid obscurity of expression, ambiguity, or unnecessary prolixity. Any speaker who refers to something that he knows is part of common ground with the listener, but who refers to it as though it is not, would be at risk of either being considered verbose or being misunderstood.

More specifically, Grice’s maxim of *quantity*, that speakers should make their contribution only as informative as required for the current purpose of the exchange, is of particular relevance to common ground. When referring to something, the speaker should give only the minimum amount of information required for the addressee to recognize it. Therefore, if the reference is to something the speaker can presuppose that the addressee already knows, then the minimum amount of required information will be very little. If it refers to something that he and the addressee do not share as common knowledge, his reference will have to contain much more information. In other words, the

quantity of information required for interlocutors to successfully resolve the reference will depend on the amount of common ground they share.

Effects of Common Ground on Verbal Reference

Previous research on verbal reference in spoken language use indicates that interlocutors do take advantage of their common ground to make direct reference as efficient as possible. Clark and Wilkes-Gibbs (1986) found that speakers and addressees worked together to ensure that direct reference was clear but that they also tried to minimize the amount of collaborative effort required when doing so. Recall that in their Tangram study (discussed in the previous chapter) the director chose different words to refer to the same single Tangram figure (Clark & Wilkes-Gibbs, 1986). Specifically, directors' referring expressions changed over repetitions of the task. One director used the following referring expression on trial 1: "looks like, sort of like an angel flying away or something. It's got two arms". By trial 6, the same director referred to the same figure with the brief noun phrase: "the angel". Clark and Wilkes-Gibbs found that on the first trial, directors referred to the figures by using descriptions and indefinite reference. On later trials, they were able to assume the addressee's prior acceptance of the description (i.e., what was now common ground) and could instead refer to the same figure with a standard noun phrase and definite reference. Because descriptions tend to be longer than noun phrases, the directors' referential expressions shortened as the interlocutors accumulated common ground. Directors used fewer words (decreasing from an average of 41 words per figure in the first trial to only 8 words per figure by the sixth), and they

took fewer turns (from 3.7 per figure in the first trial to only 1 per figure in the sixth). Over repeated trials, as they accumulated common ground, the interlocutors became more efficient in their spoken reference, while still being clear (as shown by their accuracy scores).

In an experiment by Isaacs and Clark (1987), pairs of participants were given matched sets of postcards of photos of landmarks in New York City and were asked to arrange their sets into the same order. One member (the director) had the cards arranged in the correct order, and the other (the matcher) did not. They could not see each other, so they had to rely only on words to describe the photos. Half of the participants in the study were familiar with New York City (the “experts”), and the other half were not (the “novices”). Thus, some pairs of participants shared common ground (both director and matcher were experts or both novices), and some did not (expert director with novice matcher or vice versa). When a pair of participants shared common knowledge about New York City, the director could presuppose knowledge of the names of landmarks and refer to the postcards by name (e.g., “Washington Square”). When they did not share common knowledge, the director would have to refer to the postcards using longer descriptions (e.g., “the fountain with the arch in the background”). The participants were not told whether they shared common ground, but they were able to find out for themselves very quickly (e.g., the matcher did not understand “Washington Square”). In other words, because directors were sensitive to the amount of common ground they shared with their matchers, they could be more efficient. Isaacs and Clark found that when the pairs were both

experts, they required fewer words to refer to the postcards: expert directors referring to the post cards would use the proper name of the landmark as soon as they discovered that the matcher was an expert as well. As with the Clark and Wilkes-Gibbs (1986) experiment, Isaacs and Clark also observed that, regardless of their level of expertise, the pairs required fewer words and turns over repeated trials of the same task.

Both of these studies showed that interlocutors attempt to make their references match the level of common ground they share. Speakers ascertain the minimum that they need to say in order to refer to something. Some researchers have discussed this efficiency in terms of energy use (Hunnicut, 1985; Levy & Fowler, 2000).

The following examples from my data illustrate that these interlocutors were similarly efficient. In each example, the pairs of participants had to establish that the speaker's reference to a particular toy was sufficient for their current purposes. (In the interest of clarity, for each of the examples I will refer to the speaker with a masculine pronoun and the addressee with a feminine one.) In the first example, a speaker described a toy (a finger cuff) to someone whom he knew had not seen it in a previous part of the experiment. He knew that they had not shared a common experience with that particular toy on that day. He did not, however, know whether the addressee had previous knowledge of the toy apart from the experiment. Thus his first step was to assess whether or not he could presuppose shared knowledge of the toy. He did so by asking whether the addressee had ever heard of it:

Well my first toy was what they call a finger trap. Have you ever seen those things? [(shakes head)] You like, it's like a little tube right? [OK] And you put your finger in there? [oh right the Chinese] the Ch- yeah. [finger torture things] Yeah.

The speaker first referred to the toy as “a finger trap” and then explicitly asked whether the addressee had ever seen one. Because the addressee’s response to the question (shaking her head) indicated that the name alone was not sufficient, the speaker had to increase the amount of information he contributed. To make his reference clear, he supplied descriptive information (that it was a “little tube”) and functional information (that you put your fingers in it). Recall that these techniques were consistent with those that directors initially used on the first trial in the Tangram study by Clark and Wilkes-Gibbs (1986): directors used descriptions of the figures with indefinite reference. In the example from my data, once the speaker had contributed the descriptive and the functional information, the addressee was able to identify the toy (“oh right”). The addressee also offered a name for the toy (“the Chinese finger torture things”), indicating her understanding of the reference. Once the speaker answered with “yeah”, the two interlocutors knew that they agreed that the reference to the toy was mutually understood. The speaker then did not have to continue to describe the finger cuff and could go on to discuss other aspects of his experience with the toy.

In the next example, a different speaker was talking with someone whom he knew had played with the same toys as he did previously (the finger cuff and the whirlygig). He was referring here to the whirlygig:

We had the same ones? [(nods)] Did you hit yourself with it or did it fly away from you. [Um, actually it went straight up] Yeah, same here.

The speaker could presuppose the identity of both toys with which he and the addressee had played. Because of the nature of the two toys, the information that the toy could “hit you” or “fly away” was enough to differentiate between the two. The addressee understood his reference immediately, and throughout the short exchange they were both able to refer to the toy simply as “it”. Thus, in contrast to the finger trap example (where a name, descriptive information, and functional information were all needed for clear reference), here the interlocutors could simply refer to their toy with a pronoun.

The third example was unusual because the speaker misjudged the amount of information his addressee would require. The two participants knew that they had played with different toys, so they did not share common ground:

A: Then my second one was a finger trap. (pause for 1.24 seconds)

B: Like a mouse trap?

A: No like the finger ones where you stick your fingers in both sides and when you pull them apart, you can't get your fingers out?

B: Oh, I don't know...

A: And then there's like, if you have to, twist and everything to get your fingers out.

B: OK.

The speaker began by assuming that the noun phrase “a finger trap” would be sufficient for referring to the toy. He paused after naming it but did not include a

questioning intonation (a rising pitch at the end of “finger trap”) to indicate to the addressee that he thought his reference might be inadequate. He did not explicitly ask if she knew what “a finger trap” was. His presupposition was a miscalibration, and his addressee did not understand the reference. Instead, she tried an alternative name: “a mousetrap”, which clearly indicated that she did not know what the toy was. Based on her response, the speaker then contributed an alternative name (“the finger ones”) and functional information to help her understand.

In summary, the studies by Clark and Wilkes-Gibbs (1986) and Isaacs and Clark (1987) and the three examples from my data all illustrate, in spoken language use, how speakers presuppose and can use information that they know they have in common with their addressees. When the interlocutors knew that they shared common ground, they referred to the Tangram figures, postcards of New York City, and toys as efficiently as they could. When they knew they did not, they supplied more complex and elaborate information to make their reference to the toy clearer. When one speaker misjudged the amount of information that would be required, he became less efficient because he not only had to attend to helping the addressee identify the toy but he also had to clear up the addressee’s initial misinterpretation that a finger trap is like a mouse trap.

Effects of Common Ground on Gestural Reference

The focus of the experiment in this thesis is whether the level of common ground shared between participants would influence their gestures in the same way as it has been shown to affect words. Speakers appear to design spoken

reference phrases for addressees according to what they can presuppose between them. I proposed that they would do the same with gestures, that is, they would use more elliptical gestures when they shared common ground and more elaborate and complex ones when they did not. Specifically, the experiment examined how common ground influenced speakers' gestures when they made references. As with the pilot study, I asked participants first to play with the toys separately from each other and then to discuss the toys that they each had played with.

When participants discussed their toys, their first task would logically have to be to identify what the toys were. Thus, the beginning of the conversations would always include an *identification phase*, and the gestures' communicative function in this phase would be to identify the toy. Once a toy had been identified, speakers could go on to discuss any other aspect of their experiences with it (e.g., exactly how they were instructed to make the toy work, what happened when they did it incorrectly, or how they felt about it). In the pilot studies, I observed participants playing with and talking about many different toys. Based on these observations, I selected toys for the experiment that (1) did not have readily accessible names and (2) seemed consistently to elicit iconix₁ gestures. My hope was that during the identification phase participants would use these gestures along with their words to refer to the toys, so that their hands in the gestures would represent what their hands had done in the previous actions.

I was interested in how the participants' level of common ground at outset of the identification phase would influence the physical form of the gestures that

the speakers used to refer to the toys. Therefore, I manipulated the level of common ground that the participants shared when they began. Specifically, I varied whether the speaker was describing the toy to an addressee who had played with the same toy or to an addressee who had not. Thus, the gestures in the identification phase would be serving a precise and known communicative function: they would assist in identifying a toy either for someone who had also played with it or for someone who had not.

Before their dialogue began, I told the participants whether or not they had played with the same toys. This removed the need for the speakers to infer whether or not they had common ground with the addressees, as they had to do in the Isaacs and Clark (1987) experiment. Given that speakers are sensitive to this information (Clark & Wilkes-Gibbes, 1986; Hunnicutt, 1985; Isaacs & Clark, 1987; Levy & Fowler, 2000), speakers should be more efficient when identifying the toys for the participant who had played with the same ones. Their gestures, like their words, would be only as complex as necessary, or sufficient for the current purpose, which was identifying the toy to this particular addressee.

In summary, I hypothesized that the physical form of the gestures in the identification phase of the discussion would be influenced by the interlocutors' common ground. Specifically, if the speaker and addressee had no common ground (they had played with different toys) the speaker's gestures would have to be more informative (more complex or more precise) than if the speaker and addressee had common ground (they had played with the same toys).

Method

Participants

Participants were 68 first-year psychology students who signed up for participation in return for one bonus mark (worth half of a percent) towards their course grade. I scheduled three participants for each session. Data from eight of the participants were not useable either because the third member of their triad did not attend or because of equipment failure during their participation. The final analysis included data from 20 triads, which consisted of 60 participants (44 women and 16 men). All participants consented to being videotaped in the Psychology Department's Human Interaction Laboratory. After the experiment they all viewed their videotape and gave permission for its subsequent analysis.

Equipment

The Human Interaction Laboratory has four remotely controlled Panasonic WD-D5000 color cameras and two special effects generators (a Panasonic WJ-5500B overlaid on a customized Panasonic four-camera system). I used two cameras to videotape the three participants playing with the toys in a split screen layout that recorded a face view of the Target Participant on the top half of the screen and a side view of the other two participants on the bottom half. I used two cameras to videotape both participants in each of the later dialogues in a split screen side-by-side layout that recorded a face-on view of each participant. I digitized the data from a JVC BR-S605-UB VHS VCR into AVI format onto the computer using the software Broadway (www.b-way.com), which I subsequently

used to analyze the data. I viewed the digitized data on a ViewSonic GS790 15 inch color monitor.

Materials

There were five different toys. Figure 1 is a photograph of the five toys. Table 2 is a list of the toys, their physical descriptions, and what they did. Each toy and its instructions were enclosed in a gift bag. Participants played with two of the toys.

Procedure

There were three different roles within each triad. Participants were randomly assigned their roles, which were implemented by their instructions and the toys they received. One person in each triad became the target for the analysis (the Target participant). The other two participants were assigned to the roles of the Common Ground participant and the No Common Ground participant. After filling out consent forms and getting acquainted briefly, the participants played separately with the toys (Action phase) then discussed them in assigned dyads (Dialogue phase).

Action phase. For the action phase, the lab was set up so that none of the participants could see each other playing with the toys; see Figure 2a. The Target participant sat behind a partition, and the other two participants faced away from each other. The toys were concealed in gift bags both before and after this phase. At no point during the experiment should the participants have been able to see each other's toys. Figure 2b is the split-screen view of the participants as they did their tasks.

Figure Caption

Figure 1. The five toys used in the experiment (from left to right): a popgun, a teleidoscope, a ball and cup, a finger cuff, and a whirlygig.

