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Understanding gesture:
Description, mechanism and function

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Gestures offer additional information that is not captured in speech. This essential finding is a bouncing off point for the chapters in this book, which attempt to explain what purpose gestures serves when we speak, think and communicate. Aristotle's framework is used to describe how the research on gesture can be classified into efficient causes (how speaking, thinking and communicating drive gesture) and final causes (how gesture drives speaking, thinking and communication). The chapters of the book are laid out by research that examines how gesture functions in language and thinking for the producer (Part 1) and the observer (Part 2) with a final section that discusses some theoretical implications (Part 3).

After a lull during the twentieth century, the study of gesture is burgeoning, with a particular focus on what role gestures play during speaking (Kendon, 1997, McNeill, 1992). These co-speech gestures are the focus of this book.

Gestures accompany speech across all ages, languages and cultures, making these hand movements a natural and pervasive part of all human language. What makes these gestures so interesting? As eloquently articulated in her book, *Hearing Gesture*, Susan Goldin-Meadow (2007) suggests that gesture is a "window on the mind." That is, gestures appear to reflect contents in the mind of the speaker, often "under the radar" and frequently in a way that reflects an imagistic version of what is being spoken. Gestures can even offer additional information that is not captured in speech, as the following example from Kelly and colleagues (2008) makes clear:

> Take for example, a friend who describes to you how he got into an auto accident by saying, 'I didn't see it coming.' In gesture, your friend might represent how the cars collided by making two, perpendicular flat-handed gestures that move toward one another (making a T shape). The addition of this iconic gesture would provide a much clearer and more elaborate representation of what happened: The reason your friend 'didn't see it coming' was that the other car blindsided him from the passenger side. In this way, the simultaneous coupling of gesture and speech conveys information that is much more complete than the information conveyed through speech or gesture alone (Kelly, Rodak & Manning, 2008, p. 2).

As suggested by the title of this volume, the main goal of this book is to consider why people communicate in this way—why gesture? To answer this question, we borrow a useful distinction from classic antiquity regarding how to explain phenomena. Aristotle differentiated between what causes a behavior—its *efficient cause*—and what a behavior is for—its *final cause* (Aristotle, translated by Tredennick, 1933). For example, take the behavior of walking. According to Aristotle, a working metabolic and muscular system is

an efficient cause for walking, whereas a final cause is health. In the present book, we build on this basic distinction.

As with Aristotle and much of the past research on gesture, we explore the efficient causes—or what Tinbergen (1963) calls mechanisms—of how people produce and comprehend gesture. However, what we do differently is to also focus on Aristotle's notion of final cause — in this context, what gesture is *for*.[1] Asking about the function of gesture is tricky business. After all, how does one differentiate between the natural and regular *purpose* of gesture (in the Aristotelian sense) and the happenstance and opportunistic *consequences* of it. For example, most people would agree that the natural and regular function of the human eye is to see. However, having eyes also has "unintended" effects, such as being used to show interest, assert dominance or express intimacy (Kleinke, 1986). Consider an even thornier example from contemporary times. Recent research has shown that taking a photograph of something actually causes someone to remember that thing less well than not photographing it (Henkel, 2014). Given that the primary purpose of a camera is to stably capture images, it is ironic that one unintended consequence is to degrade those pictures in the mind!

Because it is so difficult to disentangle the designed purpose(s) and unintended consequences of gesture, it is safest to refer to the *effects* of gesture in the present volume, and simply speculate about possible *functions* for it. Identifying and describing the effects of gesture is an important first step in determining whether these effects are

[1] This useful distinction was borrowed from the Four Dimensions (4D) Framework (Goldin-Meadow, McClintock & Wimsatt, unpublished manuscript). We are deeply grateful to Susan Goldin-Meadow for introducing the three editors to this framework in our graduate training. Many ideas presented in the 4D Framework run through all three of the editor's contributions to this book.

actual functions or unintended outcomes. For example, it is first necessary to establish that gesture serves both producers and viewers of gesture—in many different ways—and only then can researchers attempt to determine the ultimate and original functions of gesture, differentiating them from the myriad of trailing effects that are simply useful byproducts. So we ask: What are the many and varied effects of gesture for producers and observers, and how can one account for these effects in neural, cognitive and social terms?

An additional goal of the book is to ask the question of "why gesture" in a second way: Why *study* gesture? Of what value is gesture in our understanding of basic cognitive and social processes, such as speaking, thinking, and communicating? In the past decade, the field of gesture studies has greatly expanded and connected with new and diverse areas of inquiry. This expansion and connection has affected how we think about phenomena not typically associated with gesture. For example, traditional theories of cognition have explained human thought independently from the body, but research on gesture has contributed to a rise of newer theories that take a more embodied approach (Barsalou, 2008; Glenberg & Kaschak, 2002; Shapiro, 2010; Zwaan, 2003). With specific regard to language, research in the past decade has shown that the brain processes gesture and speech in a similar fashion, and these findings have challenged traditional views of language as a primarily "verbal" phenomenon (Kelly et al., 2008; Özyürek, 2014). These fresh connections make the study of gesture more important than ever.

