Editors' Introduction

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Editors' Introduction: Miscommunication

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Abstract

Miscommunication is a neglected issue in the cognitive sciences, where it has often been discounted as noise in the system. This special issue argues for the opposite view: Miscommunication is a highly structured and ubiquitous feature of human interaction that systematically underpins people's ability to create and maintain shared languages. Contributions from conversation analysis, computational linguistics, experimental psychology, and formal semantics provide evidence for these claims. They highlight the multi-modal, multi-person character of miscommunication. They demonstrate the incremental, contingent, and locally adaptive nature of the processes people use to detect and deal with miscommunication. They show how these processes can drive language change. In doing so, these contributions introduce an alternative perspective on what successful communication is, new methods for studying it, and application areas where these ideas have a particular impact. We conclude that miscommunication is not noise but essential to the productive flexibility of human communication, especially our ability to respond constructively to new people and new situations.

Keywords: Communication; Miscommunication; Dialog; Mutual-Understanding; Conversation; Repair

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1. Introduction

Although miscommunication has been the subject of significant attention in sociolinguistics, discourse analysis, and social psychology (see e.g., Coupland, Giles, & Wiemann, 1991), it has received much less attention in the cognitive sciences. Studies of identity, power, ideology, and social structure often see moments of miscommunication as an important window on people's assumptions about norms of behavior and an opportunity to expose the processes through which cultures are reproduced (Coupland, Wiemann, & Giles, 1991; Garfinkel, 1967). The ambitions of this special issue are substantially parallel to this work but more restricted in scope.

The starting point for this collection of papers is the idea that miscommunication offers the cognitive sciences a productive window on the representations and processes required to explain the mutual-intelligibility of human interaction. Together, the papers demonstrate four areas in which a focus on miscommunication has the potential to make substantive new contributions to cognitive science:

1. An expansion of the range of experimental and computational techniques available for studying interaction.
2. Development of new formal, computational, and empirical models of interaction.
3. New applications built on the recognition of miscommunication as a ubiquitous phenomenon.
4. A re-examination of foundational concepts such as *representation*, *meaning*, and *understanding*.

The significance of these contributions depends, in part, on their place in the wider context of work on communication in the cognitive sciences and their potential to extend this work into new areas.

2. The cognitive science of communication

With some notable exceptions (discussed below), communication has often been treated as a secondary research issue in the cognitive sciences. One reason for this is that the salient unit of analysis for cognitive science is the individual, or the individual's brain, and this naturally tends to foreground intra-individual processes at the expense of extra-individual processes including communication. This general tendency has, of course, been subject to criticism even within cognitive science (e.g., Clark, 2008; Hutchins, 1995).

Communication is also an ambiguous term. People sometimes speak of music as a powerful medium of communication but are only referring to the processes of composition or performance. Similarly, in contexts like advertising and politics, communication sometimes refers solely to the process of producing and distributing a message or image. This sense of communication implies that there is nothing much of significance beyond the processes involved in production for what is, by implication, a generic, passive audience. Miscommunication, on the other hand, is an inherently multi-person phenomenon that is defined by the inter-relationship between what people produce and their audience's reactions.

This brings the interactive processes characteristic of face-to-face conversation into focus and a practical reason why communication has received less attention: the methodological difficulties that it creates. Natural interaction is typically multi-party, fragmented, multi-modal, and highly context sensitive. It is difficult to achieve adequate levels of experimental control in a live conversation and difficult to collect many of the response measures that interest cognitive scientists, for example, concurrent measures of neural activity. It is significantly easier to study how individuals process single words or sentences alone in a laboratory than it is to study language use in conversation.

A more deep-seated, historical reason for the relative paucity of work on communication is the idea that natural languages have a structure that should be primarily understood as a computational system adapted for reasoning with only a secondary use in interaction (e.g., Chomsky 1986; Fodor, 1975). This idea is not universally accepted, not least because natural languages seem better adapted to interaction than to computation (Pinker & Bloom, 1990). However, following Chomsky (1965), it became accepted practice to study language competence abstracted away from the details of communicative performance. On this view, phenomena like miscommunication are paradigmatic examples of data that fall outside the scope of explanation. Whether or not they agreed with Chomsky, many landmark developments in formal semantics (e.g., Montague, 1974) and computational grammars (e.g., Gazdar, Klein, Pullum, & Sag, 1985) also idealized away from communicative use.