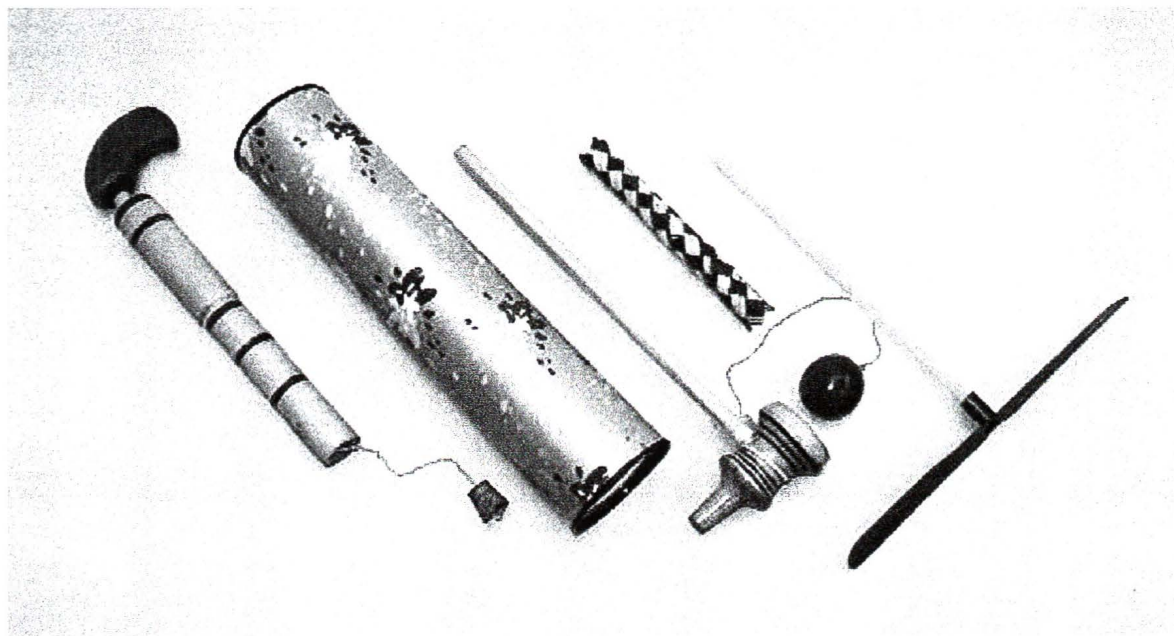


Table 2

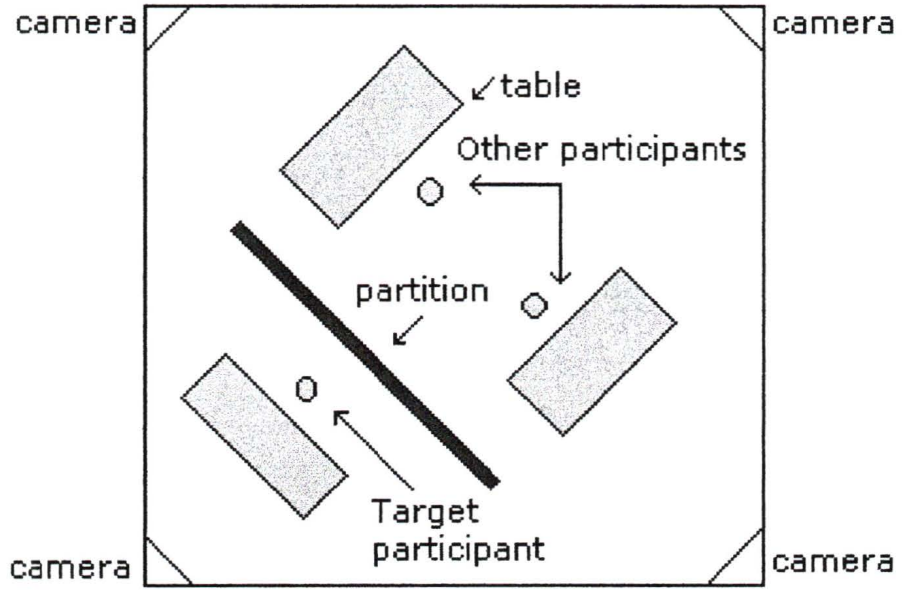
Toy descriptions:

Toy	Description	What the toy did
Popgun	a hollow wooden tube with a cork on one end attached to a curved handle on the other by a string through the center of the tube	The cork fit snugly into one end of the tube and made a “popping” sound when the handle was pushed into the tube very quickly.
Teleidoscope	A tube like a kaleidoscope but with only mirrors on the inside	It reflected whatever viewers looked at into a symmetrical pattern.
Ball and cup	a short, narrow wooden stick with a cup on one end and a ball attached to the cup by a string	Participants tried to toss the ball into the cup while keeping their elbow on the table.
Finger Cuff	hollow tube, the width and length of a finger, made of woven straw	It tightened around participants’ fingers when they put them in each end and tried to pull them out.
Whirlygig	short, narrow stick with a propeller attached perpendicularly to one end	It flew up in the air when participants rubbed the vertical rod between their palms and let go.

Figure Caption:

Figure 2a. Overhead view of the interaction laboratory set-up during action phase.

Figure 2b. Split-screen view of three participants during the action phase. The Target participant is on the top half of the screen, the Common Ground and No Common Ground participants are on the bottom half.



The design called for the Target and Common Ground participants to play with the same toys (the finger cuff and whirlygig), while the No Common Ground Participant played with a different set (the popgun and the ball and cup). However, two problems arose with the whirlygig. First, four participants inadvertently sent the whirlygig flying up in such a way that it flew over into the view of the other participants. In all four cases, the No Common Ground participant saw it, so that participant now shared some common ground with the Target participant. (For example, the Target participant would be able to refer to the whirlygig as “the toy you saw”.) Because I wanted to control common ground, I did not analyze the whirlygig data for those four groups. An additional, more serious problem occurred with the 16th triad, when one participant accidentally sent the whirlygig up into the lights where it shattered a glass light fixture. Because the inconvenience of losing whirlygig data had now turned into physical risk to the participants, I discontinued using the whirlygig for the remaining groups. For the remaining groups, the Target participant played with the finger cuff and the popgun. The Common Ground participant played with a matched set of toys, and the No Common Ground participant played with the ball and cup and the teleidoscope. This change maintained the independent variable of common ground (or not) albeit with different subsets of toys.

Dialogue phase. The dialogue phase consisted of three separate short dialogues between all possible pairs of participants, with the toys now in bags, out of view. The two participants involved in the dialogue faced each other across a coffee table. The participant not involved in the dialogue waited outside the lab.

This part of the study followed the action phase directly, making it easy for the participants to remember their two toys. Figure 3a is a diagram of the lab set-up during this phase, and figure 3b is the resulting split-screen configuration.

Their instructions were simply to discuss with each other, in pairs, how they played with the toys. I also informed all three of the participants which two of them had played with a matched set of toys and which one had played with a different set. Therefore, when any two participants began discussing their toys, they knew, at the outset, whether they had played with the same ones. First the Target participant talked with each of the other participants, one at a time, then the other two participants talked together. Note that the Target participant did not always talk with the Common Ground participant first. We counterbalanced the first two dialogues so that sometimes the Target participant talked with the Common Ground participant first and sometimes with the No Common Ground participant. Thus any systematic differences in the Target participant's gestures would not be due to whether he or she was describing the toys for the first or second time.

When the participants had completed all three short dialogues, I debriefed them, showed them the videotape of their participation, and asked them to indicate on our forms whom they gave permission to view the data.

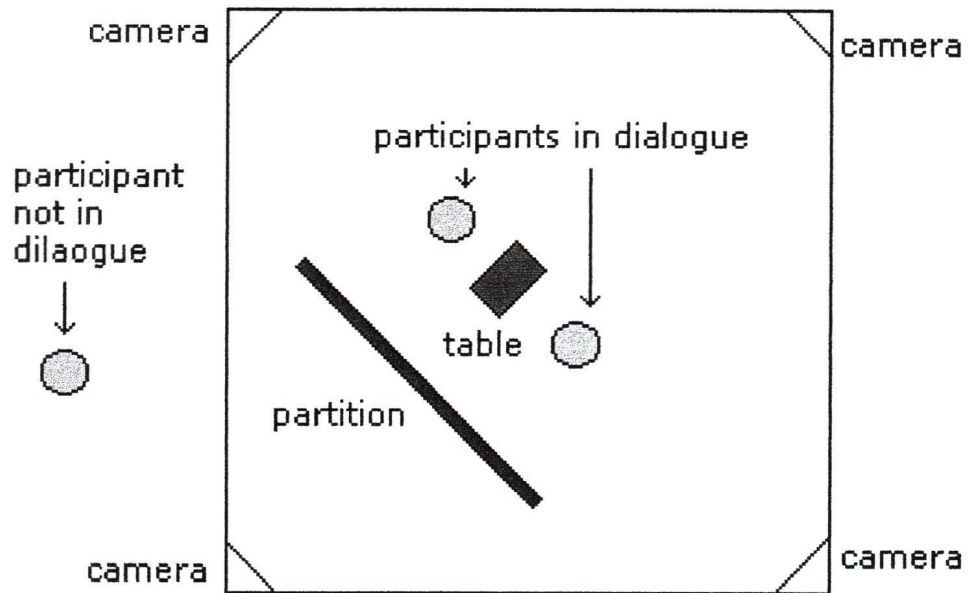
Analysis

I transferred all of the videotaped data into digitized AVI files and made shorter files of just the finger cuff discussions from each dialogue. I chose the finger cuff dialogues because there were more of them. Recall that I had far

Figure Caption

Figure 3a. Overhead view of the interaction laboratory set-up during action phase.

Figure 3b. Split-screen view of participants during dialogue phase. The Target participant is on the left side of the screen and the No Common Ground participant is on the right.



fewer useable discussions about the whirlygig because of the problems we encountered with it.

Selecting the identification phases

The analysis involved only the gestures produced during the identification phase of each dialogue, in which the initial reference to the toy occurred. Therefore, the first step was to reliably locate the exact point at which the identification phase concluded, that is, the point at which the interlocutors showed evidence that, as far as they were concerned, the addressee understood the speaker's reference. Clark and Wilkes-Gibbs (1986) described two methods that addressees use to indicate that they have accepted (understood) a speaker's reference. Their description of these methods provided criteria for the point at which I decided that the addressee had understood the speaker's reference to the finger cuff. The ending of the identification phase occurred either when the addressee asserted or presupposed acceptance. Examples of *asserting acceptance* were when the addressee said "yeah" or "right", nodded, repeated the gesture of the speaker, or offered a name for the toy. *Presupposing acceptance* was signified by the addressee allowing the speaker to continue with his turn after identifying the toy. If the addressee allowed the speaker's turn to continue unimpeded, then the addressee must have had sufficient understanding of the reference. The point of presupposed acceptance was the moment at which the speaker went on to discuss some other aspect of the toy besides information needed to identify it, for instance, when the speaker progressed on to instructions for exactly how to play with the toy or gave an opinion about the toy. Using these

criteria, two observers independently recorded where they thought the identification phase ended. In 33 of the 40 identification phases, the differences between observers' ending times were less than 1 second. In 23 of those 33, the difference between ending times was less than 0.3 seconds. For the remaining 7 identification phases, the observers discussed and then resolved the differences in ending times. The identification phases were very short, with an average length of 4.84 seconds.

There were two identification phases for each of the 20 triads. In each one, the Target participant discussed the finger cuff with one of the other two participants. In one identification phase the two participants had common ground; they had both played with the finger cuff. In the other one they did not have common ground; only the Target participant had played with the finger cuff. For each triad, I created a combined file of both of the identification phases so that they would play one after the other in the order in which they had occurred in the experiment.

The original design was a within-subjects design comparing how the Target participant's gestures in the identification phase differed when addressing the Common Ground versus the No Common Ground participant. This design assumed that the Target participant would always identify the toy first, that is, be the speaker with the other as addressee. Although this was automatically true for the No Common Ground condition (because only the Target participant had played with the toy), it was not necessarily the case when both participants could identify the same toy. Assigning the Target participant to speak first in this

condition seemed artificial, so I gave them no instructions about who was to speak first. For 11 of the 20 combined identification phases, the Target participant initiated talk about the finger cuff in the Common Ground as well as the No Common Ground condition. These 11 combined files were the data for a within-subjects comparison: the Target participant's finger cuff gestures in one condition were compared to that same participant's gestures in the other condition. For the remaining 9 combined identification phases, the Target participant initiated talk about the finger cuff in the No Common Ground condition, but the other participant initiated the finger cuff discussion in the Common Ground condition. These 9 combined files provided data for a between-subjects comparison: the Target participant's finger cuff gestures in the No Common Ground condition were compared to those produced by the other participant in the Common Ground condition.

