# *Part Two*

## *Video Research on Peer, Family, and Informal Learning*

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# *Video as a Tool to Advance Understanding of Learning and Development in Peer, Family, and Other Informal Learning Contexts*

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Video records have several properties that fundamentally change the way that inquiry takes place and video is now the standard data collection tool for studies of human interaction. This section of the book focuses on the contribution of video-based research to our understanding of learning and development in peer, family, and informal learning contexts. The authors who made contributions to this section are taking up fundamental questions about the processes and outcomes of learning as they emerge in the context of interactions between people, and between people and their physical and cultural environments. We are fortunate that these researchers were willing to share both their struggles in collecting and analyzing video records and the strategies, insights, and techniques they have developed after years of working with video as a data source. In this prefatory chapter, I begin with a discussion of how video has been an important data source for research investigating learning. I provide a summary of some of the theoretical insights that have emerged from studies that relied on film or video, drawing on the published literature including early efforts to use video as an analytic and rhetorical tool by anthropologists, developmental and social psychologists, and sociologists. In the second section, I summarize some of the challenges that video data presents, again drawing on the chapters and the broader literature. In the third section, I share four main methodological and analytical suggestions that emerged across the seven chapters and connect

these to more general insights on qualitative research. These ideas should help both novice and seasoned researchers design and carry out research that includes video records as a data source. No rules are offered here; rather, the goal is to collectively enrich our methodological and analytic creativity and become smarter about some of the challenges that video-derived data presents. Across the group of chapters, we have access to a range of approaches and there are an endless number of strategies that might be developed to fruitfully use video as a data source.

## VIDEO AS A TOOL FOR INVESTIGATIONS OF PEER, FAMILY, AND INFORMAL LEARNING

Methods used in the analysis of videotaped records are rooted in practices of disciplined observation, a core feature of the scientific method. Independent of the advent of film, social scientists developed approaches that allowed them to document, analyze, and report human behavior to their colleagues. For example, scientists interested in child development created formal approaches to looking at, recording, and describing the natural world in ways that were convincing to others who followed positivist empirical traditions. Systematic observational approaches relied on pre-established coding schemes and were designed to yield reliable judgments by independent observers of behavior taking place in naturalistic settings. Techniques for narrowing the foci of observation through methods such as time sampling, event sampling, or focal person approaches were articulated and used in many of the early studies of child development. For example, early studies of children's play often relied on what was called repeated short samples (Goodenough, 1928) where a child would be observed for one minute a day and their play coded into one of six mutually exclusive categories (Parten, 1932). After a substantial number of observations were made, proportions could be computed in order to draw conclusions about how a particular child spends their playtime. Statistical approaches for determining interrater reliability were key innovations that allowed researchers to determine whether their coding approaches led to similar observations across human coders. These methods require that the focus of inquiry and the coding systems be well worked out before the collection of data. Coding systems also need to be simple enough for two or more observers to achieve interrater reliability.

Video relieves these constraints. The persistence of the record allows researchers to move away from completely predetermined coding systems and instead, develop categorization approaches after examples are carefully studied. It allows the analyst to speed up, slow down, or stop subtle aspects of interaction that normally occur on such a short time scale that they go unnoticed. Tone, eye gaze, affect, gesture, use of material resources, attention, and physical posture can all be studied together or as separate streams. New phenomena can be named, categories described, and when appropriate, coded and quantified. Video records can also be revisited over time with new research questions and new theoretical frames, or through the eyes of researchers who come from different disciplinary traditions.

Collectively, these properties have generated a great deal of excitement among social scientists. In particular, film studies have been taken up by researchers whose in-

tellectual projects involve understanding the details of how communication proceeds in the context of face-to-face interaction. Given the time consuming nature of interactional analyses, one might ask whether the excitement over what film offers to researchers is justified. So, what have we learned from studies that use film?

### Insights Based on Film Studies of Human Interaction

A cursory review of the history of the use of film as a data source reveals that those social scientists drawn to it frequently had in common an interest in understanding issues of interdependency, mutuality, and reciprocity in human interaction. The contributions of observational studies to how we understand learning and development have been multidisciplinary and interdisciplinary. Anthropologists, psychologists, sociologists, linguists have all taken up observational work, sometimes coming together but often with very different theoretical frames. In some research programs, the focus has been restricted to questions about the immediate interactional context (e.g., when do infants first demonstrate joint attention and what are its characteristics). In others, the goal has been to articulate the relations between the details of interaction as revealed by microanalyses and larger cultural patterns. This review is by no means exhaustive but is meant to be illustrative of what has been learned, to provide some historical context for the use of film or video as a data source, and to help readers locate published research that might serve as examples of the variety of ways that video-based studies are reported.

***Interactional Patterns Within and Across Cultures.*** Early on, anthropologists took up the camera as a research tool for the study of culture (see Collier & Collier, 1986; De Brigard, 1975; and El Guindi, 1998 for reviews of the history of the use of film in anthropology). The first example may have been footage of Wolof pottery making (Lajard & Regnault, as cited in Grimshaw, 1982a). The Cambridge Expedition to the Torres Straight in 1898 brought along 16 mm cameras to capture everyday life, ceremonies, and other cultural practices seen on the island. The anthropologist Franz Boas used film in 1930 to capture the everyday life of the Kwakiutl, and attempted to have several of his colleagues analyze it. One of the first clear examples of a scholar using the unique properties of film to advance understanding of a scientific question through detailed microanalyses is a study carried out by one of Boas' students, David Efron. Efron's dissertation, published in a book (Efron, 1941) took up the question of whether gestural style was the result of cultural influences or was biologically based. This nature versus nurture question was animated by Nazi claims that gestures were genetically determined. Efron's approach involved comparative studies of the gestures of men who differed in the degree to which they had adopted American culture. He filmed the natural interactions of first generation Italian immigrants on street corners in New York City as well as other immigrant groups. His analysis of gesture was made possible by his collaboration with an artist who used the film to create frame-by-frame illustrations that allowed for precise descriptions of the form and functions of gesture. He was able to show loss of traditional gestural styles over time and in relation to the degree to which there were deeply felt ties to tradition, strongly countering the claim

that gestural style was biologically based.[1] He also showed the situational specificity of gesture use, for example, showing that in some settings traditional gestures were more likely to be used.

Around the same time, between 1936–1939, Margaret Mead and Gregory Bateson used film and photographs in combination with field notes to document parent–child interaction, ceremonial dance and practices, and gesture in Bali (Bateson & Mead, 1942). These documentary approaches were interwoven on a daily basis and Mead produced field notes to annotate the film and still photographs. These records were used to analyze gesture and body movement but they also produced several films describing patterns of child development for use in classes and as a means to share their work with the general public. The records were used in meetings with an interdisciplinary group of scholars to elicit their unique perspectives on the phenomena captured in the film.[2] In these films, Mead narrates and points out phenomena to the viewer and some text is provided that gives additional context. Occasional slow motion is used to emphasize a particular aspect of movement (e.g., Mead & Bateson, 1952).