Despite this reticence, there are many examples of work on human interaction that illustrate a productive interplay between philosophical, experimental, computational, and formal approaches to understanding communication in the cognitive sciences. Bartlett's experimental comparison of memory during free recall with memory during re-telling in conversation provides an early reference point in experimental psychology (Bartlett, 1932). Despite not working on interaction himself, Turing's (1950) proposal that unscripted conversation is the key test of machine intelligence gave interaction an enduring significance in cognitive science and helped launch the careers of many famous artificial conversational agents (e.g., Eliza, the artificial Rogerian therapist built by Weizenbaum, 1966).

One of the first attempts to produce a general, systematic theory of human communication emerged from the Palo Alto group in the 1960s (Watzlawick, Bavelas, & Jackson, 1967). Inspired by fine-grained analyses of the conduct of psychiatric interviews, they explored a combination of psychological theory and cybernetic principles of interactive feedback as a route to developing better therapeutic and computational applications. The same studies that inspired Watzlawick et al. (1967) also launched a substantial strand of observational (e.g., Kendon, 1980, 1990; McNeill, 1985, 1992) and later experimental (e.g., Bavelas, Chovil, Lawrie, & Wade, 1992) work on the fine-grained choreography of gesture and body movements in interaction, in turn, feeding the development of artificial embodied conversational agents (e.g., Cassell, 2000).

Influential lines of work also emerged from analytic philosophy. Lewis (1969) built on Schelling's game-theoretic ideas to produce an influential analysis of languages as conventional solutions to coordination problems. Austin's (1962) concept of language as action inspired attempts to build formal models of conversational "speech acts" (Searle, 1969). Grice's introduction of a principled distinction between what people literally say in conversation and what they imply by what they say provided impetus for intention based formal approaches to modeling conversation (Grice, 1975; Sperber & Wilson, 1986). These developments in formal semantics and pragmatics in turn prompted new lines of investigation in experimental psychology and in computational modeling of interaction (see, e.g., Cohen, Morgan, & Pollack, 1990).

A particularly important contribution in experimental psychology was the development of a definite reference task that provided a simple objective measure of how well a conversation was going (Krauss & Weinheimer, 1966). This initiated a program of experimental investigation that continues in contemporary psycholinguistics. It created the key experimental paradigm which, together with Lewisian and Gricean influences, provided the foundations for the influential Collaborative Model of dialog, which emphasizes the interactive, collaborative processes people use to build up mutual-understanding, or common ground in conversation (Clark, 1996).

This necessarily incomplete sketch illustrates the importance of human communication, and more specifically interaction, as a long-standing interest in the cognitive sciences. The papers in this special issue continue this tradition and review many more recent developments. However, probably the most important omission above is older: the mathematical theory of information (Shannon & Weaver, 1949). This work is an especially useful reference point for clarifying what is at issue in the contrast between communication and miscommunication as issues for cognitive science.

2.1. A definition of communication and miscommunication

Originally developed in 1948, the mathematical model of communication was immediately identified as a promising model of human interaction with the potential to apply not just to the analysis of speech communication but all human interaction (Shannon & Weaver, 1949). In the original formulation, communication was modeled as illustrated in Fig. 1. An information source selects a message from some known set of alternatives, for example, words of English, and the transmitter converts these words into a signal, for example, into vibrations of the air produced by a voice. The receiver then decodes the signal to recover the transmitted word. Shannon's innovation was to model the information transmitted by a signal through a channel in terms of the total set of alternative possible messages that could be transmitted through that channel. This enabled a new mathematical characterization of the amount of information transmitted by a given message, the capacity of an information channel, and the effects of noise on the channel.

Fig. 1 thus provides a clear picture of what successful communication is and of what can go wrong with it. Shannon's model was principally concerned with the "technical problem" of modeling information transmission in terms of the statistical rarity of a