Comparing the identification phases

Recall that my hypothesis was that the gestures used to identify the toy in the No Common Ground condition would contain more information (i.e., be more complex or more precise) than those in the Common Ground condition. That is, the gestures would have to be sufficiently complex or precise to make it possible for the particular addressee to understand a reference to the finger cuff. If the addressee had also played with the finger cuff, the speaker's gestures could be more elliptical. One other judge and I viewed the combined identification phases independently and decided which of the two phases contained gestures that were more elaborate. To make ourselves blind to condition, we covered part of

the computer screen so we could only see the participant whose gestures we were interested in. Our exact instructions were (1) to view each of the combined identification phases with the audio turned off, (2) to watch each of the combined identification phases as many times as necessary, (3) to compare the gestures in the two identification phases, and then (4) to indicate which of the identification phases contained the gestures that conveyed “more information”, were “more complex”, or were “more precise”. If we felt that the gestures were equally informative, we could indicate that there was no difference between the two. Our reliability was 90%, that is, for 18 of the 20 clips we agreed on our decisions. For the last two clips, we resolved our disagreement.

Results

As predicted, gestures produced for the No Common Ground participant were judged to be more informative, complex, and precise than those produced in the Common Ground condition. I evaluated the results using the nonparametric Binomial Test, using a conservative expected value of .5. That is, judges actually decided between three alternatives (the first excerpt contained gestures that were more informative, the second excerpt contained gestures that were more informative, or there was no difference between the two), so one could argue that the a priori probability of choosing the No Common Ground excerpt was .33, and the probability of choosing one of the other two disconfirming options added to .67. However, I chose to treat the probability of confirming or disconfirming my hypothesis as equal (.5 each), which raises the bar for achieving statistical significance.

In 19 of the 20 groups, the identifying finger cuff gestures in the No Common Ground condition were judged to convey more information ($p < .001$). In the one exception, the gestures were judged as having conveyed the same amount of information; in no instance was the Common Ground condition judged to convey more information than the No Common Ground condition. Table 3 summarizes the results for both comparisons (within and between).

In four of the common ground identification phases, no gesture was required for the addressee to identify the finger cuff, so the No Common Ground gesture was of course more complex. These four were included in the above results. However, excluding them from the analysis does not change significance levels to any sizeable degree: 15 of the 16 identification phases from the No Common Ground condition contained gestures that were judged as being more informative ($p < .001$). Table 4 presents the results with the four no-gesture groups removed.

Examples

Two different dyads will illustrate the differences between gestures that occurred in each condition. When one Target participant produced finger cuff gestures for the No Common Ground participant, she started with her index fingers apart from each other but pointing to each other. Then, in the space a few inches above her lap, she brought the tips closer together. Her index fingers were straight and in perfect alignment with each other, her other fingers were tucked out of sight into her palm, and her thumbs pointed slightly up. She then

Table 3

Number of clips for each condition that were judged to “convey more information, be more complex, or be more precise”

	Condition in which gestures were more informative			<i>p</i> value (one- tailed sign test) ^a
	No Common Ground	Common Ground	No difference	
Within	11	0	0	<.001
Between	8	0	1	=.002
Total	19	0	1	<.001

Note. Inter-rater reliability was 90%

^a Comparing No Common Ground to the sum of Common Ground + No difference, with an expected value of $p = .5$

Table 4

Number of clips that included at least one gesture in each condition that were judged to “convey more information, be more complex, or be more precise”

	Condition in which gestures were more informative			<i>p</i> value (one-tailed sign test) ^a
	No Common Ground	Common Ground	No difference	
Within	8	0	0	<.001
Between	7	0	1	=.004
Total	15	0	1	<.001

clips

^a Comparing No Common Ground to the sum of Common Ground + No difference, with an expected value of $p = .5$

brought her hands up higher so that they were about six inches above her lap, tucked her thumbs out of sight, and brought her index fingers together so that the tips were touching. Her gesture, with the straight fingers and touching tips, selected the features that would emphasize the shape of the toy as it had fit snugly around her index fingers. She was careful to let the tips touch, which may have served to indicate the tightness of the tube. She did not need to enact the pulling action for the addressee to understand her referent, and she was still in mid-gesture when they grounded.

When the same speaker did the finger cuff gesture for the Common Ground participant, her fingers were not straight, and they were not in alignment; both were pointing slightly up. She brought the tips of the two fingers closer together, but they crossed instead of touching. When she pulled them back apart, her index fingers pointed up again. She quickly brought the tips close again, but still the tips did not touch. These gestures were much quicker and less precise than the gestures she produced in the other condition. A novice addressee would not have been able to discern the tube-like shape of the toy. Although the quick bounce alluded to the previous pulling action, it would not be recognizable unless the addressee understood that the toy was a tube that fit snugly around the index fingers. The gesture was less precise and informative, and it was understandable to the addressee only because of his immediately previous experience with the same toy.

Another participant gestured several different aspects of the finger cuff to the No Common Ground participant. She contributed descriptive information by

indicating the woven aspect of the material with her fingers, outlining the shape of the tube with her index finger and thumb, and then showing the wicker material around the tube with her fingers. She then contributed functional information by putting her index fingers into the imaginary tube she had created in front of her, until her fingertips were touching. She then pulled her fingertips away from each other with a long, swift movement. When the same speaker referred to the finger cuff for the Common Ground participant, she merely put the tips of her index fingers together.

Discussion

Recall that McNeill (2000b) suggested that interaction helps to shape gestures. The experiment presented in this chapter indicates a precise way in which interaction can shape a gesture's physical form: The common ground the interlocutors believed that they shared systematically influenced the shape of their gestures. Although each speaker's initial actions with the toy somewhat determined the form of the gestures, there was a significant influence of the amount of information that would be required for a particular addressee to identify the toy. When the participants shared common ground, the speaker could presuppose the identity of the finger cuff and refer to it using more elliptical gestures. When they did not share common ground, the speaker had to refer to the finger cuff with more elaborate, informative, and precise gestures.

Recall my hypothesis that the immediate communicative function of a gesture imposes constraints on its physical form. Even when gesturing previously performed actions, speakers select features of the previous actions and

transform them. The result of these transformations is that the physical form and movements of the gesture appear quite different from the previous action.

Participants used what they knew about their common ground when selecting and transforming features of their previous finger cuff actions. They selected the features that were necessary (absolutely essential) and sufficient (but not more than was needed) to fulfill the communicative function of the gesture. In other words, they selected the features that would make the referent clear to that particular addressee.

The participants' gestures contained the *depictive* aspects (Clark & Gerrig, 1990) of the finger cuff action, that is, those features that would distinguish the intended referent from *all other possible referents*. In the Common Ground condition, the participants each played with the same two toys. Thus the set of all possible referents was only those two toys (the whirlygig and the finger cuff). The gesture produced to identify one of the toys would only have to be clear enough for the addressee to distinguish between the two. The speaker could make the gesture quite elliptically and be confident that the addressee would understand the reference. Recall that in one of the previous examples, the speaker's finger cuff gesture was simply to put the tips of her index fingers together. This gesture was enough for the addressee to distinguish between the finger cuff and the whirlygig. In the No Common Ground condition, the addressee did not know what the speaker's two toys were. The set of all possible referents included *all* other toys, so the gesture would have to be sufficiently informative for the addressee to distinguish that particular toy from any other toy. Therefore, when the speaker

gestured the finger cuff, he would have to depict more features. Regardless of the condition they were in, the criterion by which the speakers selected necessary features was that which would distinguish the intended referent from other possible referents.

Speakers transformed the selected features according to common ground as well. Gestures produced in the Common Ground condition tended to be “sloppier” and less precise than those in the No Common Ground condition. I will be discussing these transformations in more detail in Chapter Three.

While this study was principally designed to reveal affirmative evidence for how the immediate communicative function of a gesture influences its physical form, it also offers evidence that is awkward for the lexical access theory of Krauss et al. (2000). Recall that this theory proposes that individuals use gestures primarily as a means of prompting themselves when they are having problems finding a word. One of the assumptions of this theory would appear to be that gestures have specific lexical affiliates (e.g., the finger cuff gesture stands for “finger cuff”). My results do not support this assumption. First of all, if the gestures only stood for “finger cuff”, they should have had the same physical form in both conditions. Instead, the form differed with social condition. Secondly, if gestures are serving an internal, cognitive function, they should not be influenced by the social context in which they are produced. However, in my results the shape of the gestures were systematically and significantly influenced by what the speaker believed to be common ground with the addressee, something which is arguably a social influence.

In summary, the physical form of gestures was precisely related to each gesture's immediate communicative function. Gestures referring to the finger cuff were not only representing the identity of the toy in general but they were tailored to identify the toy to a particular addressee. Previous studies, such as those conducted by Clark and Wilkes-Gibbs (1986) and Isaacs and Clark (1987), showed evidence for how presupposition influences spoken language reference. The results presented here indicate that presupposition, or common ground, also influences the physical form of the gestures used to refer to something.

Chapter Three: Given and New Information

As shown in the previous chapter, common ground at the outset of the conversation influences a gesture's immediate communicative function and thereby the gesture's physical form. Information that has become common ground is *given* information; the speaker can expect that the hearer knows it. Before the information becomes common ground, it is *new* information; it is new to the discourse and serves to expand it (Kess, 1992). Thus every utterance contains some information that can be characterized as "given" and some that can be characterized as "new" (Haviland & Clark, 1974).

The following spoken-language example is from my data, and I will use it to illustrate the difference between given and new information. The two adult participants (whom I will call Alice and Ben) had just played separately with different sets of toys. One of the toys that Alice had played with was a whirlygig. Ben could not see Alice playing with her toys and had therefore not seen the whirlygig. Immediately after finishing with the toys, the two participants were asked to discuss their experiences with them. Even though they did not know what each others' toys were, they did know that they had each just played with two toys. Thus they entered into the dialogue with some information that they could take as given. In the following example, Alice had already described one of her toys and was now starting to describe the whirlygig:

Alice: And, I also had this little like, spinny thing...

The information that Alice took as given is apparent by some elliptical characteristics in her speech. The start of her utterance ("I also had") was

potentially ambiguous. However, because Ben and she shared some given information, Alice knew he would understand that she was about to describe her second toy. It is unlikely that Ben would have misinterpreted the beginning of her utterance, for example, as an introduction to a description of something that she owned as a child. (This interpretation would not be unlikely if Alice's utterance were heard in a different context.) The information crucial to interpreting her utterance was that which was given: she and Ben had each played with two toys, and now they were going to discuss the toys (not childhood experiences). The given information lead to the correct interpretation, and therefore the word "thing" could be taken as Alice's way of referring to her second toy. Her utterance also contributed information that was new to the discourse: the toy was "little" and "spinny".

Whether an addressee can consider information as given or new depends on whether the material is, at the time of the utterance, in the addressee's consciousness (Chafe, 1974). In other words, the given information must have an antecedent in the addressee's memory (Haviland & Clark, 1974). In the above example, the fact that the interlocutors had both played with two toys was fresh in their memories. Alice could assume the existence of this antecedent in Ben's memory, so she could afford to be elliptical. She could refer to her experience with the toy simply by saying "I also had". If she had not been sure that the experience and the topic of discussion was fresh in Ben's memory, she would have had to introduce the topic of the second toy more transparently. For example, if they met a week later on campus and she wanted to tell Ben about

the toy, she might have had to start the conversation differently. (Perhaps she could say, "Remember that psychology experiment we were in? I forgot to tell you about the second toy I played with! It was a little like, spinny thing...".)

Speakers must make assumptions about what the addressee is conscious of and transmit their own material accordingly (Chafe, 1974). If Alice's assumption (that Ben would know that she was referring to her second toy when she said "I also had") was incorrect, he would not have been able to understand her reference to when she continued with "this little like, spinny thing".

The previous example is an illustration of how given and new information at the outset of a particular topic of conversation manifests in the first utterance. Information that the interlocutors consider to be given is not, however, limited to that which they can take for granted at the outset. Given information, or information which has become common ground, also accumulates over the course of the dialogue (Clark, 1992). In other words, interlocutors can take more and more information as common ground as the conversation proceeds. In every utterance, information that the interlocutors had previously supplied becomes given information, whereas information that they have not previously supplied is new (Crystal, 1991). What speakers present as new information becomes given information as soon as the interlocutors mutually accept it. The thematic structure of discourse helps addressees to assess the meaning of utterances within the context of the conversation as a whole. In other words, addressees must not only identify the meaning of an utterance, but they must also integrate that utterance

into the conversation, ascertaining if there is anything in working memory to which they can attach the given and new information (Kess, 1992).

To return to the example, Alice's next few utterances illustrate how given information accumulates and how the addressee can interpret the new information correctly only by accepting it into the context of what is now given:

Alice: And, I also had this little like, spinny thing where you went, like this.

And it had like a little propeller thingy on the top. And it would fly.