This edited volume takes a wide-angle view to provide the most current perspectives on the neural, cognitive and social mechanisms of gesture, in addition to addressing its possible function in language, thinking, problem solving, and

communication across a variety of specialized communicative settings. The chapters address what effects gestures have for the gesturer as well as for the viewers of gesture. The ultimate goal of the volume is to present a range of perspectives (neural, linguistic, cognitive and social), across a variety of contexts (conversation, intervention, narration, persuasion and instruction) and methodological approaches (both naturalistic and experimental), to understand not only the mechanisms of gesture, but its possible functions as well.

Mechanisms *of* Gesture

Research on gesture in the past few decades has yielded a wealth of descriptive information about how people gesture. Many pioneering researchers and theorists have contributed to our understanding of what gestures look like and in what contexts they appear (Calibris & Copple, 2011; Goldin-Meadow, 2007; Kendon, 1997; McNeill, 1992, Streeck, 2009). Their work, as well as the work of many others, has established the study of gesture as a legitimate behavioral science and has uncovered clear and reliable patterns of gesture use in language and cognitive processes.

A natural outgrowth of this descriptive work is to ask why gestures exist in the first place. A number of evolutionary perspectives suggest that gesture evolved either as a precursor to spoken language (Bates & Dick, 2002; Corballis, 2003; Rizzolatti & Arbib, 1998; Tomasello, 2008) or simultaneously along with it (McNeill, 2012). From a mechanistic perspective, it is interesting to ask what types of neural structures, cognitive systems and social environments laid the foundation for gesture's emergence as such a powerful tool of communication over the evolutionary timeframe. In this volume, David McNeill (Chapter 5) and Spencer Kelly (Chapter 11) suggest that the tight neural

relationship between manual actions and verbal communication was a crucial mechanism for getting language "off the ground." Once launched, gesture and speech have had a close relationship in language production and comprehension ever since.

It is also useful to consider mechanisms that give rise to gesture on shorter timeframes as well. For example, on a developmental timeframe, social exposure to a particular language over several years—particularly during childhood—causes speakers to use gestures differently across different languages (Özyürek, Chapter 3). There are also powerful mechanisms of gesture on the much shorter timeframe of moment-to-moment processing, which spans from seconds to minutes. For example, when people are faced with challenging spatial and motoric tasks, they produce more representational gestures when they speak, than when they face simpler tasks (Alibali, Yeo, Hostetter & Kita, Chapter 2). And from a linguistic point of view, the choice of a speaker's words greatly constrains the types of gestures they produce with those words (de Ruiter, Chapter 4). Finally, on the very shortest timeframe—the brief span of on-line processing—there are recently established mechanisms in "traditional language regions" in the brain (e.g., the Inferior Frontal Gyrus and Superior Temporal Sulcus) that integrate gestures and speech on the order of milliseconds (Kelly, Chapter 11). The present volume approaches mechanisms of gesture across all four timeframes, because this provides a more complete picture of why people gesture than any single timeframe alone.

Functions *for* Gesture

The most novel contribution of the present volume is to synthesize what we have learned about mechanistic causes of gesture with potential functional explanations for why we produce it. It is beyond the scope of this book to speculate on whether the

evolution of gestures functioned to give humans a competitive advantage in the Darwinian sense, but as Tinbergen (1963) points out, a behavior can be functional without being the direct product of some specific evolutionary mechanism. For example, human hands evolved to interact with real objects in the environment, but they were co-opted over time to also serve the communicative function of gesturing about imaginary objects not present in the here and now. So going beyond the traditional mechanistic accounts of gesture, the present volume adopts Tinbergen's functional perspective and asks: Regardless of how gestures evolved in the first place, what do they *do for* us in present-day thinking and communicating?

The research suggests that they do a lot. Specifically, gestures have multiple effects not only for speakers producing gestures, but also for observers viewing them. For example, producing gestures can bolster the construction of mental models (Nathan, Chapter 8), help consolidate and generalize newly learned information (Cook & Fenn, Chapter 6; Novack & Goldin-Meadow, chapter 17) promote perspective taking during moral reasoning (Beaudoin, Chapter 9), and augment interventions for clinical populations (LeBarton & Iverson, Chapter 15). In addition, the study of gesture has functioned to influence thinking in other areas of study not traditionally associated with gesture. For example, Hostetter and Boncoddo (Chapter 7) show how gestures are a useful lens through which to understand theories of embodied cognition, and Nathan, Church and Alibali (Chapter 13) explore how gestures help to resolve the classic "learning paradox" in education.