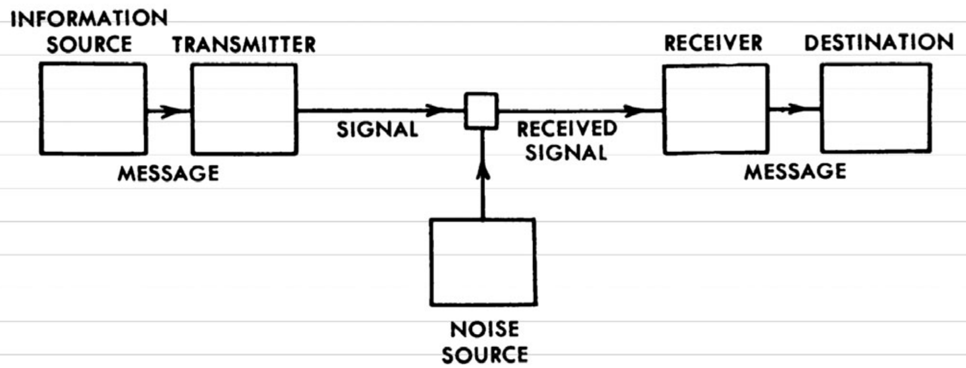

Fig. 1. The basic information-theoretic model of a communication system (from Shannon & Weaver, 1949, p. 7).

signal. Weaver proposed that it also applied to the "semantic problem" of how a signal conveys a desired meaning and the "effectiveness problem" of how the transmitted meaning then impacts on behavior. The criterion of communicative success at the semantic level was "the identity, or satisfactorily close approximation, in the interpretation of meaning by the receiver, as compared with the intended meaning of the sender" (Shannon & Weaver, 1949, p. 4). Communication between people is thus successful only if the cognitive states corresponding to the speaker's and hearer's interpretations are identical, or close enough to identical as to make no substantive difference. Furthermore, the cognitive processes corresponding to message encoding and decoding need to guarantee that the hearer is "a sort of inverse" of the speaker (Shannon & Weaver, 1949, p. 7). Miscommunication, on the other hand, is modeled as "noise" or perturbations in the channel which alter the transmission of the signal leading to uncertainty about, for example, what words were actually said or what gestures were actually performed.

This analysis of communication and its definition of communicative success is one of the most important models in the cognitive sciences. Among other things, the work of Shannon was important in the cybernetic feedback theories that influenced Watzlawick et al. (1967). Cherry (1957) provides an early review of its applications to human communication as well as early warnings about the difficulties with using statistical information theory to explain semantic coordination: Equally rare messages can be informationally equivalent while meaning quite different things. Nonetheless, it provides a clear picture of the relationship between syntactic and semantic representations of natural languages as codes, cognitive processes as encoding–decoding mechanisms that implement these codes, and of communication as the process of using signals to align processing at the source and receiver. As noted above, many theories of the formal and computational structure of natural languages adopted essentially the same idealization. Some work makes the relationship with the code-model explicit. For example, Sperber and Wilson (1986) adopted the code-model conception of the transmission of literal meaning as a necessary condition for communication and then enriched it with the pragmatic inferences required to derive implications. A similar assumption is incorporated into the Interactive Alignment model, which assumes parity between people's encoding and decoding processes over the same phonological, syntactic, and semantic representations as underpinning successful communication (Garrod & Pickering, 2009; Pickering & Garrod, 2004).

The problem with this picture is the limited analysis of miscommunication it provides. The only kind of communication problem systematically captured in the Shannon–Weaver picture is "mishearing" in which transmission of a signal is threatened by, for example, background noise. What this does not accommodate is situations in which people do not share the same code(s), that is, do not understand the same thing by an utterance or gesture. Weaver's qualification that interpretations only need to be "satisfactorily close" covers differences in interpretation that are too insignificant to impact on the conduct of the interaction. What it does not cover are situations where a problem with interpretation is detected and addressed in the conversation, for example, through a clarification question (Purver, Ginzburg, & Healey, 2003). It also fails to cover the situation in which people do, ostensibly, share the same code but the signal underspecifies the meaning, that is, where the signal to meaning mapping is not 1-to-1.[1] What is the evidence that miscommunication of this kind is important?

3. The cognitive science of miscommunication

Two basic questions for cognitive science are raised by the preceding discussion. First, does miscommunication really amount to something more substantive than noise in the system? Second, if it does, what implications does this have for our understanding of what communication really is?

As noted above, the empirical question of what happens when people encounter differences in interpretation during conversation has often been avoided as a "performance" issue in cognitive science. Nonetheless, some experimental studies have directly manipulated differences in understanding in order to explore their effects on communicative coordination (e.g., Anderson et al., 1991; Healey, 1997; Isaacs & Clark, 1987; Metzing & Brennan, 2003). However, the most developed empirical account of what happens when things go wrong comes from conversation analysis (CA), a sociological tradition built on detailed qualitative analyses of natural interaction (Sacks, 1992). For reasons that are explored further below, the relationship between conversation analysis and cognitive science is not straightforward (see also De Ruiter & Albert, 2017; and the discussion by Albert & de Ruiter, 2018) but it has had a significant influence on work in mainstream cognitive science (viz: Clark & Marshall, 1981; Levelt, 1989; Levinson, 2002; Hutchins, 1995; Healey, 2008) and is a key reference point for all the papers in this volume.