Alice's second utterance, "And it had like a little propeller thingy on top", contains both given and new information. The given information (which she marked by using the pronoun "it") was that she had played with a little toy that could spin. The utterance's new information was that the toy had a propeller on the top. By her third utterance ("And it would fly"), more given information had accumulated. Alice had played with a toy that was little, could spin, and that had a propeller on top. The new information was that it the toy would fly. What Alice meant when she said, "it would fly" was only clear if she and Ben mutually accepted that they should interpret the new information against the background of the given information. This utterance required the previous ones to be understood. The meaning of "it would fly" depended almost entirely on the accumulated given information in the conversation thus far. Alice assumed that Ben would understand her last utterance based on the information that she had already contributed. Ben also assumed that her third utterance was relevant to the information that she had previous supplied and that he should interpret it against the background of the accumulated given information.

Effects of Given and New Information on Verbal Reference

Interlocutors assume that some information is given and some is new. Research has shown that speakers can help addressees integrate new information into what has become given by marking the status of both types of information (Chafe, 1974; Clark & Wilkes-Gibbes, 1986; Crystal, 1987; Fowler, 1988; Fowler & Housum, 1987; Haviland & Clark, 1974; Hunnicutt, 1985; Isaacs & Clark, 1987; Kess, 1992; Levy & Fowler, 2000). Two ways in which speakers can mark information are by systematically using variations in syntax and prosody.

Effects on Syntax

Speakers can mark verbal information as being given or new using different syntactic features. For example, they can mark given information by pronominalizing (Chafe, 1974; Kess, 1992), using markers like “the” (definite reference) (Clark & Wilkes-Gibbes, 1986; Haviland & Clark, 1974; Isaacs & Clark, 1987; Kess, 1992), or using restrictive relative clauses and adverbs like “still”, “either”, “again” and “too” (Haviland & Clark, 1974). Recall that Alice marked that fact that there was given information in her utterance by pronominalizing the little, spinny toy with the word “it”. The speaker can also use markers like “a” (indefinite reference) for new information (Clark & Wilkes-Gibbes, 1986; Haviland & Clark, 1974; Isaacs & Clark, 1987; Kess, 1992) or use cleft construction (e.g., “it was *the whirlygig* that I played with first”) (Haviland & Clark, 1974). Addressees collaborate in the process by using the Given-New Strategy: the addressee takes the sentence, breaks it into given and new

information, and then attempts to add the new information into memory (Clark, 1992; Haviland & Clark, 1974).

Effects on Prosody

Speakers can also mark verbal information as given or new prosodically, by using intonation features (Kess, 1992). For instance, speakers can systematically attenuate given material by lowering pitch or using a weaker stress (Chafe, 1974; Fowler & Housum, 1987) or by shortening the words referring to given information, often to the point of the words being unintelligible out of context (Fowler & Housum, 1987; Kess, 1992). Addressees are able to use this prosodic information to integrate the given information into the discourse as a whole (Fowler & Housum, 1987). Fowler (1988) compared words repeated on lists and in meaningful sentences and discovered that the shortening of words depended, not on mere repetition, but on their status in a communicative context of meaningful prose. Repeated words extracted out of context were shorter when they had come from sentences than when they had come from lists. Thus, speakers appeared to have communicative intent when shortening words. They did so to mark given information, not simply because they had said the word already.

Speakers also have methods for marking information that is new. They can stress it prosodically (Crystal, 1987) or articulate it more clearly, making the words intelligible and recognizable even when isolated from the context of the utterance (Hunnicut, 1985).

Although research into the effect of the status of information on spoken language reference is well-established, inquiry into how speakers use gesture to indicate given vs. new information is much more limited.

Effects of Given and New Information on Gestural Reference

McNeill (1992) mentioned an association between gestures and the status of information. He described speakers' use of rhythmic hand movements to mark new in contrast to given information in certain discourse contexts. Levy and McNeill (1992) noted speakers accompanied more discontinuous, unpredictable references with an increased amount of gesturing. When participants narrated stories that they had previously viewed, initial references to scenes were more often accompanied by gestures than were later references. Speakers appeared to use gestures to mark elements as ones that addressees should take as presupposable later in the discourse. In other words, the gestures occurred with the new information that would be important for the speaker's later contributions. Levy and McNeill suggested that new information should be accompanied not only by more gestures in general but also by gestures of more complexity. Their analysis, however, was limited to the presence or absence of gestures. They did not expand on any relationship between information status and gesture complexity.

Levy and Fowler (2000) noted that speakers used similar patterns to mark shifts in topic. Speakers marked new information by not only using lexically long and transparent referring expressions and articulating the words carefully but also by accompanying the words with gesture. In contrast, speakers tended to

mark given information by reducing the articulation of a transparent referring expression, using pronouns, and by not using gestures. Levy and Fowler concluded that speakers marked topic change at three levels of description: lexical, articulatory, and gestural. Again, they did not expand on how the status of contributed information might affect gestures' physical form.

Thus research on the effect of given and new information on gestures is limited to observations that interlocutors tended to use gestures when contributing new information (especially if the information would be important for later contributions) and tended not to use gestures when referring to given information. To the best of my knowledge no research has mentioned how the physical form of gestures might mark the status of information. I propose that if speakers mark information as given or new in their choice and articulation of words, then they should mark it in their choice and physical representation of gestures. Indeed, the analysis reported in the previous chapter indicated that the common ground shared by participants at the outset of their dialogue influenced the physical form of the gestures. Participants produced gestures that were more informative and elaborate when they contributed new information (i.e., when the identity of the toy was new to the addressee), and gestures that were less clear and precise when they depicted given information (i.e., when the identity of the toy was known to both participants).

The intensive qualitative analysis that follows shows that the gradual *accumulation* of common ground during the course of the dialogue also affects the physical form of gestures. Participants often produced gestural depictions of

the toys they had played with, and they often produced several successive gestures with the same referent (such as a particular toy). As participants proceeded through their conversation, they accumulated more common ground and continuously added new information to the discourse. The focus of the following analysis is how the accumulation of given information and the introduction of new information affected the physical form of the gestural depictions.

The analysis required a system for dividing the information conveyed in gestures into that which is given and that which is new. I designed a system based on my hypothesis that a gesture's physical form is influenced by whether it represents given and new information. New information, because it is new to the discourse, must be the most salient information in the gesture and will therefore be in the gesture's "foreground". Analogous to the precise articulation of words marking new information, gestures depicting new information should be more precise, life-sized, and well-formed. Given information would be in the "background" of the gesture. It would draw on antecedents in previous gestures, and it would be a transformed version of those gestures. Given information would appear as a less precise ("sloppier") or smaller version of previous gestures. Thus successive gestural depictions of the same referent would each be different. I proposed that the physical form of each gesture could be accounted for by what the interlocutors considered to be, at the precise moment the gesture occurred, given or new information.

Analysis 2

Data

I analyzed a subset of data from the experiment presented in Chapter two. Because the finger cuff discussions were the data for the previous analysis, I chose the whirlygig dialogues for the current analysis, specifically the whirlygig dialogues that were between the Target participant and the No Common Ground participant, when the latter had not accidentally seen the whirlygig. I chose these particular dialogues because the two participants would begin their discussion with a minimum amount of common ground, and whether the information was given or new would be most transparent for the analysis. Ten whirlygig discussions fit the criteria.

I created digitized excerpts from the ten dialogues. Each began when the Target participant began to talk about the whirlygig and ended when the participants finished talking about it. I transcribed the spoken words in each excerpt and noted of all of the gestures that either participant made. I then focussed on the gestures that depicted aspects of the whirlygig, according to the criteria below.

Selecting Gestural Depictions

During the whirlygig discussions, interlocutors could use gestures that depicted either aspects of the whirlygig or something else. I used the following criteria to select which gestures were depictions of the whirlygig. Following each criterion is an example from the data.

Physical features of the toy. One way participants could gesture about this toy was to depict its physical aspects, such as the stick, the propeller, the stick and propeller in relation to each other, the size of the toy, and its orientation. I selected these depictions of the toy's physical features. They could be iconix₁ or iconix₂ gestures. For example, the gesture could represent the stick part of the toy either by fingers tracing an imaginary stick (the fingers depicting how fingers would trace, therefore iconix₁) or by a straight finger depicting the stick itself (iconix₂). In the following gesture, the participant used her fingers to indicate the shape, size and orientation of the toy:

“The other one was just 1like a plastic, um, stick almost 2with a propeller on it?”

In the first gesture, the participant pinched her index finger and thumb together, on both of her hands. The thumb and finger on one hand seemed to hold the bottom of an imaginary stick while the ones on the other moved as though sliding up and down either side of it. The moving hand depicted the length and the narrowness of the vertical stick. In her second gesture, the hand pinching the bottom of the virtual stick remained in position while the other pointed a few centimeters away from either side of the top of the stick, as though it was pointing to the tips of two blades of a propeller attached to the top. These two gestures contributed information about the physical features of the whirlygig that was not present in the participant's words.

Participant's actions with the toy. I also selected gestures that were depictions of the participant's previously performed actions with the toy (iconix₁ gestures).

"And, I also had this little like, spinny thing where you went, like this."

In this gesture, the speaker's palms were pressed together with the thumbs pointing up, and her fingers pointed away from her. Her left hand remained stationary while her right hand moved forward until her right arm was extended in front of her. The gesture portrayed the action of launching the whirlygig. It was an accurate portrayal of what the speaker did with the toy, which was to hold the stick between her palms while she rubbed the right hand away from her body.

The toy's movements. The whirlygig usually moved as a result of the participants' actions. It could, for example, spin, fly up in the air, or fall to the ground. I included gestures that represented the toy's movements. They could represent spinning (tracing circular patterns in the air), flying (indicating a path upwards), or falling (pointing down towards the floor). In the following example, the gesture indicated the toy's path towards the participant's face.

"Yeah it hit me in the face."

In this gesture, the participant pointed one thumb up and back towards his face as though showing the path the toy took through the air. This gesture illustrated something the toy did in response to his action: it flew straight towards his face. Without the gesture depicting the path of the toy, the addressee may have interpreted the words differently. For instance, the addressee could have

mistakenly believed that the propeller part of the toy hit the speaker as he spun it in his hands, before he launched it.

Hypothetical or imagined actions. The participants also made gestures that depicted actions that they did not actually do. These gestures, however, were still recognizable as actions that could have happened.

“if you twirl it towards you then it hits you...”

The participant rubbed his palms together once, keeping one hand stationary and moving the other back towards him. The action depicted in the gesture was not one that the participant had performed during the action phase of the experiment. It was one that he imagined, probably as a result of a warning he had read in the instructions for the toy.

Gestures that did not depict the whirlygig. Some gestures did not fulfill any of the above four criteria; they were gestures that were unrelated to playing with the whirlygig. The following example includes two gestures that I did not include in the analysis:

“₁But don’t do it ₂towards you ‘cause it might hit your face. Yup. ₃And that’s it.”

In the first gesture, the participant held up one index finger and waggled it in an imitation of an overly cautious parent. In the second gesture, she rubbed the palms of her hands together depicting an action that would cause the whirlygig to hit her in the face. In her third gesture, she made a little throw-away gesture that indicated that she was finished with the topic of the whirlygig: she tossed her left hand, palm up, into the space beside her. The first and third

gestures were not depictions of aspects of the whirlygig, so I did not include them in the analysis.

Once I noted the location of all selected gestural depictions, I used the grid system described below to parse the information conveyed in each gesture into that which was given and that which was new. Recall my hypothesis that the new information in each gesture should be the clearest, most salient feature of that gesture. In subsequent gestures, information that was previously new would become given and would be physically less precise and salient but still part of the background necessary to understand new information. The hypothesized contrast between clear, precise gestures depicting new information and sloppy gestures indicating given information is analogous to the way speakers mark the status of information in spoken language. I proposed that the changes in the visual appearance of successive gestures (e.g., emphasis or shortening) could be accounted for by the division of information within the gesture as given or new.

Grid System for Tracking Information in Successive Gestures

To keep track of the information and the way it manifested physically, I constructed a separate grid for each of the 10 whirlygig dialogues. Each square grid had the number of gestural depictions listed on the top horizontal row of squares and the words accompanying each gesture along the left side.

New information

I first noted which information was the most salient in each gesture (e.g., the vertical stick part of the toy) and checked whether that information was new

to the discourse. I then noted how the gesture represented the salient features (e.g., fingers show the stick by tracing up and down an imaginary vertical narrow stick). I recorded the new information that the gesture contributed and how it represented that information on the diagonal squares where the words that accompanied each gesture intersected with the gesture's number. Figure 4 shows a template of a grid for a whirlygig discussion that would include 4 gestural depictions. Figure 5 is the same grid with information from one of the dialogues in the analysis.

Participants used various strategies for making features salient. Within depictions of the whole whirlygig action, they often exaggerated the important feature (perhaps making it larger than life), made it very precise, or drew attention to it with an extra movement. Sometimes they abstracted the particular salient feature entirely from the whole so that the feature stood on its own. The following example illustrates how a participant made "catching" the most salient feature of the gesture:

"And you just twirl it and catch it, that's the idea."

The interlocutors had already established the twirling action in an earlier utterance, but the speaker had not yet discussed catching the whirlygig. During the gesture, he first portrayed a tiny version of the rubbing action required to twirl and launch the toy. He followed the tiny action with a life-sized, precise catching motion. Thus the new information conveyed in the gesture was that the participant had caught the toy, and the catching motion's size and precision made it the most salient feature.