Margaret Mead reportedly influenced younger anthropologists with these films including Ray L. Birdwhistell whose primary research focused on kinesics (Birdwhistell, 1952, 1970; Davis, 2002). As part of a larger network of researchers interested in the role of context in human activity, he studied gesture, emotional expression during family interactions, and was particularly focused on cross-cultural studies as a way to show the particularity and context specificity of expression in relation to meaning. Along with others, he used film analysis to contribute to an understanding that body movements and verbal communication are linked in multiple ways and can be contradictory, complementary, or reinforcing. In an interdisciplinary project that began in 1959, he collaborated with Bateson and a varied group of psychiatrists, linguists, and anthropologists to study family interactions during a therapy session. This work was reported in a still unpublished book, available only on microfiche, called the *Natural History of the Interview* (Bateson et al., 1971). Birdwhistell and Bateson collaborated on additional studies of parent–child communication, in particular analyzing the interactions of schizophrenic children and their parents. It was in this work that phenomenon of the "double bind"—defined as the delivery of contradictory messages—was articulated. Finally, Birdwhistell also created teaching films to share his approach and major insights, for example in "Microcultural Incidents in Ten Zoos," he compared the interactions of families visiting zoos from a variety of countries including the United States, Italy, and France (Birdwhistell, 1971). The film focused on the approaches and responses by families to the elephants kept in each zoo and this method helped to highlight cultural differences. In a review of the film (C. Bateson, 1972), it was noted that this production made clear that anthropological films had potential to go way beyond the entertainment function that they typically held.

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[1]The National Anthropological Archives recently acquired several hundred original captioned illustrations created by Stuyvesant Van Veen, the artist who collaborated with David Efron.

[2]The entire collection of their film is archived by the Library of Congress as part of the Margaret Mead Collection along with maps, photographs, field notes, and art.

***Interactional Spaces as Sites That Maintain or Challenge Inequity*** Other social scientists used film and video to take up the question of how inequity emerges and persists. McDermott and Roth (1978) provide a review of work on the social organization of behavior and use it to argue for the reformulation of the micro and macro distinction so prevalent in the social sciences. They highlight how studies of people in interaction allow analysts to see the mechanisms by which people organize one another's behaviors to produce larger patterns of interaction that traditional macro studies treat more generally with terms like status, gender, ethnicity, or role. In their words, "Whatever form of inequality people are doing to each other, they do it in facing formations and with talk" (p. 338). Collectively, the studies they review provide evidence for how what ultimately happens between people is emergent, and depends on what happens from moment to moment. A key insight they emphasize, quoting Bateson, is that contexts are made up of actions, and each action can be thought of "as part of the ecological subsystem called context and not as the product or effect of what remains of the context after the piece which we want to explain has been cut out from it" (Bateson, 1972, p. 338).

Many studies of face-to-face interaction in educational settings were motivated by controversial claims that achievement gaps between ethnic groups were biologically based (e.g., Jenson, 1969) and that the speech of lower class people was linguistically inferior and inadequate to the demands of modern schooling. Anthropologists, linguists, and sociologists drew on the early accomplishments of interaction analysts to produce finely detailed studies using video and audiotape as data sources to counter these generalizations. As Mehan (1998) highlights, these methods raised very different questions than those articulated by traditional studies of inequality that focused on relationships between distal variables (e.g., what demographic characteristics of families are correlated with achievement). In contrast, interactional studies framed questions in ways that asked for detailed behavioral descriptions of people in face-to-face interaction (e.g., how is inequality in turn taking arranged for in small groups). For example, McDermott (1976) showed through detailed analysis of the interactions of a low-achieving reading group how both teachers and students contributed to interactions that resulted in the absence of help for those who needed it most and overall differential access to learning opportunities relative to those in top reading groups. Another classic demonstration of how interactions arrange for the reproduction of inequality was a study of college counselors interacting with students (Erickson, 1975). This work represents a new paradigm for understanding inequality, shifting the view of its grounds as states or traits to dynamic and mutually constitutive relationships between people and their environments that can change from moment to moment and that are subject to repair (Mehan, 1998).

***Language Socialization and Socialization Through Language*** In the late 1970s, the field of language socialization emerged from the broader area of anthropology (Schieffelin & Ochs, 1996). It is an interdisciplinary field to which scholars from communication, education, and psychology have contributed. Researchers in this field are committed to linking microanalytic accounts of everyday, mundane conversation to broader ethnographic accounts of the activities, beliefs, and prac-

tices as revealed by studies of families and communities. This field assumes that language is a primary means through which children are socialized to the values, practices, and worldviews of the communities within which they develop and that children are socialized to use language in particular ways that reflect these deeper underpinnings of a community. Language socialization then is implicated in broader spheres of human development including cognitive development, identity, and gender roles. The goals of this program of research include understanding how communicative practice is organized at the level of routine events, how language practices change or remain stable across situations, and how culture can be understood to be reflected in these patterns. This commitment to link levels of analysis is what distinguishes language socialization from more established fields that also focus on language such as language acquisition and developmental pragmatics (Schieffelin & Ochs, 1996). For example, analyses of dinner time conversation in families offers evidence that epistemologies are socialized even as the immediate activity at hand is organized for other purposes (Ochs, Taylor, Rudolph, & Smith, 1992). The patterns that were observed in this study included the frequent construction and evaluation of theories as families engaged in problem solving narratives. The authors argue that these episodes of collaborative problem solving were particularly rich for intellectual development as they required cognitive decentering that was facilitated by the intimacy and trust that family relationships afford. These dinner time conversation studies have also taken up questions about how dinner time narratives reflect and contribute to gender socialization (Ochs & Taylor, 1996) and to socialization of self and identity (Forrester, 2001).

***Ecologies of Peer Interaction*** It is probably no accident that one of the first psychologists to use film to advance our understanding of peer interaction and child development was Kurt Lewin (Luck, 1997). Lewin was an experimental and applied psychologist who took up studies of group dynamics, leadership, and the role of the environment in child development. As early as 1926, Lewin began making films of natural child interaction using a 16mm Kinamo, a hand-held camera designed for the nonprofessional filmmaker (Van Elteren, 1992). He followed his own children through their daily activities as well as those of friends and relatives. His goal was to illustrate aspects of his developing theory of the life space, and film was a representational medium that could do this well. Lewin argued that the psychological life space resulted from the interdependencies between the environment and the person and that to understand behavior, both of these must be taken into account (Lewin, 1936, 1951). Prior experience and current tensions and needs were all part of what the person brought to the situation and "field of the child" is created by both the environment and the child's current psychological state.

To illustrate these concepts during a presentation in 1930 at Yale University, Lewin showed a short film about a pair of toddlers, each trying to sit on a stone for the first time. In this film, he shows the persistent strategies of the toddlers who both try to find a way to sit down while not taking their eyes off of the stone. Apparently the film made a significant impact on the audience and the personality psychologist Gordon Allport claimed that it forced some of the American psychologists in the audience to

"revise their own theories of the nature of intelligent behavior and learning" (Marrow, 1969, p. 50). In collaboration with professional filmmakers, Lewin went on to create a feature length documentary capturing the life and landscapes of a child in an urban setting titled "Das Kind und die Welt," translated as "The Child and the World" (Lewin, 1931). This project illustrates his use of the medium of film to communicate his ideas about interdependencies between the child and his or her life spaces. Lewin also used film to document the interactions that resulted from experimental work on group dynamics. In an article published in 1939 in the *Journal of Social Psychology* entitled "Patterns of aggressive behavior in experimentally created social climates," Lewin, Lippitt, and White (1939) report on their experiments carried out to compare the effect of three different leadership styles—democratic, autocratic, or laissez-faire, on children's social interactions and industry during collaborative craft activities. Although most of the data for analysis was collected through naturalistic observations, the film was used to confirm the patterns of data as we see in the following report from their article:

