Chapter 2
Methodological Dimensions

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The Productive Multivocality Project brought together analysts from different theoretical and methodological traditions to learn whether and how our approaches can complement each other and where essential differences lie. As a conceptual aid, we developed a set of five dimensions along which to describe analytic methods. This chapter discusses these dimensions, which are then used throughout this volume to briefly characterize the various analytic methods when introducing them in the case studies and also as a conceptual tool in our summary discussions of the project. The dimensions essentially take a distributed cognition view on analysis, by describing how analyses are achieved through transformations of representations in a system of analysts and analytic representations (Hutchins, 1995). Briefly stated, the dimensions as they were introduced in Chap. 1 of this volume are as follows:

1. *Theoretical assumptions*: What ontological and epistemological assumptions are made about phenomena worth studying, and how can we come to know about them?
2. *Purpose of analysis*: What is the analyst trying to find out about interaction?
3. *Units of action, interaction, and analysis*: In terms of what fundamental relationships between actions do we conceive of interaction? What is the relationship of these units to the unit of analysis?
4. *Representations*: What representations of data and representations of analytic constructs and interpretations capture these units in a manner consistent with the purposes and theoretical assumptions?

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5. *Analytic manipulations*: What are the analytic moves that transform a data representation into successive representations of interaction and interpretations of this interaction? How do these transformations lead to insights concerning the purpose of analysis?

The dimensions taken as a whole are methodological in the sense that they aid us in our study (ology) of methods, and as such they invite consideration of how theory and method are linked and influence each other. Exploring the relations between theory and method in studies of group interaction is a central theme of this volume. Below we consider methodological issues associated with each of the above dimensions in turn.

Theoretical Assumptions

What ontological and epistemological assumptions are made about phenomena worth studying, and how can we come to know about them?

Researchers carry out their work within a particular paradigm, although they might not explicitly articulate this. Some researchers may not critically examine their ontological stance (what is the nature of reality?) or their epistemological stance (how can we come to know about the nature of reality?) in relation to their methods, but whether implicit or explicit, these stances make a difference in how one carries out research (Guba & Lincoln, 1982; Tuli, 2011). For example, whether one believes that reality exists independent of ourselves and that existing laws can be discovered (i.e., positivism) or whether one believes that reality is socially constructed and therefore subjective (e.g., social constructionism) has implications for acceptable methods of evaluating claims. Yet, often young researchers are taught methods without ever being asked to consider the underlying ontological or epistemological issues, and experienced researchers may not consider these issues. Bryman (2007) notes that some researchers—especially those employing mixed methods (e.g., both quantitative and qualitative)—avoid the ontological divide by labeling themselves as "pragmatists" (e.g., Johnson & Onwuegbuzie, 2004) and thinking of their research in terms of what can be done with outcomes instead of attempting to resolve a millennia old philosophical dilemma (see also Onwuegbuzie & Leech, 2005). Finally, some authors argue (e.g., Guba & Lincoln, 1982; Johnson & Onwuegbuzie, 2004) that both qualitative and quantitative methods may be used appropriately with any research paradigm. According to Guba and Lincoln, the debate should take place in relation to the implications of assumptions inherent in the overarching paradigms and not on the relative utility of qualitative versus quantitative methods.

Since we agree with Guba and Lincoln, let's take a closer look at the implications of epistemological assumptions, which concern the relationship between the knower or would-be knower and what can be known. The answer to the ontological question constrains the answer to the epistemological one (Guba & Lincoln, 1994). For example, if there is a reality "out there," independent of our observing it, then our

posture is one of objective observation. And conversely, if we claim objectivity, then we are implying that a "real" world exists about which we can be objective. Indeed, questions of method are secondary to and dependent upon questions of paradigm, the latter being the belief system or world view (based on ontological and epistemological positions) that guides the investigator in choices of method (Guba & Lincoln, 1994).