Figure Caption

Figure 4. Template of grid arrangement of gestural depictions

	gesture 1	gesture 2	gesture 3	gesture 4
"words accompanying gesture 1"	description of gesture 1: new information & physical form			
"words accompanying gesture 2"		description of gesture 2: new information & physical form		
"words accompanying gesture 3"			description of gesture 3: new information & physical form	
"words accompanying gesture 4"				description of gesture 4: new information & physical form

Figure Caption

Figure 5. Grid filled out with an example from the data. The new information contributed by each gesture is indicated in bold print. The physical features of each gesture are indicated in regular font.

	Gesture 1	Gesture 2	Gesture 3	Gesture 4
“stick with a propeller on it...”	Stick is vertical, propeller sits on top Hand pursed as if holding the bottom of a narrow vertical stick.			
“twirl it away...”		Prototypical whirlygig action Includes one rub, right hand moving forward, left hand moving backwards, and release.		
“if you twirl it towards you then it hits you...”			Possible incorrect action Moving hand rubs towards speaker instead of away.	
“just twirl it and catch it...”				He caught it after doing the action. Tiny whirlygig action followed by a life-sized catch.

Given information

For each gesture, I then recorded whether and how the physical aspects of that gesture re-appeared in subsequent gestures. I kept track of this information in the squares underneath the description of each gesture. So, for example, the column underneath any particular gesture would note which physical features of that gesture appeared in subsequent gestures as well as how those features were transformed. Figure 6 is the completed version of figure 5.

Participants often included physical features of previous gestures in their later gestures. That is, depictions of information that was once new often emerged, transformed, in later gestures as given information. In the above twirling example, the participant had depicted a larger version of the twirling motion earlier in the conversation. When the twirling motion was new information, it was large and precise. When the same motion re-appeared later as given information, it was tiny and much less precise. Often gestures continued to re-appear in subsequent gestures, which represented the given information as it accumulated through the course of the dialogue.

Physical features of previous gestures often appeared in subsequent ones. In later gestures, physical features of previous ones could be transformed (changing in size or precision) or retained only as spatial information (the location of a previous gesture had a meaningful relation to a later one). The following descriptions and examples indicate these two ways in which physical features of earlier gestures re-appeared in later ones. In the examples, I have underlined the

Figure Caption

Figure 6. Grid filled out with a complete example from data.

	Gesture 1	Gesture 2	Gesture 3	Gesture 4
“stick with a propeller on it...”	Stick is vertical, propeller sits on top Hand pursed as if holding the bottom of a narrow vertical stick.			
“twirl it away...”	Given information retained only as spatial reference. Whirlygig action portrayed in same space as vertical stick.	Prototypical whirlygig action Includes one rub, right hand moving forward, left hand moving backwards, and release.		
“if you twirl it towards you then it hits you...”	Given information eliminated physically, but still necessary to understand gesture 3. (Need vertical stick between palms to do action)	Given info (rub) retained but now sloppy: hands not in physical contact. Rub also transformed: RH now moves back and points to speaker.	Possible incorrect action Moving hand rubs towards speaker instead of away.	
“just twirl it and catch it...”	Given information eliminated physically, but still necessary to understand gesture 4. (Can catch vertical stick.)	Given info (rub) retained but even sloppier: only one right finger brushing past left index finger.	This gesture now eliminated physically and the given info is not necessary to understand gesture 4.	He caught it after doing the action. Tiny whirlygig action followed by a life-sized catch.

location of each gesture, but have numbered and described only the gestures that clearly illustrate the particular means of re-appearance.

Transformed gesture. Previous gestures, once established as understood, might be altered. A gesture that was once in the foreground (conveying new information) might fade into the background by becoming smaller or less precise in a later gesture (now conveying given information). Aspects of a gestures that faded into the background usually conveyed information that the interlocutors could take as given. For example:

“1twirl it away... if you twirl it towards you then it hits you in the face. 2Just twirl it and catch it...”

Gesture 1 was a prototypical whirlygig launching portrayal, including the right hand moving away from the body while rubbing the stationary left hand and releasing. Gesture 2 was a transformed version of the launching action: instead of involving the whole hand, the rubbing action appeared only as the right fingers brushing past the left index finger. Immediately following the tiny rubbing motion, the participant made a life-sized, clear catching motion. Thus the complete gesture still contained the launching action, but transformed into an almost imperceptibly tiny version. The launching action had become given information, and it did its communicative job by providing an appropriate background for the concept of “catching”.

Retained only as spatial information. Gestures often disappeared in later depictions, but the later depictions used a related location that served to support the new information:

“where you 1went like this. 2And it had a little propeller thingy...”

Gesture 1 was a portrayal of the whirlygig launching action, where the palm of the participant’s right hand rubbed past her left palm. The participant performed the gesture in the space directly in front of her body. In the next gesture, she used the index finger of one hand to trace a large horizontal circle (the propeller) over the top of where she had started the previous launching gesture. Thus she traced the location of the propeller where it would have been in relation to the launching gesture. Although the elements of the previous gesture were not physically present anymore, they lingered on as essential spatial reference, or as given information for the new information (location of the propeller) being contributed by the second gesture.

When physical features disappeared. The previous two descriptions indicated how features of previous gestures were physically present (transformed or retained spatially) as given information in subsequent gestures. Often, however, aspects of previous gestures were not physically present at all in later gestures. These features, although physically eliminated, were still necessary to interpret the new information in later gestures. In other words, information conveyed by the earlier gestures did not disappear, even though the physical features of the earlier gestures were no longer present. In the following example, information from a previous gesture was no longer present physically or spatially. The given information was, however, still essential to the meaning of the later gesture. Again, I describe only the gestures that are relevant even though I have indicated the location of all gestures:

“propeller you spin. 1And then... 2yeah, it hit me.”

In gesture 1, the participant performed the prototypical whirlygig launching action. In gesture 2, the participant pointed one thumb towards his face. The previous launching gesture was completely eliminated physically. The participant did nothing in gesture 2 that resembled the launching action, and the location of his thumb-pointing was not meaningfully related to the location of the launching action. However, the information from the previous gesture was essential to the addressee’s understanding of the second gesture. The speaker had to have performed the launching action in order for the toy to fly into his face. The launching action was given, and the interlocutors had established the information sufficiently for it to be eliminated altogether from the gestures.

I used the grid system to divide the gestures into new and given information. Information that was once new could physically re-appear in later gestures as given information. When given information disappeared in subsequent gestures, it was still necessary for understanding those gestures.

Patterns Emerging from Grid System

The grid system revealed systematic patterns in the physical form of the gestures. Later depictions, because they were supported by information supplied by previous gestural depictions, became “packed” with information. At the same time, given information became less salient physically (just as given information can do so prosodically in spoken language reference). Later gestural depictions became more schematic and contained fewer (and more sloppily depicted) physical features of the previous gestures. Often the last gestural depiction in

each dialogue contained none of the previous physical features, but required most to be understood.

All the grids are included in the Appendix. The finished grid for each group displays the following information:

1. The diagonal from top left to bottom right indicates the new information in each gesture and how that information was depicted.
2. Reading down the column underneath each gesture reveals how that gesture appeared in all subsequent ones. In other words, how the new information from that gesture was subsequently represented (by physical transformations) as given information in later depictions.
3. Reading across the row to the left of each gestural depiction reveals all of the given information from all previous gestures that had accumulated. All of this information would contribute to the addressee's correct interpretation of the new information that the speaker was presenting in the gesture at the end of the row.

Recall my hypothesis that later depictions would be "packed" with given information while simultaneously becoming more schematic physically. If this were the case, the column underneath each gesture should show the physical features gradually disappearing, and the row to the left of each gesture should show more and more necessary conceptual information. By keeping track of the residuals of each gesture through all subsequent gestures, the grid shows that these two patterns did emerge. First, information in gestures faded over time. A gesture's salient information, which was clear and precise at first, became less

well articulated in subsequent gestures until it disappeared all together. As this pattern continued, gestural depictions of the whirlygig became more and more schematic over the course of the narrative. Second, successive gestures did become packed with more and more accumulated information. Thus through successive depictions, information was gradually accumulated and gathered into the given part of the depiction where it could support new information.

In summary, the grids clearly indicated that as gestures accumulated, they contained more and more information, yet this given information was represented in a more schematic manner. In later gestures, it was very simple and often not very precise. To understand, participants had to draw on accumulated information from the previous gestural depictions.

Discussion

The purpose of this analysis was to begin to account for physical differences in conversational hand gestures when they had the same referents. My overall hypothesis is that the physical form of a gesture is influenced by the immediate communicative function the gesture is serving at the moment it occurs, in this case, by which information is given or new. To investigate specific communicative functions, this analysis drew a connection between physical transformations that attenuated or exaggerated aspects of the gesture and the verbal use of prosodic variation to mark given and new information. According to this hypothesis, multiple gestures depicting the same referent (such as portraying an action that the participant had done earlier) would be different if each gesture were serving a slightly different communicative function.

In fact, given and new information in each gesture did explain the changes in its form. Specifically, each gesture made the most important, new information most salient and the given information less salient. Through successive gestures depicting the same hand action, participants tended to mark given information by making it smaller and less precise and to mark new information by making it larger and more accurate. Thus, through the course of the conversation, gestural depictions of the same hand action became physically more schematic while at the same time becoming more conceptually complex. The physical form of the gestures was indeed influenced by an aspect of communicative function: how the information was to be integrated into the discourse.

Chapter Four: General Discussion

The investigation into why conversational hand gestures take on the particular physical form that they do proved to be a fruitful one. Chapter Two described an experimental manipulation that provided evidence for how common ground influences gestures' physical form. Interlocutors' level of common ground explained physical differences between gestures that were identifying the same referent (the finger cuff). Gestures that functioned to identify this toy when it was not part of the interlocutors' common ground were elaborate and precise. Gestures identifying the toy when it was part of the interlocutors' common ground were imprecise and not as complex. Thus common ground accounted for the variation between gestures.

The qualitative analysis in Chapter Three built on this finding by showing how accumulating common ground (given information) explained variation within gestures by the same person, for the same referent. The sloppy, small parts of these gestures were depicting information that the interlocutors could take as given, and the larger, precise parts of gestures depicted information that was new to the discourse. Through successive gestures, information that was once new and represented in a salient manner became given, fading into the background of later gestures.

Both analyses began with the assumption that hand gestures are symbolic. That is, gestures stand for something. By recording both the gestures and the referent actions, I could compare the symbolic and nonsymbolic versions. Because gestures are encoded analogically, and especially in cases

where gestural representations were of actions, we would expect their physical form to be the same as their referents. A comparison of the two, however, revealed that although they did resemble their referents, they did not have exactly the same physical form. Thus the referent could not have been the exclusive determinant of the gestures' form.

Differences in physical form between actions and gestures could be partially attributed to the constraints imposed by the different function that each serves. Actions are constrained by their purpose. In my study, the actions required to play with a finger cuff were constrained by the shape of the hollow tube in which the participants put their fingers, how hard they could pull without breaking the toy, and whatever actions they had to engage in to extricate their fingers when they were done. The physical form of gestures is also constrained by their purpose, which is to communicate. Gestures produced to identify the finger cuff had to represent the salient features that would identify the finger cuff out of other possible toys.

These two different purposes provide one explanation for why there is a difference between the action and gesture. They do not, however, predict the ways in which precise communicative functions might systematically influence gestures' form. In other words, knowing that there is an overall influence of a communicative context on a hand movement is too broad to account for the range of variation within that communicative context. Therefore, I presented a theory about how *immediate communicative function* constrains the physical form of gestures. That is, nested within the overall communicative context that shapes

a gesture's form is the immediate communicative function that the gesture is serving at the precise moment when it occurs. This fleeting function is different for each gesture, which explains why successive gestures with the same referent are different from each other. Thus, as the functions changed, the gestures do as well.

It would appear as though each gesture's fleeting immediate communicative function would be idiosyncratic, subjective, and almost impossible to predict. However, I proposed that a gesture's immediate communicative function (and therefore its physical form) depends on some of the same principles on which words depend and was able to constrain the context (and even manipulate it) so that I could predict systematic changes in the form of the gestures. My first analysis indicated that, just as interlocutors adjust their lexicon to the level of common ground that they share, they adjust their gestures as well. My second analysis showed that, just as interlocutors mark given and new information in their speech, they also do so in their gestures.