> There are the judgments of observers who found themselves using terms such as "dull," "lifeless," submissive, repressed, and apathetic in describing the non-aggressive reaction to autocracy. There was little smiling, joking, freedom of movement, freedom of initiating new projects, etc.; talk was largely confined to the immediate activity in progress, and bodily tension was often manifested. *Moving pictures tell the same story.* (italics added, p. 283)

The methodology section of this article reports a heroic effort to record the boy's interactions. Continuous stenographic records of conversation were collected, a predetermined coding scheme was used to capture directives and responses, a descriptive running record of activity in each subgroup was recorded, and a minute-by-minute structure analysis of the groups was made. Four observers were present, sitting behind a low burlap wall, and each had their own observational task. Film was used to "make movie records of several segments of club life" (p. 274). Like many anthropological films, the purposes of filming were to confirm patterns that were observed and coded, and to illustrate types of interactions rather than to serve as a data source per se. A 31 minute narrated film was created based on these experiments and is still available for purchase (Lewin, 1938). The film shows prototypical group interactions in the three experimental conditions. It also includes graphs summarizing the coded data collected during the experiment and appears to have been produced to share with both research colleagues and nonspecialist audiences.

More recently, video has been used by sociolinguists, psychologists, and linguistic anthropologists to obtain records of children's talk and interaction with minimal adult presence (Ervin-Tripp, 2000; Topper & Boultan, 2002). Video-based studies of play episodes among peers have helped to understand how conflicts can be regulated through explanation of resistance to the proposals of partners (Gottman, 1983); how cooperative play sessions are sequentially related to parallel play between peers (Bakeman & Brownlee, 1982) and how competence in peer interaction and parent– child interaction quality are related to adapting to a new sib-

ling (Kramer & Gottman, 1992). Studies of the emergence of a negative reputation and subsequent rejection by aggressive boys has been studied by analyzing the patterns of interaction in play groups of previously unacquainted peers over time as they relate to the development of reputation and status in the group (Coie et al., 1999). Some research is beginning to make links between institutional level practices and between peer interaction. For example, Ochs, Kremer-Sadlik, Solomon, and Sirota (2001) videotaped interactions between autistic children and their peers at several schools. One of their findings was the role of student atmosphere and classroom practices on positive inclusion in activities. Similarly, Matusov, Bell, and Rogoff (2002) found between school differences in the quality of peer collaboration and were able to link it to classroom practices.

In a recent review, Kyratzis (2004) summarizes research that has examined how children elaborate games, how conflict talk contributes to peer culture, how identities are talked into being through peer conversation, and how adult culture is resisted in peer activity. These studies demonstrate the ways that children socialize one another and oppose established norms rather than simply adopting those that are conveyed by the adult world. Collectively, the studies she reviews suggest that constructs such as social competence, need to be elaborated to include linguistic practices that allow children to position themselves and others and to alter participant frameworks. For example, in video-based studies of elementary school children playing hopscotch, the analyses suggested that sophisticated multimodal strategies were used to challenge fouls and establish social order (Goodwin, Goodwin, & Yaeger-Dror, 2002). Intonation, gesture, body position, and pitch were all critical to communicating stance and achieving joint recognition of when rules were violated. Grounds for rejecting turns were established through explanation or replaying the move. Other discourse-based studies of peer groups have focused on the ways that status is established through talk that forges alliances, often by excluding others. These ethnographic accounts paint a very different picture of leadership than do studies of social competence that rely on rating scales or responses of children to vignettes of socially ambiguous situations and highlight the importance of interdisciplinary work that can capture peer interaction as it occurs in everyday settings.

***The Social Infant.*** Video studies have made important contributions to our understanding of early emergence of sophisticated social awareness in infancy and the bidirectional influences between caregiver and child (Lewis & Rosenblum, 1974). Trevarthen and Aiken (2001) review the important role that film-based studies had in documenting the coordinated interactions of mothers and their infants during naturalistic interactions. Methods of conversational analyses were adapted to provide accurate measurements of the timing of contributions of mothers and infants. Infants as young as 2 months were found to mutually regulate interests and feelings with their mothers. Video studies have helped document early social competencies of infants such as the capacity for joint attention (Adamson & Bakeman, 1991) social referencing (Walden & Baxter, 1989; Walden & Ogan, 1988), affective engagement with partners (Striano & Berlin, 2005), and imitation (Meltzoff & Moore, 1983).

### Intimate Partners and Family Interactions

The work on early infancy also led to new analysis approaches such as sequential and times series methods for describing patterns of interaction that were taken up in studies of adult interaction. In particular, studies of dyad-level differences in interactional quality among married partners were pioneered by Gottman and his colleagues. Gottman and Notarius (2002) review the progression of research on marital relationships that began in the 1950s. They mark the publication of Bateson, Jackson, Haley, and Weakland (1956) on the double bind as a turning point in this line of research. It led to a shift from personality-based explanations to studies that observed couples in interaction and focused on processes of communication. In the 1970s, Gottman developed methods that involved both videotaping interactions of couples at a specially constructed "talk table" while the couples also rated aspects of their own communication. Out of this work came the general finding that unhappy couples' interactions were marked by negative affect and a greater likelihood of reciprocating negativity than those of happier couples. This research was aided by other applications of video, namely the study of facial expressions of emotion that led to a coding system called the Facial Action Coding System (Ekman & Friesen, 1978; Ekman, Friesen, & Ellsworth, 1978). At the end of the review, Gottman & Notarious (2002) call for moving the research on couples' interactions out of the lab and into the home. They argued that this move would advance our understanding of the role of emotional regulation in family well being and would provide more ecologically valid accounts of the ways that conflicts emerge and resolve than do lab studies where conflicts are generally stimulated (e.g., couples are asked to discuss a matter that is likely to evoke conflict). This call for more ecological research echoes trends in the social sciences more generally where there is a focus on activity systems as they emerge in real-life contexts. An example of one such effort is the Center on Everyday Lives of Families (see http:// www.celf.ucla.edu/). In this interdisciplinary research effort, one of six centers funded by the Sloan foundation, a video archive is being collected and analyzed in order to understand the ways that families manage the challenges faced by dual-career couples and their children.

### Learning Through Activity With Peers, Parents, and Community

The last area of research I'll revview is most closely linked to the contributions in this section. Research programs organized around developing *cultural-historical-activity theory* have used film to carry out microanalyses that focus on the ways that divisions of labor emerge in collective activities and how artifact and cultural tools mediate thinking and learning (Engestrom, 1999; Lave & Wenger, 1991). Analyses of video has contributed to our understanding of learning through game play (e.g., Guberman & Saxe, 1981; Nasir, 2005); learning through apprenticeships; learning through work (e.g., Beach, 1993); learning through collaborative problem solving (Barron, 2000, 2003; Cornelius, & Herrenkohl, 2004; Herrenkohl & Guerra, 1998; Hogan, Nastasi, & Pressley, 1999; Stevens, 2000) and learning from siblings (e.g., Maynard, 2002). Several issues have animated this area of research including

the cognitive consequences of schooling leading to comparative studies of learning processes and practices in school and out of school (see Bransford et al., 2006); how cognitive and relational aspects of interaction are intertwined in ways that are consequential for learning (Barron, 2003; Cornelius & Herronkohl, 2004); and how individual cognitive change is coupled to change at the community or societal level (Saxe & Esmonde, 2005). In a recent overview of a related theoretical approach, the situative perspective, Greeno (2006) argues that a productive goal for research on learning would involve the integration of methods and constructs from the traditional cognitive science perspective and from interactional studies of learning. Cognitive science has historically focused on individual cognition and worked to understand how people create mental representations, use them in problem solving, and remember. Interactional studies of learning focus on coordination between people and between the material and informational tools they access. Greeno describes an approach that combines aspects of both interaction analyses and an analysis of information structures that are generated and shared in joint activity. Through analyses of videotaped records, the goal is to produce coordinated accounts of learning across multiple levels and foci of analyses.