3.1. Conversation analysis and repair

The procedures people use to deal with potential troubles in ordinary conversation were among the first generalizations made by conversation analysts. Troubles in the CA sense are more diverse than noise, and include misarticulations, malapropisms, use of a "wrong" word, unavailability of a word when needed, and trouble on the part of the recipient in understanding (Schegloff, Jefferson, & Sacks, 1977). Conversation analysts have provided detailed descriptions of the procedures people use to diagnose and repair these difficulties (Jefferson, 1983; Sacks, Schegloff, & Jefferson, 1974; Schegloff, 1987, 1992). These mechanisms are organized in terms of structural relationships between sequences of turns and turn constituents and, it is claimed, are independent of the type of problem encountered. They are primarily analyzed in terms of where in the sequence of turns in a conversation trouble is signaled, who (nominally) produced the source of the trouble, who responded to it, and where in the sequence it is resolved. Albert and de Ruiter (2018) and Purver, Hough, and Howes (2018) provide examples and further explanation of these structures.

What are the prospects for a cognitive science of miscommunication? There are several points of contact between the CA analysis of repair and cognitive science. The fact that repair sequences are both incremental and jointly managed highlights the fundamentally interactive nature of these processes (see Byun, De Vos, Bradford, U., & Levinson, 2018; McCabe & Healey, 2018; Purver et al., 2018). This creates particular difficulties for sentential approaches to the formal semantics of dialog and alternative approaches, inspired by a consideration of patterns of misunderstanding, are also explored in Ginzburg and Kolliakou (2018) and Larsson (2018).

CA repair mechanisms are unusual in that they appear to operate in any conversational context and are considered to be "the only type of turn with unrestricted privilege of occurrence" (Schegloff, 1993, p. 115). Although quantification has sometimes been resisted in CA, estimates of the frequency of repair in cognitive science support the claim that it is ubiquitous with around one repair event every 20 words, or roughly once every three turns in ordinary conversation (Brennan & Schober, 2001; Colman & Healey, 2011). Enfield (2017) recently estimated that specific, explicit repair initiations like "Huh?" or "Who?" occur on average once every 84 seconds in ordinary conversation.

Quantitative results also indicate that repair types are not, as CA analyses originally suggested, independent of context or problem type. Rates of repair approximately double when people are engaged in a task that demands high levels of coordination and the distribution of repair types also changes (Colman & Healey, 2011). Specific repair types are associated with specific problem types (Purver et al., 2003) and patterns of repair also vary systematically with factors such as age and gender (Bortfeld, Leon, Bloom, Schober, & Brennan, 2001). Purver et al. (2018) provide further quantitative estimates of repair frequencies and show how they also vary between corpora collected under different conditions and, perhaps more obviously, with the quality of the transcriptions which often involve some normalization of the original speech. This makes it likely that the current quantitative estimates underestimate the frequency of repairs.

Repair is not just frequent; evidence is accumulating that at least some of the mechanisms involved are universal across human languages (Dingemanse, Torreira, & Enfield, 2013; Dingemanse et al., 2015). It also appears that some of these mechanisms generalize across modalities with evidence of specialized visual repair devices used in communication mediated by gesture or sign language (e.g., Manrique & Enfield, 2015; Mortensen, 2012). Byun et al. (2018) review some of this work and also show how basic repair procedures are of critical importance for signers in situations where people do not have a common sign language. Similarly, in experiments in which people communicate solely by drawing, Healey, Swoboda, Umata, and King (2007) identified graphical analogs of repair mechanisms that appear to play a key role in people's ability to create and coordinate invented graphical languages.