These two analyses underline the importance of studying gestures from a functional point of view, rather than a taxonomic one. My plan to do a functional analysis of gestures was initially limited by the widespread assumption that gestures can be defined by category. That is, I began my studies with the assumption that one of the categories was iconix₁ (where hands in the gesture represented hands doing an action). I planned to include only iconix₁ gestures in my analysis. This taxonomic decision proved to be cumbersome in my analyses when I found participants making much more complicated gestures that seemed

to defy easy categorization. For example, they represented the whirlygig with pinching fingers that seemed to trace outlines of the toy, by pointing to imaginary propellers, by blending their launching actions with the toy's spinning trajectories. None of these gestures could be neatly placed into a typology; trying to force them into categories did not seem like an effort that would be particularly illuminating. Furthermore, if I had limited my analysis to the pure iconix₁ gestures, I would not have discovered how given and new information were represented within the gestures. The approach I ultimately chose served to remind me speakers do not limit themselves to certain types of gestures. They probably do not realize that their combination of gestures is creative, unorthodox (at least from the taxonomic perspective), and is still following logical principles, such as common ground. Instead, speakers use whatever means are available to contribute to the conversation. In this case, they used imaginative and effective gestures to convey the identity of their toys, what they did with them, and even what they imagined doing with them.

A taxonomic approach, because of its assumption that gesture can be defined by type, can serve the purpose of revealing associations between gesture types and communicative situations. But a taxonomy of gestures does not explain physical variation within gesture types (or even between gestures with the same referent) and cannot deal with gestures that could be included in more than one category. A functional approach, besides explaining the physical form of gestures, recognizes that gestures can fulfill several functions at once (Bavelas, 1994).

My findings also emphasize the importance of including the social context when considering models of communication and speech/gesture production. A purely cognitive model of the speaker, which does not take into account an addressee, cannot include principles that exist only within interaction. Common ground simply does not exist within an individual; it can only exist between two or more individuals. Thus one can only study the effects of common ground on speech or language when the speaker is considered in relation to an addressee. Likewise, whether information is given or new in a discourse depends on what the interlocutors have mutually accepted as presupposed. The current status of the information exists only within their interaction. To study the effect of given and new information on speech or gestures can only be accomplished by situating speech and gesture within the interaction.

The status of information within the dialogue depends on even more than just its existence within an interaction. Exactly when the utterance (or gesture) occurs in relation to what has already been said affects whether it can be considered as conveying given or new information. New information is only new until the interlocutors have mutually accepted it; then it becomes given information. As given information, it then provides a background for the incoming new information. Thus it was crucial in my second analysis not to isolate any gesture from the sequential context of the dialogue. It would not be clear why some gestures looked the way they did, or even what they meant, unless I considered them in the temporal context of all of the other gestures.

Finally, my analyses would not have been possible without the videotaping of social interaction in a laboratory, both with and without the experimental manipulation conducted in Chapter Two. The prelude to my analysis was inductive, it began in the laboratory by videotaping spontaneous conversations about the toys. By repeatedly observing the interactions, I noticed that the gestures produced to identify something that was common ground between interlocutors were quick, sloppy, and schematic. These initial observations led to the deductive method of an experimental design whereby I could manipulate common ground between interlocutors. The experimental manipulation confirmed that the difference I had noticed initially was predictable and would occur systematically. By defining, predicting, and producing the effects (i.e., by constraining the topic of conversation) that I had seen in spontaneous interaction, I was able to learn more about the determinants of the physical form of gestures. Without the affordances of the laboratory (e.g., cameras and microphones) and the potential of experimental control, I would have had less confidence in the veracity of my theory that common ground and the status of information as given versus new affects the physical form of gestures.

Future Research Possibilities

The analyses presented here suggest some interesting directions for further research. For instance, the common ground manipulation demonstrated how people truncate or abbreviate gestures when they share common ground. Note that all of the gestures in the excerpts were iconix₁ gestures, where the participants used their hands in the gestures to represent what their hands had

done in the actions. Was this type of gesture elicited because the speakers knew that the addressees had also manipulated the toy? That is, did the gestures represent actions because the interlocutors had shared a common experience of acting upon the toy? If this were the case, it suggests a remarkable amount of sensitivity to a precise type of common ground. I had chosen toys because they were likely to elicit iconix₁ gestures, so it is not possible from this particular experiment to answer this question. However, it would be easy to manipulate the type of common ground participants shared. For instance, one could instruct the Target participant to play with the toy and the other participant to only look at it. If the Target participant knew that the addressee had only seen but not manipulated the toy, one could look for differences in the way the Target participant depicted the toy. It would be of some interest if the speaker were sensitive to the nature of their common ground and would use a gesture to indicate the shape of the toy (e.g., depicting a tube shape or woven material), rather than the action used to play with the toy.

There are also inquiries of a much broader nature that could be stimulated by these findings. For instance, the design presented here could be useful for understanding the acquisition of language pragmatic skills used in gestures as well as spoken language. One possibility could be to investigate whether there is a correlation between the age in which children begin to be sensitive to principles such as common ground and given versus new information in their speech and when these principles begin to influence their gestures.

Another possible direction could lead to a deeper understanding of atypical communicative skills. For example, in Asperger Syndrome, individuals have intact language skills, but they have marked difficulties with language pragmatics (e.g., being sensitive to common ground when speaking) as well as difficulties with nonverbal communication (Landa, 2000). These individuals would seem to be at a double disadvantage in my common ground experiment. First, they may or may not spontaneously use gestures to identify the toy. Second, if they do not take into account common ground in spoken language, it is questionable whether they would do so in any gestures that they might use.

Another example of atypical communication skills is aphasia, where an individual's verbal language is disrupted, but his or her social skills are often left intact. Skills such as orientation to other interlocutors and effective gesture-use are necessary to compensate for difficulties with spoken language. Goodwin (2000) described a rather complex interaction within a family where one member was severely aphasic. Their communicative success was dependent on the aphasic man's sensitivity to the orientation and speech of the other family members, their orientation and attention to him, and his repertoire of gestures. In an experiment such as mine, it is likely that individuals with aphasia would use gestures exclusively when identifying the toys. Whether they would take common ground into account would be interesting. If common ground influenced their gestures, it would suggest the possibility of an intact pragmatics system that can be expressed in spontaneous gestures. Also, it is possible that their gestures in general would be more developed and clear, so that successive gestural

depictions might have an even more obvious delineation between given and new information.

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Appendix A

Experimenter Instructions

Experimenter Instructions - Toys 2001 Matched- Mismatched**Set up: matched with B's table (near camera 3)**

1. participants arrive. They choose a slip of paper that has A, B or C on it. Ask B to sit in front of camera 3, C to sit in front of camera 1, and A to sit in front of camera 4.
2. Give them each a clipboard with the consent forms and a pen.
3. Collect signed forms and start instructions:

Hi, welcome to the Interaction Lab, and thank you for participating in our study. My name is Jennifer- and Chantelle is in the control room.

Today I am going to ask you three to do a couple of things while we videotape you. I'll give you instructions for the first task in a minute, and the second after you've completed the first. But before we start with the tasks, I would like to give you all a chance to get a bit acquainted with each other. You can talk about things like your academic interests, hobbies, or whatever you'd like. I'll give you about two minutes to introduce yourselves. Then I'll come back into the room to give you further instructions.

Any questions?

Part I: Action phase

For this next part, you'll each sit at a table. (B and C), you'll sit at these tables where you already are, and (A), you'll sit at the one behind the screen. You'll see that there are two numbered bags under your table. Inside each bag you'll find one toy and a set of instructions. I would like you to read the instructions before you play with the toy. You will have a short time to play with the first toy and then I'll let you know through our lab speakers that it is time to go on to the second. Put the first toy back into the bag and go on to the next one. Please leave the bags on the ground.

Any questions so far?

When you have finished with both your toys, I'll come back in with some more instructions about the second part of the study. You can start as soon as I leave the room.

Part II: Discussion phase

(A), do you mind coming back here where you were during my last instructions?

For this part, I would like you to discuss, for a few minutes, what you did with the toys. I'd like you to do this in pairs. So first, A and B can talk while C waits in the hall, then A and C can talk while B waits in the hall. Finally, B and C can talk while A waits in the hall. So you'll talk to each other about how you played with the toys.

For your information, A and B had the same two toys, and C had a completely different set.

Do you have any questions? OK, I'll take (C) out in the hall. Once we are gone you can begin talking to (B).

Finishing up

That's it for the actual experiment. Thanks so much for participating. Before you go, we'd like to tell you about this study, and allow you to have a look at your videotapes. Once you've seen them you can let us know if we can keep them, and, what situations you would be comfortable with us showing them. I'll also give you your participation slips.

Experimenter Instructions - Toys 2001 Mismatched-Matched

Set up: matched with C's table (near camera 1)

1. participants arrive. They choose a slip of paper that has A, B or C on it. Ask B to sit in front of camera 3, C to sit in front of camera 1, and A to sit in front of camera 4.
2. Give them each a clipboard with the consent forms and a pen.
3. Collect signed forms and start instructions:

Hi, welcome to the Interaction Lab, and thank you for participating in our study. My name is Jennifer- and Chantelle is in the control room.

Today I am going to ask you three to do a couple of things while we videotape you. I'll give you instructions for the first task in a minute, and the second after you've completed the first. But before we start with the tasks, I would like to give you all a chance to get a bit acquainted with each other. You can talk about things like your academic interests, hobbies, or whatever you'd like. I'll give you about two minutes to introduce yourselves. Then I'll come back into the room to give you further instructions.

Any questions?

Part I: Action phase

For this next part, you'll each sit at a table. (B and C), you'll sit at these tables where you already are, and (A), you'll sit at the one behind the screen. You'll see that there are two numbered bags under your table. Inside each bag you'll find one toy and a set of instructions. I would like you to read the instructions before you play with the toy. You will have a short time to play with the first toy and then I'll let you know through our lab speakers that it is time to go on to the second. Put the first toy back into the bag and go on to the next one. Please leave the bags on the ground.

Any questions so far?

When you have finished with both your toys, I'll come back in with some more instructions about the second part of the study. You can start as soon as I leave the room.

Part II: Discussion phase

(A), do you mind coming back here where you were during my last instructions?

For this part, I would like you to discuss, for a few minutes, what you did with the toys. I'd like you to do this in pairs. So first, A and B can talk while C waits in the hall, then A and C can talk while B waits in the hall. Finally, B and C can talk while A waits in the hall. So you'll talk to each other about how you played with the toys.

For your information, A and C had the same two toys, and B had a completely different set.

Do you have any questions? OK, I'll take (C) out in the hall. Once we are gone you can begin talking to (B).

Finishing up

That's it for the actual experiment. Thanks so much for participating. Before you go, we'd like to tell you about this study, and allow you to have a look at your videotapes. Once you've seen them you can let us know if we can keep them, and, what situations you would be comfortable with us showing them. I'll also give you your participation slips.

Appendix B

Instructions Provided to the Participants for the Toys

Instructions for ball and cup:

- Try to catch the ball in the cup while **keeping your elbow on the table at all times.**
- We'll let you know when it is time to stop playing with the toy.
- Please don't forget to put the toy back into its bag!

Instructions for whirlygig:

- Hold the rod vertically between your flattened palms with the propellers on top. While holding one palm stationary, quickly rub the other palm **away** from your body and release the toy.
- It is important to rub the palm **away** from you so that the toy spins away from you. If you rub the palm towards you the toy might hit you!
- You can get out of your chair to retrieve the toy if you need to.
- We'll let you know when it is time to stop playing with the toy.
- Please don't forget to put the toy back into its bag!

Instructions for finger cuff:

- Put the index finger of each hand into the tube as far as possible.
- Pull your hands apart firmly and quickly.
- If you have difficulty removing the tube, turn this card over for further instructions.
- We'll let you know when it is time to stop playing with the toy.
- Please don't forget to put the toy back into its bag!

To get your fingers out:

- Press fingertips together, you will feel the tube loosen slightly. Use your thumbs to hold the tube in this position while you pull out your fingers.

Instructions for popgun:

- Pick up the tube. Pull back the handle to make the string go into the tube. The cork should fit snugly into the tube.
- Now, as fast as you can, push the handle to make the cork "pop" out of the end. Try different speeds to make different popping sounds.
- We'll let you know when it is time to stop playing with the toy.
- Please don't forget to put the toy back into its bag!

Instructions for teleidoscope:

- Pick up the tube. You'll notice that there is a large lens on one end and a small viewing hole cut out of the other. Look through the tube from the viewing hole end. **While staying seated** try looking at different things (like the cameras, your table, the door, etc.) through the tube.
- We'll let you know when it is time to stop playing with the toy.
- Please don't forget to put the toy back into its bag!

Appendix C

Permission to View Form

Communication Research**Dr. Janet Bavelas**

Please indicate below the way(s) we can use the videotape made during this experiment. You can select some and not others—or none at all. Your experimenter will answer any questions you may have about these options.

Your tape would be kept in a secure place and labeled only with a code number, not your name. These sheets, which connect your tape with your code number, are kept in a separate place. Obviously, however, videotapes are not anonymous to anyone who knows you or would recognize you.