In summary, the use of video for microethnography of face to face interaction has contributed to advances in our understanding of the context specificity of behavior, the social nature of learning and development, and relationships between institutional practices and face to face interactions. Early landmark contributions were made by a diverse group of scholars who held very different perspectives. These have been followed by a similarly diverse set of investigations designed to continue to draw out the implications of earlier work. Film-based studies have also contributed to the generation of more interdisciplinary approaches to the study of human learning and development as the medium of film serves as an important boundary object for social scientists from different disciplines (Star & Griesemer, 1989). The authors in this section are contributing to this broad program of research.

## CURRENT RESEARCH AGENDAS DRIVING THE USE OF VIDEO AS A DATA SOURCE

In the most general sense, the questions that were pursued by early video analysts are still being pursued today: how do persons and environments interact in the genesis of activity, behavior, and new ideas? Of course the questions have taken different forms and there are new theoretical concepts at play. Ecological perspectives have been developed by theorists who came after Lewin (Brofenbrenner, 1979) and activity theory has emerged that articulates the importance of understanding learning systems (Engestrom, 1999; Greeno, 2006).

As the chapters in this section attest, there is a great deal of interest in merging social and cognitive accounts of learning and in understanding how learning takes place within and across the life spaces of homes, neighborhoods, communities, and through distributed resources such as books and computers (Barron, 2004, 2006). For example, Palmquist and Crowley (this volume) investigate how the "islands of expertise"

that children develop through everyday interactions with their families influences conversation. They build on ecological approaches to the study of child development and document the importance of understanding the role of prior family interactions and children's prior knowledge in shaping a visit to a museum. They compare the kinds of interactions and conversations that occur when families are accompanied by a child who has developed more or less expertise in the domain reflected in a museum visit.

Doris Ash also focuses on learning in museums. In her work, the unit of analysis is the family and she is particularly interested in linguistically and culturally diverse families. She asks, "How does learning occur over time in families as shown by their increasing appropriation of canonical scientific discourse?" Drawing on Linde's (1993) insights that conversations can accumulate over time as ideas, and themes are revisited and recombined in new ways, "ideas emerge, submerge, and reappear in morphed forms, traceable over time but only in hindsight." To study these processes, she invites families for repeated visits to the museum setting. She wants to understand how these conversations and the everyday ideas that they contain support the development of academic concepts. Vom Lehn and Heath (this volume) ask questions about the quality of experience at museum exhibits and specifically "what kinds of interaction and communication occur with partners who arrived together and with those who one happens to meet and how does explanation occur, when does it arise, how does it emerge and develop?" Callanan, Valle, and Azmitia also ask about the role of conversation between children and parents in the emergence of understanding of scientific concepts. They too follow families in museums but they also set up laboratory contexts that are designed to stimulate conversation about scientific phenomena. In particular, they are contributing to an exciting line of work on how gesture mediates and reflects learning (e.g., Goldin-Meadow, 2000) and describe how gestures are an important aspect of both child and parent communication about scientific concepts.

Taking a sociocultural perspective, Angelillo, Rogoff, and Chavajay describe their use of video across studies in a research program that seeks to understand how cultural histories and practices shape the way that people engage with one another. They want to go beyond analyses that isolate individual actions to ones that capture how participants in interaction mutually contribute to social events. They want to understand the nature of intersubjective engagement and how it is culturally linked to experiences. To investigate this, they carry out comparative studies of interactions between families who have different culture histories including the extent to which adults have experienced Western schooling. For example, in some of the work they describe in this volume, parents and children are asked to work on puzzles together. The way that family members share or divide the work is investigated.

Building on research in small group learning, Hmelo-Silver, Katic, Nagarajan, and Chernobilsky have used video to develop a case study of a single group of students who are working together on a problem-based learning unit that focuses on learning and cognition. They want to understand what happens in effective groups, how cognition is distributed, and what role different leadership styles and artifacts play in supporting a group's learning interaction. Finally, the chapter by Engle, Contant, and Greeno describes a research project that was organized to develop deeper accounts of the process

of conceptual growth in classrooms. They want to articulate how participation in activities accounts for changes in students' abilities to explain concept of adaptation. They too use a case study approach where student's conversations were tracked over several weeks. They use this case to illustrate the methodology they used to explain one group's progressively deeper engagement in scientific content over several weeks.

As the previous summary suggests, scholars who use video-based data in their research draw on a diverse collection of theoretical and methodological traditions. For example, the authors of these chapters include references to ethnomethodology, sociology, conversation analysis, developmental psychology, situated learning perspectives, cognitive psychology, sociocultural theory, and ecological perspectives. Similarly, a broad range of methodologies and approaches to inquiry can be found. For example, video might be productively collected in an experimental context where conditions are controlled in within-subject designs or participants are randomly assigned to conditions (e.g., Karrass & Walden, 2005; Meltzoff & Moore, 1983; Walden & Ogan, 1988) in order to derive behaviorally dependent measures that are predicted to differentiate conditions. Within the set of chapters in this section, we don't have any examples of experimental work but instead, see single case-study approaches (Engle, Greeno, & Contant; Hmelo-Silver; vom Lehn; Christian) or nonexperimental comparative designs (Palmquist & Crowely; Ash; Angelillo, Rogoff, & Chavajay; Callahan). There are also examples of stimulated naturalistic situations. Callahan and her colleagues bring families into a lab where they all look at the same materials. In museum studies, the participants are recruited after they have chosen to be in a particular place such as a museum or classroom. Despite these differences, all researchers who use video face substantial challenges. There is no single community of practice that has organized around video data and there are few guidebooks or conventions. The following is a sampling of some of the common challenges faced by researchers who choose to use video technology in their work.

## CHALLENGES OF VIDEO AS A RESEARCH TOOL

Video comes with a dual set of challenges—challenges of capturing good records and challenges of analysis. Early on, there were calls for the creation of standards for capture and analysis that might help address some of the basic challenges (e.g., Grimshaw, 1982a) and this request goes on but remains controversial in intent and scope (e.g., see Derry, this volume). Although standards may be too limiting, it is helpful to at least have a sense of decision points that are made by researchers as often as they are made without thinking through the implications of choices.

### Challenges of Collecting High-Quality Video Records

#### *What, Where, When, and How to Capture*

Despite the ease of obtaining high-quality equipment, the capture of high-quality video can be a challenge (Roschelle, 2000). Debates about how to capture phenomena of interest that were present from the beginning are ongoing. Even Mead and Bateson disagreed about the ideal way to capture records of interaction. Bateson

preferred a hand-held approach that allowed the camera operator to zoom in on interesting events. Mead wanted a stationary camera placed on a tripod that would yield long sequences and records that could be analyzed by scientists who were not there during the filming (see http://www.oikos.org/forgod.htm for a record of a conversation where they discuss their differing views). Several researchers have pointed out that the first theoretical decisions that are made come way before the analysis phase and include issues such as where to point the camera, what to include in the frame, and when to begin and stop recording (Hall, 2000; Lomax & Casey, 1998). These decisions result in a data source that is already theoretically burdened. This fact became obvious to early adopters of film who had a clear sense of what they were looking for. For example, Birdwhistell argued that full body images were needed for the study of kinesics and he noted that camera people were often tempted to zoom and change frame leading to less than ideal footage. In one famous example, the psycholinguist George Miller notes how hiring an educational video producer to collect nursery school video data for studies of linguistic interaction unfortunately yielded video records that were collections of clips zooming in and panning around the nursery, so that audio recordings became a more useful data source (Miller, 1977).