Although CA characterizes repairs as local operations on the surface structure of a conversation, there is experimental evidence that repairs have subterranean effects that go beyond the local detection and resolution of troubles. For example, Jefferson (1983) described forms of embedded correction in which people repeat part of a turn with a word or phrase substituted without any overt signal of a problem.[2] Experimental work has shown substitutions of this kind appear to be a powerful mechanism for word acquisition by children and may be more effective than explicit correction (Chouinard & Clark, 2003; Saxton, 1997). In adult interactions, Brennan and Schober (2001) showed that self-repairs in which people revise what they are saying mid-turn, often termed "disfluencies" in linguistics, can demonstrably add to the intelligibility of speaker's turns for their addressees. McCabe and Healey (2018) provide further evidence for the beneficial effect of the use of self-repairs by mental health professionals on the quality of clinical interactions. In addition, there is experimental evidence that selectively interfering with specific repair mechanisms can speed up or slow down semantic coordination in dialog (see e.g., Healey, 2008; Healey, Mills, Eshghi, & Howes, 2018).

Returning to the question posed at the start of this section, it appears that there is a strong case for claiming that people encounter problems with communication frequently, that these problems display a variety and complexity that goes considerably beyond signal noise, and that the processes for dealing with them involve specialized devices that have a systematic impact on subsequent coordination.

This is a substantial departure from Shannon and Weaver's picture and a significant challenge to some contemporary theories of communication. For example, psycholingusistic models that try to model conversation as primarily an egocentric process (Barr & Keysar, 2002; Horton & Gerrig, 2005; Horton & Keysar, 1996; Keysar, 2007; Keysar, Barr, & Horton, 1998) or rely on mechanisms such as mutual-priming (Pickering & Garrod, 2004, 2006) rapid autonomous prediction (Pickering & Garrod, 2013) or automatic "mirroring" and "resonance" (Iacoboni, 2009) all focus on explaining interactions in situtations in which processing does not diverge in significant ways between different participants. However, differences in processing appear to be ubiquitous in natural conversation and adjusting to differences in understanding looks more like the rule than the exception. The assumption that "adults routinely process language egocentrically, adjusting to the other's perspective only when they make an error" (Keysar et al., 1998, p. 46) becomes analogous to claiming that drivers routinely drive in a straight line, steering only when there is a curve in the road.

At a minimum, cognitive science needs a much richer conception of the mechanisms people use to detect and deal with miscommunication. The preceding discussion and the collection of papers in this volume suggest this is achievable and that the mixed methods and disciplines of the cognitive sciences can make a productive contribution with potentially important practical applications (see e.g., McCabe & Healey, 2018; Schober, Suessbrick, & Conrad, 2018).

3.2. Communication and miscommunication

This leads to the second and more fundamental question posed above: What implications does this have for our understanding of what communication really is? Conversation analysis has a distinctive answer to this question. Garfinkel (1967) rejected the idea that shared understanding should be analyzed in terms of matching mental states of the kind incorporated into Shannon and Weaver's picture. Instead, Garfinkel argued that shared understanding should be understood as a practical achievement and analyzed in terms of the everyday procedures, like repair, that people use to decide if they understand each other: "The appropriate image of a common understanding is [...] of an operation rather that a common intersection of overlapping sets" (Garfinkel, 1967, p. 30). This rejection of questions about identity of meaning in favor of empirical analysis of the processes people use to settle questions of meaning is echoed by Schegloff:

> [...] intersubjectivity is not a matter of a generalized intersection of beliefs or knowledge or procedures for generating them. Nor does it arise as "a problem of intersubjectivity." Rather, particular aspects of particular bits of conduct that compose the warp and weft of ordinary social life provide occasions and resources for understanding, which can also issue in problematic understandings. (Schegloff, 1992, p. 1299)

These remarks highlight how the promising empirical bridges between cognitive science and CA are built on different conceptual foundations, especially with respect to what shared meaning and understanding really are. The practical, procedural answer given by CA has the advantage that it turns an "in principle" problem about the possibility of communication into a practical empirical question about what people actually do. However, it also runs into two problems about meaning that have been important in cognitive science.

First, Garfinkel's commitment to uncovering how people actually produce social order translates to a methodological commitment in CA that only things which participants themselves orient to as relevant for interaction should be used to explain interaction. As a result, miscommunication is only miscommunication if it is recognized and dealt with as such by participants themselves. However, this makes some intuitions about referential meaning difficult to accommodate. Frege's (1892) distinction between sense and reference was designed to capture situations in which people are mistaken about what they are referring to. So, for example, two people might believe they are referring to the same thing, even though to a third-party they are not. The participants might never discover the mismatch, and it might not have any consequences for the interaction. Nonetheless, it seems odd to argue that there is therefore no miscommunication in this situation. There is a strong intuition that the participants meant something different when they made their references even if they were not aware of it (see also, e.g., Putnam, 1975).