- | | | |
|---|------------|-----------|
| 1. Viewing and analysis by Dr. Bavelas and her research team: | yes | no |
| 2. Playing as an example for professional audiences (e.g., at a professional conference or another university): | yes | no |
| 3. Playing for other research participants (e.g., from Psychology classes) who might rate various verbal and nonverbal aspects: | yes | no |
| 4. Playing as an example for classes at UVic: | yes | no |
| 5. Playing as part of instructional material for communication research: | yes | no |
| 6. Available on the Internet on sites restricted to professionals in the area of communication research: | yes | no |
| 7. Available to the public via Dr. Bavelas's UVic Dialogue Project website: | yes | no |
| 8. As a still photo in a journal article: | yes | no |
| 9. Available as a CD in conjunction with a journal of communication research: | yes | no |
| 10. None of the above; please erase the tape: | yes | no |

Name: _____

Signature: _____

Date: _____

Experiment: TOYS 2001

Group : _____

Appendix D

Debriefing Given to Participants

Toys Study 2001 Debriefing

People can use their hands for actions that accomplish something, for example, to type at a keyboard. People can also use their hands to communicate information to others through gestures, for example, making typing motions in the air when talking about “typing”. A gesture for “typing” will be a modification of the original typing action. The function of the gesture is to communicate, not to accomplish actual typing.

The purpose of the study in which you just participated is to examine (1) the differences between actions and gestures and (2) the reasons for these differences. Our hypotheses are that gestures will differ systematically from their original referents and that these transformations will be due to differences in function.

You helped us by providing us with a videotape record of playing with the toys (actions) and then talking about them (with gestures). We will be able to examine the precise actions you performed for each task and then compare them to your gestures. Using digitalized copies of the tapes, we can watch your actions and your later gestures simultaneously. This will help us to look for systematic differences between the two. Clues to this will be the exact timing of your gestures within your narrative.

Here is an example from a previous pilot study similar to the one in which you just participated: A participant gestures the action she did with the whirlygig. For two of these gestures she slows her hand movement down considerably. This slower movement is tied with additional changes in her fingers: they are more spread apart and bent than they were in her original action. These transformed gestures occur at the underlined portions: “...the first time I kinda did it like, weakly...” She is showing her partner with her words (weakly) and her gestures (slow and sloppy) how she did it the first time. In the recording of her original actions, one can see that the results of her first attempt are that the toy rises up only a little way before slowly drifting down to the floor. Her purpose seems to be to describe and explain why the whirlygig did not fly very far. The reason the toy flew so slowly was because she did the action too weakly. When one looks at the actual action, one notices that the action does not resemble her portrayal at all. In fact, it is not immediately apparent that the action is too slow until the toy takes off. Therefore, rather than simply re-enacting her original action, she must be tailoring her illustration to her immediate narrative purpose: the whirlygig didn’t fly far and this is why.

Appendix E

Form Judges Filled Out for Quantitative Analysis

Finger cuff- Quantitative analysis:

Within-Subjects (A did the initial identifying gestures for both conditions)

- You will be comparing the clips of the gestures of the person on the left side.
- Please do this with the audio turned off.
- Watch the two clips as many times as you need to.
- Compare the gestures in clip one to those in clip two.
- **Please indicate which clip contains the gestures that you feel convey more information, are more complex, or are more precise.**

Gr#	1	2	No difference
3			
12			
20			
15			
4			
11			
14			
5			
22			
23			
13			

Between-subjects (A did the identifying gesture for one condition, C for the other.)

- You will be comparing the clips of the gestures of one person to the other.
- For each clip, the person you should watch is indicated.
- Please do this with the audio turned off.
- Watch the two clips as many times as you need to.
- Compare the gestures in clip one to those in clip two.
- **Please indicate which clip contains the gestures that you feel convey more information, are more complex, or are more precise.**

Gr #	1	2	No diff
17	R	L	
21	L	R	
8	L	R	
9	R	L	
6	R	L	
19	L	R	
7	R	L	
2	L	R	
18	R	L	

Appendix F

Spoken Word Transcripts from Qualitative Analysis

Group 2

"The other one was just like a 1plastic, um, stick al 2most (nods) with a propeller on it? (m-hm) And 3you have to push, 4holding (nods) your one palm steady you have to 5... (nods), 6push the other one and let it go 7so that it flies (nods and smiles). not But don't do it 8towards you 'cause it might hit your (laughs) face. Yup. not And that's it (nods)."

Group 4

A: My second one was like a 1propeller kind of thing, 2it's like a little helicopter thing (laughs) 3with like 4you know the 5stop part and 6there's ??? one stick and 7you just kind of spin it with your hand? (OK) 8and it just kind of twirls (wow) in the air. not It's really cute, I mean considering not something so simple, not 'cause it just flies around, (yeah) it's kinda cool. (right on).

Group 5

A: not I had a little 1stick with propeller on it? (OK) 2Twirl it away from you so that it won't hit your face (OK). If you 3twirl it toward then it hits you in the face. And 4you twirl it and catch it, that's the idea.

Group 6

A: preliminary And then the other one that was like, preliminary it was like an airplane sort of thing 1like it had a rod here 2and then two propellers 3and you're supposed to go like this (yeah) 4and it's gonna f-, it's supposed to fly 5but it kept like hitting me, and, I couldn't get it to work...

Group 7

A: 1I had a, a stick 2with a propeller on top, 3and we're supposed to rub it 4away from 5my body and I guess it's 6supposed to spin. 7... (OK) And then I had...

B: And that's why 8it like, was flying away.

A: Yeah (OK).

Group 8

A: And, I also had this ^{preliminary} little like, spinny thing ₁ where you went, like this. ₂ And it had like a little propeller thingy on ₃ the top. And it would fly.

B: ₄ Was it a top? Oh it went up actually.

A: ₅ Yeah, like it would go flying in the air ₆ like I dropped it at the very end (laugh) (Oh OK).

Group 10

A: And then, ^{preliminary} You know one of those things that you spin, ^{preliminary} and it goes up? ^{preliminary} You just kinda go like this with your hands... ^{preliminary} and then... it, it spins... [^{preliminary} ... (puzzled look)] ₁ It's like it has a little whirly ₂ thing at the end, it's kinda like this, ₃ it's like a "T" [OK] ₄ And then, you spin it, ₅ and so- and then it, flies [Oh OK. I know what you're talking about.] ₆ K well it flew up, ₇ and... yeah like, it ₈ just kept going I'm like "oh". ^{not} I had to get out of my seat (laughs) It was fun. Very good toy.

Group 12

A: ^{preliminary} And the other one was this like ₁ propeller thing? ₂ Where you go like this with one hand ₃ and like goes in the air. And I was ₄ like, I caught it in the air, I was ^{not} like "yes".

Group 13

A: Mine was one of those um ₁ little helicopter ₂ things with the ₃ ... [Oh really] ₄ spin it [₅ one of the twirly things] ₆ and then it goes yeah (laugh).

Group 14

A: And a um... ^{not} I don't know what to call it, a little ₁ propeller you spin? [oh yeah, ₂ and then] ^{not} You probably saw it you probably saw it [no I didn't see it...] ₃ yeah it hit me in the face. [(laughs)] Like make ₄ sure you rub the palms away ₅ from you, like, and then ₆ it, yeah. Or it will hit you in the ₇ face, and I thought I ₈ did it. Hit me in the face twice. Pretty funny.

Appendix G

Grids for Qualitative Analysis

Group 2	Gesture 1	Gesture 2	Gesture 3	Gesture 4	Gesture 5	Gesture 6	Gesture 7	Gesture 8
"like a plastic, um, stick at(most)."	Show vertical stick Fingers trace up and down narrow stick.							
"(al)most with a propeller on it."	Retained only as spatial reference. Propeller placed on top of virtual stick.	Show propeller on top Fingers point to both ends of propeller.						
"and you have to push"	Retained only as spatial reference. Whirlygig action performed in same space.	Retained only as spatial reference. Whirlygig action performed in same space.	Whirlygig action Including rub and release only.					
"holding your one palm steady you have to..."	Eliminated physically. Conceptually necessary (stick sits between palms).	Eliminated physically.	Retained as spatial reference and as left hand position within whirlygig action.	Stationary hand Shows left hand by slapping with right.				
"..."	Eliminated physically. Conceptually necessary (stick sits between palms).	Eliminated physically.	Less well formed action: bigger angle between hands and smaller movement.	Retained as a more rigid left hand within the whirlygig action.	More accurate whirlygig action Rub and release with stationary hand.			
"push the other one and let it go"	Eliminated physically. Conceptually necessary (stick sits between palms).	Eliminated physically.	Even less well formed action: bigger angle between hands and even smaller movement.	Eliminated physically. Conceptually necessary (rigid hand important to success of action).	Retained only as the less well formed action.	Action with release. Rub and more stylized release.		
"go so that it"	Eliminated physically. Conceptually necessary (stick sits between palms).	Eliminated physically. Conceptually necessary (propeller will make it spin).	Eliminated physically. Conceptually necessary (rub makes it spin).	Eliminated physically. Conceptually necessary (rigid hand help to make it spin).	Eliminated physically. Conceptually necessary (rub makes it spin).	Retained only as spatial reference. Spinning path is above whirlygig action.	Spinning path of toy Finger traces circular spinning path.	
"towards you 'cause it might hit your 'face.'"	Eliminated physically. Conceptually necessary (stick sits between palms).	Eliminated physically. Conceptually necessary (propeller will make it spin).	Eliminated physically. Conceptually necessary (rub makes it spin).	Eliminated physically.	Eliminated physically. Conceptually necessary (rub makes it spin).	Eliminated physically. Conceptually necessary (release to make toy fly in face).	Eliminated physically. Conceptually necessary (toy will spin into face).	Possible incorrect action Whirlygig action with other hand.

Group 4	Gesture 1	Gesture 2	Gesture 3	Gesture 4	Gesture 5	Gesture 6	Gesture 7	Gesture 8
"Propeller kind of thing"	Shows spin Index finger spins twice pointing slightly forward.	Shows spin again Index finger spins twice pointing up.	Junction of stick and propeller Fingers pinch at where junction would be.	Top of toy Index finger points to top of the toy.	Propellers Index finger and thumb show location and width of propellers.	Stick Index finger and thumb show location and width of stick.		
"It's like a little helicopter"	Transformed into higher spin that resembles actual spin of whirlygig.	Eliminated physically.						
"With like"	Eliminated physically.	Eliminated physically.	Retention of stick and propeller Fingers pinch at where junction would be.					
"You know the"	Eliminated physically.	Eliminated physically.	Retained as spatial reference. Top of the toy is where the junction is.	Top of toy Index finger points to top of the toy.				
"top part"	Eliminated physically. Conceptually necessary (spin happens because of propellers).	Eliminated physically. Conceptually necessary (spin happens because of propellers).	Retained as spatial reference. Propeller sitting on top of junction.	Retained as spatial reference. Propellers at top of the toy.	Propellers Index finger and thumb show location and width of propellers.			
"and then there's ????"	Eliminated physically.	Eliminated physically.	Eliminated physically. Conceptually necessary (stick and propeller must be joined).	Eliminated physically.	Retained as slightly blurry spatial reference. Stick drawn through propellers.	Stick Index finger and thumb show location and width of stick.		
"and you just kinda spin it with your hand."	Eliminated physically. Conceptually necessary (spin happens when you rub).	Eliminated physically. Conceptually necessary (spin happens when you rub).	Eliminated physically. Conceptually necessary (stick and propeller must be joined).	Eliminated physically.	Eliminated physically. Conceptually necessary (propellers spin when you rub).	Eliminated physically. Conceptually necessary (stick sits in between hands).	Whirlygig action. One rub, stationary hand, release.	
"and it just kinda twirls."	Transformed into higher spin that resembles actual spin of whirlygig.	Transformed into spin with a bigger radius. (more life-sized.)	Eliminated physically. Conceptually necessary (stick and propeller must be joined).	Eliminated physically.	Retained as spatial reference- spin radius matches size of propellers.	Eliminated physically. Conceptually necessary (stick between rubbing hands causes spinning).	Eliminated physically. Conceptually necessary (the rub caused the spinning).	Spin again. Index finger spins slowly five times, pointing up.

Group 5	Gesture 1	Gesture 2	Gesture 3	Gesture 4
"stick with a propeller on it..."	Stick is vertical, propeller sits on top Hand pursed as if holding the bottom of a narrow vertical stick.			
"twirl it away..."	Retained as spatial reference. First whirlygig action portrayed in same space as vertical stick.	Prototypical whirlygig action Includes one rub, right hand moving forward, left hand moving backwards, and release.		
"if you twirl it towards you then it hits you..."	Eliminated physically. Conceptually necessary. (Need stick between palms)	Rub retained but hands not in physical contact. Right hand now moves back and points to speaker.	Possible incorrect action Moving hand rubs towards speaker instead of away.	
"just twirl it and catch it..."	Eliminated physically. Conceptually necessary. (Can catch vertical stick.)	Retained only as one right fingers brushing past left index finger.	Eliminated physically.	He caught it after doing the action. Tiny whirlygig action followed by a life-sized catch.