In the setting of this project, we expected that everyone would include "interaction" among the phenomena worth studying and possibly some version of "learning." Rather than simply naming phenomena, it is more illuminating to identify what the method assumes about the forms interaction and learning take and the aspects of phenomena worth attending to. In what follows, we use learning as an example. How is it defined? What exactly about learning is being focused on? Researchers conceptualize group interaction and learning in different ways, depending on the researcher's framework (Greeno, Collins, & Resnick, 1996; Suthers, 2006).

One definition of learning might be the permanent modification, due to interactions with the environment, of the disposition of an individual to carry out a behavior or perform a mental activity (Le Ny & Sabah, 2002). Within the behaviorist view of this definition, an example is operant conditioning, in which a learner changes behavior that operates upon the environment in order to maximize rewards and minimize punishment. Psychology as the behaviorist views it is a purely objective experimental branch of natural science (Watson, 1913) and is therefore aligned with the positivist ontological stance. The cognitivist view of this definition of learning—like behaviorism—understands learning as resulting from experience within a stable, objective world, but instead of focusing on direct contingencies between stimuli and responses, it uses models of mental processes to mediate the stimulus–response relationship (Kirschner & Whitson, 1997). In either case, these theoretical orientations lead naturally to methods that quantify relationships between environmental stimuli or conditions and measurable aspects of behaviors on relatively moderate time scales.

Alternative views of learning still consider the individual as the agent of learning but attempt to apprehend learning in the context of social interaction, with other individuals, groups, or communities. The Vygotskian approach radically reoriented learning theory from an individualistic to a sociocultural perspective, but social can refer to both an interaction between two people (e.g., adult–child) or to wider interactions within culturally defined structures (Kozulin, 2003). Each psychological function that is to be learned is seen as appearing twice during development, once in the form of interaction with others and a second time as an inner internalized form of this function (Vygotsky, 1978). In a similar socially oriented view, Tomasello (1999) argues that human cultural learning is possible because as individuals, we have the ability to understand others as beings like us, who have intentional and mental lives like our own. In order to socially learn the conventional use of a tool or a symbol, children must understand why (to what end?) someone else uses that tool: What is its intentional significance? These sociocultural views on learning do not fit into the positivistic stance, long the dominant view in science. Tongue in cheek, Kozulin (op. cit.: 435) notes the difficulties for Vygotsky: his "samples are small, data are unclear and/or ambiguous, advanced statistics are absent, and it is not clear

how he controlled the independent variables." But since we can safely infer that these are not measures for success in Vygotsky's ontological and epistemological view, it doesn't matter. From Tomasello's (1999) evolutionary perspective, much can be accomplished culturally in a quarter of a million years, and young children have countless learning experiences by actively engaging with their cultural environments over the course of several years, days, or even hours. As Tomasello's goal is to explain the universal features of what is unique to human cognition (e.g., the creation and use of material, symbolic, and institutional artifacts with accumulated histories) but also the particularities of specific cultures, he focuses in "Vygotskian fashion" (p. 10) on the kinds of evolutionary, historical, and ontogenetic processes that might have transformed the fundamental skills shared with primates (e.g., perception, memory, attention, categorization) into what is specific about human cognition. Thus, these theoretical perspectives lead to methods that examine a much broader range of time scales and relevant objects (e.g., the role of cultural histories and artifacts).

But what if we want to talk about the group of the agent of learning instead of individual learning as influenced by external social or cultural influences? Stahl (2010) argues that there are distinct phenomena and processes at the individual, small-group, and community levels, and analyses at each level reveal different insights. He gives an alternative to (1) theories with a psychological view of mental processes at the individual level but that still acknowledge social and cultural influences and (2) theories at the community level (e.g., Engeström, 1999; Lave & Wenger, 1991; Suchman, 1987). Stahl (2006) introduced the term *group cognition* to refer to processes at the small-group level that are neither reducible to processes of individual minds nor imply the existence of a group mind. They are processes like "interpersonal trains of thought, shared understandings of diagrams, joint problem conceptualizations, common references, coordination of problem-solving efforts, planning, deducing, designing, describing, problem solving, explaining, defining, generalizing, representing, remembering and reflecting as a group" (Stahl 2010, p. 35). Suthers (2006) prefers to dispense with the cognitive metaphor, calling processes at this level of agency *intersubjective meaning-making* and points out that these processes involve compositions of interpretations of aspects of prior contributions that are taken up by participants. Intersubjective meaning-making is similar to distributed cognition (Hutchins, 1995), but the focus is on interpretations of meaning that have generative power rather than transformations of representations that implement a computation in a socio-technical system. Methodological consequences of this theoretical conception of learning include the need foreground the interactional processes by which groups accomplish learning and to derive explanatory accounts from these actual processes (Koschmann, Stahl, & Zemel, 2004; Koschmann et al., 2005).