The second problem is due to the emphasis on local in-the-moment co-production of understanding: "The defense of intersubjectivity is locally managed, locally adapted and recipient designed" (Schegloff, 1992, p. 1338, original emphasis). Taken at face value, this implies that communication (or miscommunication) is a purely local matter. As noted above, Schegloff explicitly discounts the role of knowledge in explaining how mutual understanding is produced, but this begs the question of how people are able to engage in these processes at all. What cognitive or neural resources do people need to bring to a conversation in order to be able to perform repair? Their knowledge, however incomplete, of the syntax, semantics, and pragmatics of a language, seems highly relevant to how they actually go about repairs (see e.g., Byun et al., 2018). People's ability to engage in repair appears to be continuous with other aspects of their knowledge of language and this seems to demand explanation in terms of some form of non-local, transferable knowledge, a point also developed by Ginzburg and Kolliakou (2018).

3.3. *Communication is miscommunication?*

How can we connect these dots? The problem for theories of interaction has traditionally been understood as communication is possible, how can we explain this? The default answer has been to reason from the fact that we can communicate to the conclusion that something—concepts, contents, ideas, senses, codes—must be shared. In cognitive science, this naturally becomes the hypothesis that what is shared is "in the head" and that we need to define some equivalence in cognitive representations or brain states to explain equivalence of meaning.

This special issue invites a different way of framing the problem. Miscommunication is possible, how can we explain this? In practice, we do not seem to require that people have the same interpretation of what words mean in order to be able to use them successfully; people normally discount differences in interpretation in ordinary conversation (Putnam, 1988). As Fodor and Lepore note, it seems to be a "patent truth that no two speakers of the same language ever speak exactly the same dialect of that language" (Fodor & Lepore, 1992, p. 10). What this amounts to is the possibility that we never actually satisfy the shared code picture of communication. Moreover, even if our mental representations of a word happen to be "sufficiently similar," this might not be enough to determine sameness of meaning. What a word means seems to depend partly on facts about the world and partly on facts about the practices of our speech communities, neither of which has to be encoded in anybody's head (e.g., Burge, 1979, 1986; Putnam, 1975).

Miscommunication can provide us with an alternative set of foundations for interaction that defuses these difficulties. Like Garfinkel, we can abandon the idea that sameness of meaning depends on sameness of mental states. We can substitute identity criteria for meaning based on internal cognitive representations with criteria based on observable behavior in interaction. As a result, sameness of meaning is defined by what actually happens in particular encounters between particular people and is indexed to the physical and social environment of the interaction, that is the specific problems encountered, the specific things talked about, and the specific practices of the relevant speech communities. Importantly, this does not entail that mental representations or brain states are irrelevant for communication. They retain their causal role—anyone trying to build a machine that communicates has to put something "in the head" of the machine, that is, endow it with representations and processes that enable it to engage in interaction. Rather, as McDowell and Pettit (1986) put it, the point is that it may be that what is in the head bears no constitutive relevance to questions of sameness of meaning.

All this might seem to be too much of a concession for cognitive science and the idea that meanings are not, ultimately, reducible to mental states can seem highly counter-intuitive. However, it preserves some important intuitions. It maintains the causal relevance of cognitive and brain states to our ability to interact. It also maintains a systematic connection between what happens in interaction to patterns of individual and communal language use. Whenever we encounter a problem in communication, we can use the structured processes of repair to update our (partial and contingent) understanding of what words mean and adjust to different people and different patterns of use. As a result, it maintains the possibility of a naturalized theory of meaning.

What changes is our concept of what successful communication really is and the idea that shared codes should play any role in explaining how it works. Instead of assuming communication is underwritten by shared languages encoded in "sufficiently similar" mental representations, shared languages become an emergent and constantly evolving product of interaction. Instead of thinking of effective communication as formulating a "perfect" message, it becomes about finding optimal ways to uncover and address misunderstandings (cf. Reddy, 1979). This helps to guarantee the flexibility of natural languages and underwrite our ability to adapt them to new people and new situations. The viability of this program consists in whether it suggests new lines of research and opens up new areas of application. The papers gathered in this volume provide some encouraging signposts.

Acknowledgments

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Notes

1. Thanks to Matt Purver for this point.
2. It is sometimes argued this is not strictly a repair because it is not presented as explicit or exposed, but we gloss over this distinction here.

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