Group 6	Gesture 1	Gesture 2	Gesture 3	Gesture 4	Gesture 5
"like it had a rod here"	Vertical stick Index finger, pointing up, draws a straight vertical line.				
"and then two propellers"	Retained as spatial reference. Propellers sit on top of stick.	Propellers Index finger draws propellers on top of stick.			
"and you're supposed to go like this"	Retained as spatial reference. Rub happens where the stick was positioned.	Retained as spatial reference. Rub happens with propellers on the top.	Whirlygig action Includes one rub, stationary hand, and release.		
"and it's gonna fly"	Eliminated physically. Conceptually necessary (stick had to be rubbed between palms to make the toy fly).	Eliminated physically. Conceptually necessary (propellers make the toy fly up).	Retained as spatial reference. Hand starts at end of rub and then rises over whirlygig action.	Toy goes up Hand moves up slightly.	
"but it kept like hitting me."	Eliminated physically. Conceptually necessary (stick had to be rubbed between palms to make the toy fly).	Eliminated physically. Conceptually necessary (propellers make the toy fly up).	Retained as hands facing each other. Also same hand moves forward (as with action) while the other goes up towards face.	Eliminated physically. Conceptually necessary (toy flies up and therefore could hit face).	Toy goes towards face Hands start palms together then one moves back towards face.

Group 7	Gesture 1	Gesture 2	Gesture 3	Gesture 4	Gesture 5	Gesture 6	Gesture 7	Gesture 8
A: "I had a, a stick"	Stick and what happens to it Hands rub together- not touching.							
"with a propeller on top"	Retained as spatial reference. Propeller on top of rub.	Propeller Finger circles propeller location.						
"and we're supposed to rub it"	Transformed into more accurate rub. Hands touching and rub more precise.	Retained as spatial reference. Whirlygig action occurs under propeller.	Whirlygig action Including small rub, stationary hand and release.	Whirlygig action Including one big straight rub, stationary hand and big release.				
"away from"	Transformed into more accurate rub. Hands touching and rub more precise.	Retained as spatial reference. Whirlygig action occurs under propeller.	Transformed into more dramatic rub and release.					
"my body. And, I guess"	Transformed into more accurate rub. Hands touching and rub more precise.	Retained as spatial reference. Whirlygig action occurs under propeller.	Retained completely.	Smaller faster rub and release.	Spinning toy Another small whirlygig action followed by spinning path upwards.			
"supposed to spin"	Transformed into more accurate rub. Hands touching and rub more precise.	Retained as spatial reference. Whirlygig action occurs under propeller.	Transformed into more dramatic rub and release.	Same size but rub not as straight, fingers more spread out and not as held together.	Eliminated physically. Conceptually necessary (explains where toy spins and that it happens as a result of action).	Whirlygig action Including big rub, stationary hand and release.		
"..."	Transformed into more accurate rub. Hands touching and rub more precise.	Retained as spatial reference. Whirlygig action occurs under propeller.	Transformed into more dramatic rub and release.	Same size but rub not as straight, fingers more spread out and not as held together.	Eliminated physically. Conceptually necessary (explains where toy spin and that it happens as a result of action).	Retained completely.	Whirlygig action Including big rub, stationary hand and release.	
B: why it like, was flying away.	Eliminated physically. Conceptually necessary (toy flew as a result of action).	Eliminated physically. Conceptually necessary (toy flew as a result of location of propellers).	Eliminated physically. Conceptually necessary (toy flew as a result of action).	Eliminated physically. Conceptually necessary (toy flew as a result of action).	Eliminated physically. Conceptually necessary (toy flew as a result of spinning and action).	Eliminated physically. Conceptually necessary (toy flew as a result of action).	Eliminated physically. Conceptually necessary (toy flew as a result of action).	Path of toy Index finger points from lap, up and to the right, and then back to lap.

Group 8	Gesture 1	Gesture 2	Gesture 3	Gesture 4	Gesture 5	Gesture 6
A: Where you went, like this.	Portray whirlygig action Includes rub, stationary hand, and release.					
And it had like a little propeller thingy on	Retained as spatial reference. Propellers placed on top of where this gesture occurred.	Location and motion of propellers Finger points to propellers spinning.				
the top. And it would fly.	Whirlygig action now smaller and release aspect eliminated.	Retained as spatial reference. Action and consequence occur under propellers.	Show consequence of action. Whirlygig action again with hand showing path of toy.			
B: Was it a top? Oh it went up actually.	Whirlygig action only a tiny rub with hand in a less precise orientation.	Eliminated physically. Conceptually necessary (toy flies because of propellers).	Smaller whirlygig action now with pointing finger.	Clarify where toy goes Whirlygig action again with pointing finger showing path.		
A: Yeah, like it would go flying in the air	Eliminated physically. Conceptually necessary (action made the toy fly).	Eliminated physically. Conceptually necessary (propellers make the toy fly).	Action eliminated but pointing finger retained.	Only pointing finger retained.	Confirm where toy goes Finger points up higher in air	
like I dropped it at the very end.	Eliminated physically. Conceptually necessary (action made the toy fly, which it had to do before it could fall).	Eliminated physically. Conceptually necessary (propellers made the toy fly, which it had to do before it could fall).	Eliminated physically. Conceptually necessary (toy followed path upwards before it could fall).	Eliminated physically. Conceptually necessary (toy followed path upwards before it could fall).	Eliminated physically. Conceptually necessary (toy followed path upwards before it could fall).	To show where toy ended up after flying Thumb points back behind speaker.

Grp 10	Gesture 1	Gesture 2	Gesture 3	Gesture 4	Gesture 5	Gesture 6	Gesture 7	Gesture 8
"It's like, it has a little whirly"	Spinning Index finger points up and traces 2 circles.	Propeller Right hand creates shape of propellers						
"thing at the end"	Retained as spatial reference. Propeller inside circle.							
"It's like a T"	Eliminated physically.	Retained completely	Stick and propeller RH is propeller and Left finger forms vertical stick.					
"and then, you spin it"	Eliminated physically. Conceptually necessary (spinning happens as a result of action).	Eliminated physically. Conceptually necessary (propeller retained as what spins).	Retained as spatial reference. Action performed on stick and propeller.	Whirlygig action Including one rub, stationary hand, release.				
"and so, and then it flies"	Transformed into more spins. Same location bigger size.	Eliminated physically. Conceptually necessary (propeller retained as what spins).	Retained as spatial reference. Spinning matches size and location of propellers.	Retained as spatial reference. Spinning occurs above action.	Spinning Index finger points up and traces 4 circles.			
"K well it flew up"	Eliminated physically. Conceptually necessary (spinning happens as a result of action).	Eliminated physically. Conceptually necessary (propeller retained as what spins).	Retained as spatial reference. Action performed on stick and propeller.	Transformed into only contact between palms. Rub, stationary hand eliminated. Release symmetrical.	Eliminated physically. Conceptually necessary (spinning result of actions).	Two whirlygig actions Including only contact between palms.		
"and..."	Eliminated physically. Conceptually necessary (spinning makes toy fly).	Eliminated physically. Conceptually necessary (propeller retained as what makes toy fly).	Eliminated physically. Conceptually necessary (stick and propeller respond to action and make toy fly up).	Retained as spatial reference. Path above action.	Eliminated physically. Conceptually necessary (spinning makes it go up).	Retained as spatial reference. Path above action.	Path of toy Hand points up and to the left.	
"just kept going I'm like "oh""	Eliminated physically. Conceptually necessary (spinning happens as a result of action).	Eliminated physically. Conceptually necessary (propeller retained as what spins).	Retained as spatial reference. Action performed on stick and propeller.	Only rub retained. Hands in different location, with different orientation.	Eliminated physically. Conceptually necessary (spinning result of actions).	Only rub retained. Hands in different location, with different orientation.	Eliminated physically. Conceptually necessary (toy follows path as result of action).	Whirlygig action Just a rub between fingers.

Group 12	Gesture 1	Gesture 2	Gesture 3	Gesture 4
"a propeller thing"	Spinning propeller Index finger draws circle in air.	Whirlingig action Including one rub, stationary hand, release.		
"go like this with one hand"	Retained as spatial reference. Action performed under spinning propeller.	Retained as spatial reference. Path is above spinning.		
"and like goes in the air"	Eliminated physically. Conceptually necessary (spinning makes toy fly so it can be caught).	Retained as spatial reference. Catching is above action.	Path of toy Index finger points up high.	Catching toy Hand makes a grab for stick part of toy after it flies in the air.

Group 13	Gesture 1	Gesture 2	Gesture 3	Gesture 4	Gesture 5	Gesture 6
A: "little helicopter"	Propeller Hands start at junction of top of stick and go out to represent propellers	Stick Left hand draws vertical stick				
"things with the"	Retained as right hand sitting at end of the propeller and as spatial reference. Stick in the middle of propeller.					
"..."	Retained as spatial reference. Action performed under propeller.	Retained as spatial reference. Action performed on stick.	Whirlygig action With two rubs and stationary hand, but no release.			
"Spin"	Retained as spatial reference. Action performed under propeller.	Retained as spatial reference. Action performed on stick.	Elaborated with more correct movement.	Whirlygig action Including one rub, stationary hand and release.		
B: "Oh really one of the twirly things"	Eliminated physically. Conceptually necessary (the propeller spins).	Eliminated physically. Conceptually necessary (stick between palms makes toy twirl).	Retained as the first half of whirlygig action.	Retained as the second half of whirlygig action.	Whirlygig action Including three rubs- one back and forth and one with a proper release	
A: "it and then it"	Eliminated physically. Conceptually necessary (the propeller spins).	Eliminated physically. Conceptually necessary (stick between palms makes toy twirl).	Eliminated physically. Conceptually necessary (toy follows path as a result of action).	Eliminated physically. Conceptually necessary (toy follows path as a result of action).	Eliminated physically. Conceptually necessary (toy follows path as a result of action).	Path of toy Index finger points up.

Grp 14	Gesture 1	Gesture 2	Gesture 3	Gesture 4	Gesture 5	Gesture 6	Gesture 7	Gesture 8
A: "propeller you spin"	Spin it between palms Rubs palms together, hands parallel fingers straight, thumbs up.							
B: "and then"	Hands not as parallel and fingers not as straight.	Abbreviated whirlygig action Rub once and release.						
A: "yeah it hit me"	Eliminated physically.	Eliminated physically. Conceptually necessary (released toy files, hits face.)	Path of toy One thumb points towards face.					
"sure you rub the palms away"	Multiple rubs turn into one rub. Hands look the same.	Retained with more precise details.	Eliminated physically. Conceptually necessary (toy followed path as result.)	Prototypical whirlygig action Including one rub, stationary hand, release.				
"from you like"	Multiple rubs turn into one rub. Hands look the same.	Retained with more precise details.	Eliminated physically. Conceptually necessary (toy followed path as result.)	Retained completely.	Prototypical whirlygig action again.			
"it, yeah"	Eliminated physically.	Eliminated physically. Conceptually necessary (toy took path after whirlygig action.)	Retained and elaborated. Instead of one thumb, speaker uses two, bigger movement.	Eliminated physically. Conceptually necessary (toy's path after whirlygig action.)	Eliminated physically. Conceptually necessary (toy took path after whirlygig action.)	Path of toy With both thumbs.		
"face. I thought I"	Eliminated physically.	Retained with more precise details.	Eliminated physically. Conceptually necessary (toy followed this path as result of action.)	Retained completely.	Retained completely.	Eliminated physically. Conceptually necessary (toy followed path as result of action.)	Prototypical whirlygig action again.	
"did it. Hit me"	Eliminated physically.	Eliminated physically. Conceptually necessary (path after action.)	Two thumbs not one and less exact. (Smaller and quicker.)	Eliminated physically. Conceptually necessary (path after action.)	Eliminated physically. Conceptually necessary (path after action.)	Thumbs retained but less exact. (Smaller and quicker.)	Retained physically- beginning of path gesture is same as end.	Path of toy Thumbs point to face.

VITA

Surname: Gerwing

Given names: Jennifer Jay

Place of birth: Red Deer, Alberta, Canada

Educational Institutions Attended:

University of Victoria (psychology)	2000-2003
University of Victoria (psychology)	1997-2000
Camosun College/Victoria Conservatory of Music	1991-1993
University of Victoria (music)	1987-1991

Degrees Awarded:

B.A. (with distinction), psychology	University of Victoria	2000
A.A.Mus	Camosun College	1993
B.Mus (first class)	University of Victoria	1991

Selected Honors and Awards:

Faculty Association Tuition Scholarship	2001-2003
University of Victoria President's Scholarship	1998-1999
Barbon Piano Teacher Training Scholarship	1992
Banff Centre for Fine Arts Entrance Scholarship	1991 and 1989
Madeline Till Award	1989
Allan Macy Scholarship	1988
IODE Martlet Chapter Bursary	1988

Publications:

Bavelas, J. B. & Gerwing, J. (2003) [Review of the book Language and Gesture]. Journal of Linguistic Anthropology, 13 (1).

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Jennifer Jay Gerwing

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