Although we did not originally mean for the theoretical assumption dimension to also include methodological assumptions, such assumptions could well fall under this dimension if stated in epistemological terms (how we come to know about the phenomenon of interest). For example, ethnomethodology (Garfinkel, 1967) and

arguably to a lesser extent conversation analysis (Goodwin & Heritage, 1990) are based on the theoretical assumption (if we may attempt a brief gloss of Garfinkel's complex prose) that no sociological entities (norms, rules, etc.) external to actual instances of behavior are needed to explain the organized nature of that behavior, as this ordered nature is accomplished by the very methods that participants use to make their behavior organized for and to themselves. Therefore, the constructs used to describe participants, action, and context must be used by or at least recognizable in the orientations of the participants themselves. This stance has radically emic implications for researchers' methods. For example, it excludes hypothesis testing, application of coding schemes, or generalization beyond the situated accomplishment of the participants. Even interviewing informants, normally considered appropriate for emic anthropological research, is excluded, as the methods by which participants organize their interview behavior are not the same as their methods of participation in their culture (Goodwin & Heritage, 1990). Essentially, ethnomethodological inquiry is a process of uncovering participants' analysis of their own behavior.

Another example of a methodological assumption, but this time stemming from a positivistic paradigm, is the idea that only experimental inquiries allow you to determine whether a treatment causes an outcome to change (Light, Singer, & Willet, 1990; cited by Maxwell, 2004). Maxwell explains that this view of causality stems from Hume, who argues that we cannot directly perceive causal relationships, and thus, we can have no knowledge of causality beyond the observed regularities in associations of events (Maxwell, op. cit.: 244). Holding this assumption about causality implies that causal inferences require a systematic comparison of situations in which the presumed causal factor is present or absent (or perhaps varies in strength) as well as being able to control for other possible explanatory factors. On the other hand, realism (as opposed to positivism and some aspects of constructivism) gives an alternative view of causal explanation that sees "causation as fundamentally a matter of processes and mechanisms rather than observed regularities" (Maxwell, op. cit.: 246). Maxwell goes on to explain that realism asserts that some causal processes can indeed be directly observed (contrary to what Hume argued), that context is intrinsically involved in causal processes (and is not just reduced to a set of extraneous variables), that mental events and processes are real phenomena that can be causes of behavior, and that causal explanation does not inherently depend on preestablished comparisons.

These examples all illustrate how methodological assumptions depend upon overarching ontological and epistemological viewpoints. Assumptions about the nature of reality, about context, language, or knowledge, collectively constitute a mechanism for investigation that produces or reflects interpretations framed in its own terms and not neutral descriptions and explanations (Yanchar & Williams, 2006). In the following sections, we show how the other methodological dimensions also depend on ontological, epistemological, and their associated methodological assumptions. They are purpose of analysis, units of interaction, representations, and analytic manipulations.

Purpose of Analysis

What is the analyst trying to find out about interaction?