Hall (2000) lays out five examples of how technical arrangements influence the data record that will be available for analysis. One example described how a technology that helped track eye gaze changed the ecology of normal sense making so much that it raised questions about the validity of findings. In the other examples, decisions about what is important in a scene resulted in shots being taken at different distances that included different aspects of a scene of people in interaction. In his work, he has developed the approach of always trying to get multiple perspectives by using both a stationary camera that can take a wide angle shot and hand-held cameras that can be used to zoom in when participants are using resources or creating representations that might be important for the analysis. Hall's examples highlight that the perspective that is captured by the camera is always influenced by the researcher and ironically, is often a perspective that is not one that any one of the participants being filmed would have had. In most cases, the camera will miss some subtle information that would be available to a close observer. For example, emotional expression offered by the eyes. Compared to a live observer, a camera is much more restricted. Whereas an observer can track movement across the room or quickly focus on an object near at hand or across the room, a camera has limited depth of field (Rochelle, 2000). For these reasons, Erickson (1982) argues that engaging in fieldwork is necessary to understand the setting and should ideally occur before videotaping so that there is a better idea of what to capture. He argues that the video records should be collected with the goals of systematic sampling. He suggests identifying the full range of variation in types of events and then establishing the typicality of these events in terms of frequency.

### *Desire to Capture Over Time and Context*

Although in some ways, a camera positioned in one spot is ideal for later analysis, it can also limit what you see. In addition, researchers may be confronted with the problem of their participant moving. Wireless microphones represent one solution

but it might be the case that the actions of that participant could be of interest. In this situation, both stationary and hand-held camera approaches are needed or new innovations such as head mounted cameras might be used. Panoramic video capture is being explored as one means for capturing a fuller contextual view of interaction (see Pea & Hoffert, this volume).

### *The Presence of the Camera*

There is also the classic problem of observer or camera effects. That is, does the presence of a camera fundamentally change the behavior of interest? And, do the participants shape what actually gets videotaped in subtle or not so subtle ways (see Lomax & Casey, 1998 for examples). Although most researchers feel that eventually participants forget about the camera, it is always an issue to consider. vom Lehn and Heath (this volume) always use a stationary camera with no camera person as they feel strongly that the presence of a person operating the camera can constrain interaction. They also echo what Birdwhistell and others have noted—that there is a tendency to zoom and pan that can inadvertently diminish the quality of the record.

### *Issues of Audio, Particularly in Classrooms, Homes, or Other Very Busy Settings*

Capturing high-quality audio can also be a challenge, particularly in classroom contexts. The natural acoustics of most classrooms are horrendous. Couple this with the scraping of chairs, the rustling of paper, and multiple people speaking in a narrow space and often at the same time, the researcher is confronted with an extremely difficult situation. Even professional TV film crews used to shooting in all kinds of difficult situations, and now shooting classroom interactions for a professional development company producing video cases, have commented that classrooms present greater challenges than war zones (M. Atkinson, personal communication, December, 2004). The wise researcher will develop methods to check for sound quality early and often. The research team and future transcriptionists will be quite grateful for that effort.

### *Informed Consent*

Finally, there are a number of issues that arise when considering how best to get the informed consent from research participants (Grimshaw, 1982c). Hall (2000) outlines the different communities that might be interested in the video that was collected for a research project including the research group, students in undergraduate or graduate classes, professional colleagues, teachers, and the general public. University Institutional Review boards currently address the issue of multiple uses in very different ways. At some universities, the IRB provides standard forms that ask parents or participants to indicate what specific uses of videotapes they agree to. Categories might include permission for use as a transcribed event where the video is discarded after transcription, use to analyze within the research team or with professional colleagues,

or use to illustrate learning phenomena to a general audience or to show at professional conferences. However, many of us now want to share our video records with colleagues via distributed archives for joint analyses. How do we ensure that the data will be safe and how do we communicate the level of safety (e.g., encryption standards) that our team will employ in ways that can be understood? Given how unpredictable future uses might be, how do we best communicate this to our study participants?

There are other complications that can arise. What happens when not everyone in a school, classroom, or family unit gives their consent (Pepler & Craig, 1995)? And what if someone changes their mind about being involved at a later time? Museum researchers may not be bound to the same regulations as researchers who work in a university setting. Still, as described by vom Lehn and Heath (this volume), a great deal of attention is paid to making sure that signs are posted so that visitors know they might be studied and every attempt is made to open communication channels so that unwilling participants have a way to have their records discarded. Palmquist and Crowley (this volume) and Callahan and Azmitia (this volume) also report on the methods they use to invite museum goers to participate in ways that won't disrupt their visits or seem objectionable. For example, they note the importance of understanding deeply the goals of the institution, establishing good relationships with staff, and family desires and preferences. This latter perspective is essential in order to design procedures that will yield a high proportion of families agreeing to participate in the research.

## Challenges for Analysts

### *Volume of Data*

The downside of the ease of collection, and the general belief that capturing video will provide a rich data source, is the volume of potential data that can result. There is a tendency to collect the records first and plan for the analysis later. The desire to capture everything can result in office bookshelves filled with tapes, unanalyzed and often without any index as to what is included on each tape other than a label that indicates place and date. Classroom research is particularly likely to generate a huge amount of data as researchers try to capture the implementation of a multiweek curriculum unit and perhaps in more than one classroom. How does one decide which events to look at and of what length? The wise researcher develops at least some basic systematic approach for cataloging the events that occur on different days so that when it comes time for selecting a place to start, one is not relying on memory for what happened on what days.

### *Complexity and Richness—The Dual Problems of Selecting a Focus and Learning to See*

The volume of data leads to the next challenge—how to reduce the data set in some logical way. Engle, Faith, and Greeno nicely summed this challenge up when they noted that the problem generally is not finding something to talk about but choosing among them and fashioning a coherent account (chap. 15, this volume). If the data set

is quite large, strategies for coming to an understanding of what the whole corpus represents need to be developed. Units of analysis must be chosen (events that occur over minutes, group work that occurs over days, a curriculum unit that occurs over weeks) and sampling methods need to be designed so that more fine grained analyses can take place. Decisions about how to create an index need to be made.

Erickson (1982) provided a set of recommendations for those interested in studying face-to-face interaction. He described four stages of analysis and suggested that analysts move from reviewing whole events to increasingly shorter exchanges. He described criteria for recognizing boundaries between events and segments within events. Although his suggestions won't apply to everyone, they provide a nice example of how to develop a systematic approach to selecting what to analyze.

The power of video to capture layers of communicative exchange including dialogue, prosody, and posture is wonderful but can also present an enormous challenge to the research team. Erickson (1982) suggests the strategy of using the technological affordances of video to shift one's perceptual stance by choosing a focus of attention (e.g., gesture or talk) for each replay of a segment. He also suggests watching without sound or listening without viewing as ways to obtain more information about an event.