Importantly, combining mechanistic and functional approaches to explain gesture provides insights that may be missed by focusing on just one class of explanation alone.

One insight is that mechanisms and effects of gesture can have an iterative relationship, such that an effect of gesture can in turn also be a mechanism for it. Returning to an earlier example, walking results in making legs stronger, and strong legs in turn are a mechanism for walking, which makes legs even stronger, and the cycle continues. With regard to gesture, Holler and Bavelas (Chapter 10) show that gesturing can create a shared understanding between two people, and this shared understanding can then serve as a mechanism for tailoring and improving how those two people use gestures in the remainder of the interaction—and from here, the cycle can repeat itself. In this way, the behavior of gesturing is strengthened due to the reciprocal relationship between its mechanisms and effects.

A second insight is that a mechanism for a speaker's gesture may be different than its effects—intended or otherwise—on addressees. For example, simultaneously holding multiple moral viewpoints may be a mechanism for producing certain gesture-speech patterns in a speaker (Beaudoin, Chapter 9), and this may result in generating insights for that speaker. However, at the same time, an addressee may be affected in different ways: The gestures may enhance or disrupt common ground (Nathan, Alibali, & Church, Chapter 13), clarify or confuse an important concept (Singer, Chapter 14) or make it easier or harder for a non-native speaker to crack the meaning of the utterance (Stam & Tellier, Chapter 16). This is an important point often ignored in the research on gesture, perhaps for good reason. After all, it is hard enough to identify effects of gesture for a speaker or addressee individually, but studying both effects at once is even more challenging. However, given the pervasiveness and multiplicity of these overlapping effects of gesture, we view the diverse chapters in this volume as a springboard for future

attempts to unify these diverse effects—across speakers and addressees—in a single explanatory model (see Novack & Goldin-Meadow's chapter 17 for a comprehensive model). And as we have mentioned earlier, we further hope that this book paves the way for a bold new articulation of what effects of gesture are actual design features—that is, ultimate and original *functions*—and what effects are simply useful byproducts of those functions.

Structure of the Book

In the tradition of past books on gesture, each chapter describes different aspects of co-speech gestures, in addition to exploring their various mechanisms. Going beyond this well-established approach, the chapters will also explore the myriad neural, cognitive and social effects of gesture for speakers and viewers. Together, this multi-faceted approach provides a deeper and more thorough picture of why we gesture.

The book is divided into three parts. The first part examines the mechanisms and potential functions of gesture specifically for the *producer*. There are two sections within Part One. The first section examines how gesture facilitates the process of language production. Broadly speaking, the authors in these chapters argue that the process of speaking involves activating and organizing images to be articulated, and the images ultimately assist speakers in packaging information for verbal expression. The second section focuses on the role of gesture production for thinking and problem solving. The authors in these chapters argue that gesture contributes to cognition in a range of ways. Gesture grounds our thinking in perceptual-motor representations, imagery and metaphor, and anchors our conceptual processes to an embodied understanding of the world. Gesture also serves to make problem-solving strategies explicit, both in the realms of

mathematical thinking and social problem solving. As argued in this section, gesture may function to make explicit to the gesturer those perceptual-motor images involved in problem solving.

The second part of the book examines the mechanisms and possible functions of gesture for the *observer*. Kelly's chapter anchors this section by providing a framework for why speech and gesture may be tightly linked for some aspects of language, but not for other aspects. This framework helps to explain the many different communicative effects of gesture covered in Part Two. For example, gesture increases the persuasiveness and acceptance of a message even when the communicator is not human. Other chapters explore potential functions of gesture for children (typically and atypically developing) and adults in learning contexts—specifically, gesture can be used as a tool to ground abstract verbal information to the perceptual context and provide perceptual imagery when concrete objects are not visible. Finally, other chapters demonstrate that gestures used in instructional input become an important way to establish shared understanding between the learner and the teacher.

The third section includes two chapters that provide discussion about theoretical implications of the research that has focused on gesture function. These concluding chapters illustrate a number of important themes that arise in this book. One theme is that it is important to evaluate gesture function using a combination of methodologies to allow for a deeper understanding of gesture's purpose. Also gestures may serve many purposes, simultaneously for both the observer and the producer. Gestures represent action but not direct action which make them particularly useful for abstract thinking and generalization. The final paper ends as the book begins, addressing the scientific

evaluation of the mechanisms and functions of gesture. Only through careful multidisciplinary collaboration can we progress in our understanding of gesture's role in so many expressive processes.

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