Some example purposes of analysis were already stated in the theoretical assumptions section. The reader will recall that Tomasello's far-reaching goal is to explain the universal features of what is unique to human cognition, but he attempts to accomplish this through the study of how intentional tool use is socially learned. A major goal for Vygotsky (Kozulin, 2003: 436) was to draw a developmental path of a given phenomenon (e.g., mediated memory, scientific concepts). To achieve this goal, he carefully investigated the developmental phases of the phenomenon in question in every study. Vygotsky's objective of studying "not only the final effect of the operation, but its specific psychological structure" led to the method of double stimulation, in which secondary stimuli are offered that the learner can incorporate as auxiliary means to problem solving (Vygotsky, 1978). Some other examples of purposes of analysis within computer-supported collaborative learning, expressed at different levels of granularity, are (1) descriptively characterizing the phenomenon by making interaction apparent; (2) finding causal relationships between variables, e.g., how to link process quality and knowledge construction; (3) design-oriented purposes, such as how to mediate and transform learning and teaching with technology; (4) practice-oriented purposes, such as how to support instructors; (5) seeking metrics to use in other research or applications, such as how to measure the quality of collaboration; and (6) methodological purposes, such as how to define the process of interaction analysis (derived from Lund, 2011).

For understanding specific analytic methods, it is more informative to consider "near" purposes (e.g., "the recognition of inter-animation patterns among voices," to take an example from Trausan-Matu, this volume) rather than ultimate "far" purposes (e.g., to understand how learning takes place in small groups). Thus we will generally characterize analyses in terms of near purposes. Of course, the connection to the larger purpose can be made as well (e.g., stating how understanding interanimation of voices might bear upon understanding learning in small groups). This dimension serves as a nice bridge between what has been foregrounded under theoretical assumptions to what relationships the analysis will actually attend to.

Units of Action, Interaction, and Analysis

In terms of what fundamental relationships between actions do we conceive of interaction? What is the relationship of these units to the unit of analysis?

Originally, this dimension was called simply "Unit of Interaction," as the relational structure that makes an analysis an analysis of interaction (rather than some other kind of analysis) is important for understanding our methods. However, over the course of the project, we found that (1) unit of interaction is easily confused with unit of observation, action, or analysis and that (2) it is informative to identify these other units as well as the unit of interaction. Therefore we discuss all of these units explicitly.

In some paradigms, the unit of observation is the smallest entity for which data is gathered. For example, the unit of observation may be student's response to a single question in a student-test administration (and there are many students and several tests). In conversation analysis, the units over which we work can be below the utterance level. The unit of observation is the smallest data available to be coded, quantified, or interpreted.

But often the unit of observation is at a finer grain than the unit you are interested in making a claim about. For example, you might be making observations at the individual student level, but you are interested in comparing performance of students who work with an intelligent tutoring system versus performance of those using a textbook. Your analysis would aggregate students across these two groups, and the groups become your units of analysis. Unit of analysis is relative to the analysis: different analyses can take the same data and operate with different units of analysis. Hierarchical analysis explicitly works with multiple nested units.

Interaction is *inter*-action: something between actions. There are more than just two actions; there is also some kind of relationship between them. We therefore assumed that any analysis of interaction would work with a relationship between actions as one of its fundamental units. The way one characterizes interaction is a crucial difference between methods.

We asked the analysts in this book to include the unit of observation and other units of analysis in their description, but we requested that their description of unit of interaction clearly state what relationships between actions are taken as fundamental to the analysis. If interaction is related sets of actions, then the analyst should specify what that relation is and whether units of action are logically prior to the interaction or can only arise after identifying the unit of interaction. For some methods the unit of interaction may be obvious as it is very explicit in the method, such as in polyphony (Trausan-Matu, Chap. 6, this volume), uptake analysis (Looi, Song, Wen, & Chen, Chap. 15, this volume; Medina, Chap. 16, this volume), or relevancies between adjacency pairs (Stahl, this volume). For others it may require more thought, for example, while a statistical breakpoint analysis in statistical discourse analysis (Chiu, 2008; Chap. 7, Chiu, this volume-a) does not explicitly ask about relationships between individual acts, it seeks to group acts by discontinuities in variables between sets of acts within two contiguous time spans. As it turned out, some analyses, such as Jeong (Chap. 18, Jeong, this volume), did not work with an explicit relationship of interaction.