### *Re-Representation of Interactions With Transcription*

Most often for analyses to proceed, the information in the film or video will need to be re-represented in transcript form. Transcription is costly even when one is transcribing a single person speaking. When there are two or more persons who may speak in overlapping turns the challenges are magnified. Time estimates for transcribing the dialogue of two or more speakers suggest a ratio of 4:1 to 10:1, depending on the detail of the transcription needed, degree of speech overlap, and quality of the audio. Thus, for every hour of speech the team should expect 4 to 10 hours of transcription work. And, this is an estimate for transcribing only the speech. Nonverbal behavior such as gesture, posture, emotional expression, and actions might also be described (e.g., Erickson & Shultz, 1982; Goodwin, 2000; Kendon, 1977). Clearly tough choices have to be made about when to transcribe and what to transcribe. The authors contributing to this section have generated a number of unique approaches to this issue (e.g., some have made the decision to code directly from tape, bypassing the need for transcription). There is no single way to address this—the important point is to come up with some rationale for choices made.

### *Reporting*

Although there have been some attempts to create multimedia journals that could include some video as part of the publication (e.g., Sfard & McClain, 2002), there is general agreement that video records must be accompanied by clear written analyses. In most cases, the video records will be left behind in the reporting phase of the project and what was observed must be re-represented. Coding and subsequent quantification is a common approach to reporting results. However, although our ability to code behaviors can rest on the well worked out techniques and methods de-

scribed earlier, there is still the limitation of losing the whole feeling of an interaction. Narrative description is another method of representation; however, narrative accounts are not credible to many experimentally minded social scientists. One solution to this is to use multiple methods of representation in any data set. For example, in my own studies of group interaction during collaborative problem solving experiences, I was interested in both coding and statistically analyzing aspects of interactive behavior, such as how ideas were responded to in more and less successful groups. I found patterns that reliably differentiated more and less successful groups. However, the ways that these sequences unfolded for individual groups differed in some important ways that were masked by the quantification. In my case, I chose to combine what Bruner (1986) described as a paradigmatic approach (coding and statistical analysis) with narrative approach (that preserved the sequence of interactions). Within the narrative approach, I used three types of representation to convey the complexity of the interaction. First, I used transcripts to illustrate key aspects of dialogue; second, I provided behavioral descriptions that conveyed aspects of the interaction such as facial expression, tone, gesture as they occurred across short periods of time; and third, I used still frames to further illustrate the body positioning of the interacting students at key points. The theoretical explanation for how groups managed to utilize the collective knowledge and cognitive capacities in their group relied on both these narrative accounts where I was able to describe more fully the feeling of the interactions and the codes that were measures of types of reactions and of aspects of joint attention. The problems of re-representing the complexity in video are not trivial and we are in the beginning stages of figuring out field creative ways to do this. We can learn a great deal from one another's attempts to do this well within and across disciplines.

### *Vividness of Examples and Generalizability*

The richness of the video record can lead research teams to be drawn to particular examples that might be especially vivid or compelling. Once chosen for analysis, a huge amount of time can be invested leading to an unwillingness to give up the example or perhaps even to look for counterexamples. This is not necessarily a bad thing, and in fact, what Erickson has referred to as "cherry picking" can be theoretically productive. However, it raises questions about how one can develop methods that decrease the probability of overemphasizing certain examples. I think here, it is helpful to look at the arguments made by ethnographers and other qualitative researchers who invest in case based data. For example, in contrast to yhe idea of statistical generalization is the idea of logical generalization introduced by David Hamilton and discussed by Erickson (2002). Logical generalization is demonstrated not by statistics but by repeated empirical case studies that confirm similarity in processes across cases.

Another issue that can arise is the magnification of events that may really not be significant to the participants. As Lemke (this volume) suggests, some particular interaction that flies by participants in a matter of seconds may not be noticeable to them. The fact that we as analysts can slow it down and study the nuance does not necessarily mean that the phenomenon has huge import for human interaction.

In summary, video capture and analyses can be extremely time consuming and expensive. Before stepping out into the world to capture records of interest, researchers should ask themselves questions about what phenomena they want to capture, how they might want to use the data to communicate or collaborate with new communities, and they should understand the nature of the place in which they plan to film including aspects of the acoustical and physical environment. Plans for indexing tapes as they are collected can save the research team time and frustration. Fortunately, the researcher new to this kind of work can build on the wisdom of more experienced colleagues. The authors in this section agreed to make visible some of their approaches to working with video that helps to tame the complexity (chap. 13, this volume). Below I summarize insights around four general themes that emerged from my reading of the accounts of their work.

## Insights on Productive Inquiry Practices

### *Importance of Theory Inquiry Cycles Before, During, and After Data Is Collected*

Designing a plan for research with a set of questions and ideas about the phenomena that one wants to capture and record is a sensible approach whether or not one will collect video. However, it is particularly important when video recording will be the primary tool for data capture. As it was noted earlier, the ease of videotaping interactions makes it tempting to collect the data first and worry about what to do with it later. Our most experienced researchers in this section suggest that substantial time and attention should be devoted to conceptualizing the research questions that might be addressed with the video records in advance. Why is this so important? First, reflection on the kinds of questions that might be pursued may fundamentally change strategies for data collection. For example, if one decided beforehand to organize questions about how material artifacts might facilitate coordination in groups, the decision about where to aim the camera might differ or explicit collection and reproducing of the artifacts might take place. Second, different decisions about sampling interactions might be made. If change in groups over time is of central interest, then adequate samples might be collected from predefined points in a group's work. Third, doing some work beforehand, crafting good questions can be critical for the analysis phase of the research project. Having good orienting questions to begin with helps to maintain a perspective that prevents one from getting lost in the details that video records include.

The concern that was described earlier about generalizability of findings can be countered by explicit attention to the logic of one's inquiry and the processes used to create explanations and generate claims. Issues of reliability and validity of all kinds (internal, convergent, external, descriptive) apply to video based data as they do to any other kind of quantitative or qualitative data analysis. At the same time, one wants to remain open to discovering new phenomena. The chapters in this section offer us examples of a variety of approaches. Some of the authors describe processes that share a family resemblance with an approach to qualitative research more generally called analytic induction, developed by Znaniecki (1934). In analytic induction, a few cases are

explored in depth and explanations are developed. New cases are examined for their consistency with the explanations and when they are not consistent, the explanation is revised. For example, Engle, Greeno, and Conant (this volume) suggest an approach they call "progressive refinement of hypotheses." In this approach, a general question is framed and records are collected in an appropriate setting. Once records are collected, more specific hypotheses are formed after some viewing of the records. These hypotheses are then examined in relation to other aspects of the data set leading to more complete explanatory hypotheses. They argue that multiple iterations through hypothesis generation and evaluation lead to greater robustness and increased likelihood that the findings might be replicated in other contexts. As was noted previously, Engle, Greeno, and Conant are interested in conceptual change and designed a data collection plan that would allow them to have pre and post-assessment information that would reflect changes in students' conceptual understanding, and they would have video data of the conversations that were likely to have been generative for that conceptual growth. They articulated a plan for how they would use the records and they represented the problem they were trying to solve in theoretical terms.

Angellio, Rogoff, and Chavaray (this volume) also point out that in their work, the initial questions are first framed at a general level, for example, "what cultural variations and similarities occur in the ways that mothers aid toddlers in problem solving." This general question was then refined as the records were analyzed. Ash describes how, in her program of research, she moved from a general question about how scientific sense making occurs to a series of more focused inquiries about conversations—such as the role of questions or analogies and metaphors in exploring content.