Inclusion of this dimension was partly influenced by conversation analysis. CA was developed in order to analyze "practices of reasoning and inference that inform the production and recognition of intelligible courses of action. Central to the achievement of this objective has been the development of a theory of context that links processes of interpretation to action within a reflexive, time-bound process" (Goodwin & Heritage, 1990). Contrary to former linguistic approaches that worked on isolated or invented sentences, CA sought to treat the stream of speech actually uttered by a speaker in conversation as forms of action that were situated within specific contexts. The analysis of any utterance should therefore begin from the action (talk or other forms of action) and other aspects of the setting that it emerges

from. In CA, the emblematic notion of the unit of interaction is the "adjacency pair" (e.g., such as question–response or greeting–greeting), developed by Sacks and Schegloff (Sacks & Schegloff, 1979; Schegloff & Sacks, 1973) where a current action requires the production of a reciprocal action at the first possible opportunity (Goodwin & Heritage, 1990). When a reciprocal action does not occur, participants (and hence CA analysts) attempt to understand why this was the case. This particular definition of the unit of interaction is supported by an ontological assumption, namely, that such adjacency pairs are not a description of statistical regularities in patterns of action nor are they a specification of some internalized rule that drives behavior. Rather, they illustrate how participants constrain one another and analyze each other's actions in order to produce the appropriate reciprocal action and develop coherent interactional sequences (Goodwin & Heritage, op. cit). However, in this volume we intend "unit of interaction" to allow for other ontological assumptions and also to extend to nonconversational media. Although CA originally focused on audiotaped and transcribed talk, it later extended the notion of action and reciprocal action to include multimodality (e.g., gestures, gaze, posture, and coordination of technological artifacts), as is particularly evident in the work of Goodwin (2000, 2003). In the CSCL context, Suthers and colleagues have been inspired by ethnomethodology and conversation analysis in order to also argue that not only the meanings of utterances are contextual and negotiated in order to support action, but also the same is true for nonlinguistic representations that support action (Suthers, Dwyer, Medina, & Vatrapu, 2010; Suthers, Dwyer, Vatrapu, & Medina, 2006). They use the term "uptake" instead of "adjacency pair" as a generalized building block of interaction that can be constructed of relations between nonadjacent events and found in diverse media.

Representations

What representations of data and representations of analytic constructs and interpretations are used to capture these units in a manner consistent with the purposes and theoretical assumptions?

Analyses of interaction (as undertaken by researchers rather than ethnomethodological participants) almost always include the construction of representations of the interaction—the "data" record such as a video or audio recording and practices of constructing and interpreting successive analytic representations, sometimes beginning with a "transcript" and possibly including representations of segments (units of analysis), annotations, codes, links, aggregations of units or of metrics, summaries, etc. Thus, analysis can be characterized in part by what representations are constructed.

The ability to create and manipulate visual representations is a cognitive skill that scientists acquire as they become accomplished participants in the methods that define a particular domain. Gooding (2010) argues that the important feature of a representation is its plasticity and integrative power, enabling its adaptation to the

changing social and cognitive demands of the creative process (see also "cognitive dimensions of notations," Blackwell & Green, 2003). He also argues that this adaptability of representations is managed in the context of three constraints: (1) theories about the domain and problem-solving methods regarding it (in our case, group interaction); (2) "imaging conventions" or notations (two examples for group interaction are social network analysis and transcriptions); and (3) "material resources" of imaging technologies (an example for group interaction is synchronizing multiple streams of data: videos, transcriptions, and traces of computer-mediated human interaction) (Dyke, Lund, & Girardot, 2009). Using the terminology of Suthers (2001), "representational tools" are a form of material resource that make the imaging conventions of "notations" available in software settings; and these notations may offer variable affordances for individual and group interaction.