At the same time, one should expect new research questions to emerge from viewing the tapes. Both the Angellio, Rogoff, and Chavaray chapter and the Engle, Contant, and Greeno chapter point to specific findings that emerged that were totally unanticipated. The good questions that they started with were also addressed and the answers informative for their projects but the novel phenomena, they believe, were more theoretically fruitful. vom Lehn and Heath actually begin their analysis directly after they begin collecting records. In what they call a preliminary analysis, they refine their questions and determine whether unanticipated phenomena have emerged for which they might want to develop data capture approaches. They reserve their more intense analysis time for the subsequent records that they collect. This approach is similar to what is considered piloting in experimental approaches to inquiry.

Palmquist and Crowley had also developed specific research questions and a detailed research plan prior to the collection of records. In contrast to Engle, Greeno, and Contant, their research team did make some predictions before collecting data. They predicted that there would be differences between more and less expert children in the roles they took on during their visit to an exhibit called "Dinosaur Hall." To examine this general hypothesis, they decided to collect data on family interaction in the context of this one exhibit hall and designed interviews and assessments to get information about the dinosaur knowledge, interest, and experience of the children and their parents directly after the visit.

Hmelo-Silver, Katic, Nagarajan, and Chernobilsky (this volume) took a single case-study approach. They purposively selected one group to analyze using perfor-

mance criteria and impressions of the high engagement of group members. They wanted to understand the kinds of interactions that occur in effective groups. Fourteen hours of video were reduced to nine clips that ranged in length from 40 secs to 2 ½ mins. Individual team members generated specific hypotheses after viewing the clips and these hypotheses were refined in whole group discussion. This was a first investigation of the interactions of well-functioning groups and the team plans to design additional studies in order to more fully test the validity of the observations they made about the role of artifacts and leadership as supportive conditions for effective problem-based learning groups.

It is also of note that the authors in this section do not for the most part rely only on the data offered by the video record. As was discussed earlier, the point of view of a camera is always limited. Field notes, photographs of the surrounding field of action, interviews, copies of posted documents, might also be relevant and useful for enriching the video data that will be analyzed at some later point in time and for offering opportunities for triangulation across sources of evidence. For example, vom Lehn and Heath (this volume) collect exhibit specifications, copies of gallery guides, instructions, and carry out interviews not only with visitors but with exhibit designers, curators, museum managers, and educators.

In summary, an experienced researcher may have intuitions about what is going to be interesting and film in a way that is more open ended than the previous advice would suggest and come out with fantastic data. Their intuitions are based on knowledge of the theoretical questions animating the field, familiarity with other empirical findings, and experience in particular settings. Their questions may be more implicit than explicit. For someone who is newer to this kind of analysis, planning up front about what one is after can increase the probability of having interesting contrasts and in collecting the kinds of data that will allow for a systematic analysis that addresses the questions.

For those starting to plan a project that will use video records, it would be wise to focus first on theory-driven questions and develop concrete plans for a first pass at using the video records. Having good questions will help maintain perspective and prevent one from getting lost in detail. At the same time, one should anticipate new discoveries and be ready to articulate questions that can be followed and refined and tested through multiple passes of the video records. Multiple cycles are to be expected and an explicit approach to this can strengthen the likelihood of generating strong findings that are both reliable and valid.

### *Intermediate Representations Are Critical for Data Selection and Pattern Finding*

A second suggestion that can be culled from these chapters is the importance of intermediate representations of the data for identifying which segments to analyze and for understanding patterns within and across segments. Once again, there is a wide range of approaches represented. Some of the authors in this section rely heavily on content logs for identifying segments for analysis. Content logs can be created while video is being collected, for example, in the form of rough field notes. Or, content logs

can be created later. They can be extremely detailed, taking a brief standard unit of time (say 3 mins) and describing the major events that took place or they can consist of a several sentence description of the content of a whole hour of instruction. Content logs allow the research team to develop a sense of the corpus of data and facilitate the selection of episodes for further detailed analysis. This kind of indexing should be distinguished from systematic coding. Systematic coding, as we will be discussing, is best done after extensive work has been completed to establish the meaning of codes and the central units that should be coded.

Ash (this volume) has developed a three-part analytical scheme that allows her to analyze scaffolding, everyday knowledge, and biological content and to connect these across time. She begins with a representation she calls the flow chart, which catalogues a family's museum visit from start to finish, including any pre/posttest interviews that were done. The goal is to mark major events and the occurrence of conversations about biological themes. Topics and themes can be coded from this representation to compare families across visits or visits across families. The coding system for identification and categorizing of biological events is itself a complex endeavor that has gone through many iterations. The flow chart representation is also key for selecting the data for her second level of analysis—the significant event. Significant events are selected based on four criteria: 1) They have recognizable beginnings and endings (usually they take place in one exhibit); 2) they have sustained conversational segments; 3) they integrate different sources of knowledge; and 4) they involve inquiry strategies such as questioning, inferring, and predicting. The third level of analysis involves more microlevel analyses of the interactions that occur within significant events. For example, Ash and her team use discourse analytic frameworks to study how ideas are developed over time through the kinds of responses that any utterance affords such as justifying, exemplifying, or reformulating.

Angellio, Rogoff, and Chavaj (this volume) illustrate their approach to representing and re-representing video data in the context of a study that compared mother–child interactions in four distinct cultural communities. The researchers used a protocol that introduced the children to a set of novel objects. The first step that the team took was to generate descriptive accounts of the 1½ hour home visits. These were not event logs but actual descriptions of how mothers helped their toddlers learn about the novel objects in the context of the visit. These accounts were lengthy and often resulted in as much as 30 pages of descriptive writing. These descriptive accounts were not transcripts but were written to help the rest of the research team visualize the sequence of interactions and to capture the purposes and functions of action and dialogue.

As was noted earlier, transcripts of talk and gesture are often needed. Just as it has been argued that the decision about where to point the camera is a theoretical move (Hall, 2000), decisions about what and how to transcribe are argued to be theoretical decisions as well (Ochs, 1979). Even when there is only an audio record, transcripts can vary dramatically in their detail and the kinds of information that is recorded. Like maps of the physical world, the features that are encoded in the representation depend on the purposes of the user of the representation. For example, pauses, overlaps in turns, laughter, intonation, volume, and degree of enunciation are types of informa-

tion that may or may not be included, in addition to the actual words that people say. Video data adds new possibilities including gesture, posture, visual images, and the like. Multimedia transcription raises new challenges and possibilities. vom Lehn and Heath provide an example of how they use different kinds of transcripts and layouts to capture not only dialogue but gaze direction, posture, and hand movements (also see the examples offered by Goodwin, 2000; Kendon, 1977).

Once transcripts are created, the spatial layout of turns can be designed to make phenomena easier to see. For example, some researchers create conversation maps of various kinds. When completing my studies of peer interaction and problem solving, I was inspired by the representations of conversation used in an article by Resnick, Salmon, Zeitz, Wathen, and Holowchak (1993). They were shared in a two case comparison of groups of college students to show how conversations about the same content could take very different turns depending on the tone and tenor of participants. In my study, transcripts of the turns of each speaker were entered into a unique column and turns were linked by arrows labeled according to an emerging and, at that point, dynamic coding scheme. These maps covered my office walls for a period of months and, although they were not used to communicate findings, they were critical in helping me see patterns of differential responding to problem-solving proposals that were then key to my later quantitative coding and qualitative analysis described earlier (Barron, 2003). Still images from the video were also used as a data source once I had developed the insight that joint attention was a key feature that differentiated more and less successful triads. The images held still aspects of interaction around a particular turn that included a proposal for a solution and allowed me to get a clearer look at the body postures, gestures, and degree of mutual orientation that co-occurred with the dialogue and helped to compare more and less successful turns within and across groups.

### *Coding and Re-Representation of Video Data Are Critical Processes*

It is by no means universal that video records are coded in a way that can yield quantitative data. Many researchers prefer to focus on examples and do not care for counting types of events within or across cases. However, others find coding and quantification a useful aspect of their project. Erickson (1977, 1982, 1986) has written extensively about possible roles of quantification in qualitative research and has a useful discussion of the synergies between approaches. He argues that determining what to count (the qualias or kinds of entities) is more challenging than doing the actual counting. Other excellent discussions of the development and use of observational coding schemes and associated statistical techniques include a primer on the topic of sequential analysis by Bakeman and Gottman (1997) and a paper by Chi (1997).

The authors in this section who discuss their approach to coding describe the development of codes as an iterative process. Like the processes of generating questions or creating representations, the development of a coding approach benefits from iterative cycles, distributed expertise, and moving across levels. For example, Angelillo, Rogoff, and Chavajay begin their chapter by offering a critique of approaches to the study of social interaction that code individual acts by participants and then relate them statistically. They suggest that this approach misses the core of phenomena of social interaction,

which is mutual constitution of events by participants, a perspective they share with ethnomethodologists. In their chapter, they describe one approach to investigating patterns of shared engagement that combines qualitative and quantitative approaches. The core of the process involves close ethnographic analysis of a few cases in order to build up a coding scheme based on the observed phenomena that can then be applied to multiple cases. They illustrate this approach using two studies—one that focused on cultural variation in mother's and toddler's contributions to understanding novel objects across four culturally distinct communities, and the other that investigated patterns of joint activity between Guatemalan Mayan mothers and children completing puzzles. The research team went into their cross-cultural analyses with some ideas of the kinds of interactions that might differ across the four cultural groups; for example, the relative reliance on words versus nonverbal demonstration. However, as is the case with many video studies, the video-based data of interactions led to the discovery of new phenomena such as differences in the ways that the mothers from different cultures motivated engagement. Once these phenomena were identified, the team worked to refine the definitions of the categories so that they could be reliably coded. Angelillo, Rogoff, and Chavajay also make the important point that it is important not to be blind to the histories and intentions of research participants. In their work, they seek to gain an insider perspective as they develop their codes. In addition, they continually compared the definitions with individual cases to ensure that they were not distorting the researchers' understanding of the interactions to fit the codes. Once coded, the team used graphs to display codes for individual mother–child dyads in addition to carrying out statistical analysis to confirm that differences were statistically significant. Another representational innovation that turned out to be important for the team was the creation of a diagramming method that allowed the researchers to characterize types of coordination around shared tasks that involved multiple people. In the end, the diagramming resulted in a four-level scheme of types of mutual engagement and these "birds eye" top view diagrams were used to help code videotapes at 1-minute intervals.

Systems of analysis clearly develop over the course of multiple research projects. Ash articulates the changes that have occurred in her coding system and the evolution that resulted in a system they call *tools for observing biological talk over time* (TOBTOT). Through the careful analysis of the talk of families, consultation with biologists, psychologists, and educators, and the work of her research team, they believe they have come up with a system that can be used across projects and not only by their team. She notes that more than a dozen iterations have occurred to get to what they consider now to be a stable and generative system.

### *Interpretive and Question Generation Activities Benefit From Explicit Social Processes*

One of the first papers reflecting on group processes of video analysis described an approach they called *interaction analysis* that included group viewing of video where analysts would be free to stop the tape at any point for discussion and where insights were later harvested by organizers of the analyses from audio recordings of group sessions (Jordon & Henderson, 1995).

Many of the authors in this section explicitly highlight the importance of a variety of social processes as core to their research practice. Rogoff uses the distributed ethnographic analysis of the team members in research meetings to generate codes. In addition, they have developed explicit group activities to support the development of precise questions that will be addressed through their more refined coding. One of these is what they call a "focusing exercise" that involves creation of research questions and coding definitions with the purpose of identifying which could be most productively examined by the data at hand and which were more peripheral. In addition, this exercise is used to help the team think ahead to how they will be summarizing the data. This research team also uses coders who are unaware of the hypotheses of the studies to help articulate the coding scheme and they work to imagine the responses of particular reviewers to their coding systems as a way to push their articulation of clear codes. Although reliability of the coding schemes is critical, these authors make the point that their goal is not to be blind to information about the participants but rather to know their cultural history in as much detail as possible. Because the work involves comparisons of interactions across cultures, insider perspectives are particularly important to bring to the group so that the team can better understand the meanings behind particular actions, gestures, and terminology. Recursive cycling between ethnographic analysis and coding help ensure validity and generalizability for the Rogoff team.

Engle and colleagues also used group viewing sessions relying on the internal research group but also invited outside experts to join in. Ash solicits the expertise of biologists and science educators to elaborate and check the validity of her coding schemes. vom Lehn and Christian occasionally have large viewing meetings where students and museum practitioners join in. Palmquist and Crowley are now collaborating with a sociolinguist who is directing the research team's attention to a number of dimensions that they would not have focused on and they note their ever-changing perception of their data as they sit down with colleagues who come with different interests or disciplinary perspectives.

The Hmelo-Silver, Katic, Nagarajan, and Chernobilsky study provides an example of inviting research participants in to share their reflections on the videotaped records of the interactions to which they contributed. The team carried out 2-hour interviews that involved showing two of the key participants the nine clips that were the focus of analysis. The reflections on these clips were used to enrich the analysis and check on the meaning of certain actions observed in the tape. This approach has been used in studies of teacher decision making and can be considered as a relation to methods developed for use with other kinds of media, such as photographs (see Harper, 2000 for a discussion of photo elicitation techniques). It is an intriguing way to add to the data available for analysis and I expect that its use might become more refined in years to come, as a way to bring both emic and etic perspectives to an inquiry (Pike, 1954).

## SUMMARY AND FUTURE DIRECTIONS

Video analysis can be extraordinarily productive as a way to deepen our understanding of learning and human interaction. From early in the history of its development, film was used as a tool to help overcome the limits of real-time human

information-processing capacities. Like the invention of the microscope or the telescope, film radically increased our perceptual power, making the invisible visible and subject to analyses (Asch, Marshall, & Spier, 1973; Davis, 2002). Familiar processes can be made strange by slowing them down or speeding them up. It provides social scientists with new ways to test theories and to challenge simplistic explanations of how the world works and perhaps more importantly, it is a vehicle for discovery and encourages interdisciplinary collaboration.

As we look to the future of video research, it seems likely that much will be gained from the development of video collaboratories, (see chapter by Pea & Hoffert, this volume). When researchers come together with common interests and unique data sets, there are rich opportunities for increasing the generalizability and validity of our findings. TalkBank, led by Brian MacWhinney (see his chapter, this volume), is one initiative that may increase our collective capacity for analysis and learning by sharing data. By looking across data sets, we can capitalize on the distributed efforts of researchers across disciplines and advance our understanding of peer, family, and informal learning while setting the stage for the development of more comprehensive and valid theories of learning and development.

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