We can understand the process of analysis, particularly multivocal analysis, as a form of *distributed cognition* (Hutchins, 1995). Distributed cognition is neither solely internal nor solely external but takes place through transformations of a system of representations that are distributed between the two. The social and cognitive acts of analysis, like other such acts, involve translations between representations. To take an example from Suthers and colleagues (Suthers et al., 2010; Suthers & Medina, 2011), a time-ordered representation of individual contributions and their characteristics such as actor, linguistic content, and medium can be translated into a relational graph based on how words, phrases, and ideas are echoed across contributions and how actors address each other (polyphonic analysis does something similar); and this graph of observable contingencies can be converted into a summary representation of uptake evidenced by such contingencies, which in turn is folded into a sociogram of who uptakes from whom with what frequency (Suthers & Rosen, 2011; Suthers & Desiato, 2012).

The representations we use say a lot about our methods. They may also suggest implicit theoretical assumptions (although not in a deterministic manner: the researcher also has agency). Consider, for example, transcripts. Some analyses may require different information than others, and part of the value in transcripts is that they are selective, making some aspects of the data salient at the cost of others. Gail Jefferson (2004) compares unelaborated transcripts by Harvey Sacks with her own notational conventions that capture the nuances of prosody and timing. She illustrates how some questions of interpretation do not even arise, let alone can be resolved, without the information her notation includes. Yet, in making prosody and timing salient, the salience of the interaction as a verbal conversation is somewhat obscured. Also, her notation focuses primarily on verbal acts and relegates nonverbal acts to annotations or parenthetical comments, implying that nonverbal acts are merely contextual or play a subordinate role. One might use separate columns for verbal and nonverbal acts, but this implies that there is non-overlap and does not highlight the coordination across multiple verbal and nonverbal semiotic fields (Goodwin, 2003). Ochs (1979) provides a detailed discussion of how the notational format of transcripts has biases that can be derived from or have theoretical implications, with examples in the transcription of interaction between an adult and a very young child. When transcripts are written in sequential order, as is

common for conversation analysis, there is bias towards reading contributions as contingent upon immediately prior contributions and setting up expectations (preferences) for immediately following contributions. However, very young children do not necessarily attempt to make their contributions relevant to the immediately prior contribution. They may engage in running narratives where their contributions are more relevant to their own prior contributions. As a fix for this, Ochs suggests placing participants in their own separate columns, aligned horizontally for time, but enabling one to read each participants' narrative independently. This may then lead to a new bias: in languages in which we read in the left-to-right direction, the interlocutor placed on the left may be seen as dominant or as the initiator of all interactions. To counter this bias, Ochs suggests placing the adult on the right-hand side.

Once the transcript is constructed, we then construct other analytic representations from it that offer restricted and selected narratives about what the world was like at a particular moment through a combination of symbolic, iconic, and indexical signs (Duranti, 2006). As Duranti points out, both a transcript's evolution and the evolution of the transcript's interpretations can provide us with a record of our epistemological and theoretical changes. We will see examples throughout this volume, including how graphs of relationships between events make interactional structure explicit under concepts of adjacency, polyphony, transformations, and uptake (Looi et al., Chap. 15, this volume; Lund & Bécu-Robinault, Chap. 17, this volume; Medina, Chap. 16, this volume; Stahl, Chap. 28, this volume; Trausan-Matu, Chap. 6, this volume); how interaction can be differentially understood through representations of changes in values of collections of variables (Chiu, Chap. 7, this volume; Chap. 23, this volume) or is understood primarily through the physical artifacts that it produces (Jeong, this volume); and how it can be abstracted to networks of relations between concepts and/or persons (Goggins & Dyke, Chap. 29, this volume; Teplovs, Chap. 21, this volume). Here we have only touched on a few ways in which representations of different facets of human interaction show a variety of ways of portraying and understanding interactional phenomena. Many more examples are possible when considering other analytic representations: see Chap. 33 (Dyke, Lund, Suthers, & Teplovs, this volume) for further discussion.

Analytic Manipulations

What are the analytic moves that transform a data representation into successive representations of interaction and interpretations of this interaction? How do these transformations lead to insights concerning the purpose of analysis?

The foregoing account has already noted that the act of analysis can be viewed as consisting of certain manipulations and transformations of representations, presumably beginning with data representations and then deriving analytic representations and interpretations. The manipulations operate on the representations described by the previous dimension, translating one to another. In the process, the unit of

interaction is involved, being identified and either interpreted directly or transformed in other ways into what is worth interpreting. The final representation(s) should make salient something relevant to the identified purpose of analysis. Just as we understand interaction as not consisting of isolated acts but rather as acts being understood in relation to each other, analysis is not understood as isolated representations, but rather the representations are understood in relation to each other and the practices through which they are transformed and interpreted. These practices will reflect theoretical assumptions, particularly the epistemology of the tradition within which notations become representations. As a simple example, a tradition in which learning is a matter of uncovering participant practices for doing learning will "transform" (they would not put it this way) records of participant interaction into rich accounts of how particulars of coordinated vocalization, gaze, gesture, etc. offer and affirm interpretations of meaning among the group, while another tradition that seeks accounts of regularities between theoretical constructs across the "noise" of multiple settings may take the same transcript and generate counts of codes related to these constructs and aggregate them numerically for statistical characterization. We will see many examples of different kinds of manipulations throughout this volume.

Conclusions

We end this chapter with an anecdote by Richards (1995) illustrating how the methodological dimensions of two researchers from different disciplines guide what aspect of a phenomenon of interest they focus on. Richards was at a faculty party where researchers discovered that one batch of homemade beer was less bubbly than another one. A biologist suggested that it was because there was less air in the bottle, and decreased oxygen meant that the yeast would die sooner, thereby converting less sugar to alcohol and producing fewer bubbles. A physicist countered that it was instead crucial to calculate how much pressure was building up in the bottle and that the increased pressure was what was probably killing the yeast and that what should be examined was what the effect of more fluid and less air would be on the amount of pressure in the bottle.

As Richards tells it, the party quickly formed into two groups: one of biologists and one of physicists, each discussing the theory that made sense within their respective scientific traditions. Neither group talked to each other, and it was clear that they were not going to compare results. Neither group was posing more interesting or more relevant questions, but perhaps if they had conversed and worked together, they would have discovered ways of converging. It may be safe to say that both groups were operating in positivistic paradigms, with their associated theoretical assumptions of discovery of objective universal laws and indeed both were trying to understand the bubbliness of the batch of beer (purpose of analysis). However, each had a different unit of analysis (e.g., relation of oxygen quantity to yeast life vs. relation of pressure to yeast life) and therefore different representations and analytic

manipulations. Richards doesn't give the solution to the enigma, but both hypotheses can be tested by first keeping constant pressure and decreasing oxygen level and then keeping constant oxygen level and increasing pressure and, in both cases, checking to see if the beer is equally less bubbly in both cases than a "control" batch of beer, from which the experimental values of oxygen and pressure varied.

Although in this particular case one or both theories may be true (they are not necessarily incompatible) and this result is verifiable by experiment, such an example helps us to see how some disciplinary views on what constitutes explanation of phenomena may be more difficultly reconciled. If we consider an experimental cognitive psychologist and a conversation analyst, it is already difficult to converge on a similar purpose of analysis. The former is most likely in a positivistic paradigm, using quantitative analyses in an attempt to discover causal connections between isolated variables, whereas the latter will be in a constructivist paradigm, using qualitative analyses in order to describe the details of participants' negotiations of events in a particular context. Both may be interested in human interaction but will focus on different aspects of it and employ different units of interaction and therefore different representations and analytical transformations. As Richards (op. cit.) asks (p. 59): "As we give up truth or nature as the ultimate determinant, and assume some degree of incommensurability between traditions, how do I, as a scientist, make a rational decision to accept or join a new tradition?" We hope this book gives researchers, both new to and experienced in their fields, a means to answering this question while they examine more critically the tradition(s) they have been educated in.

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