Parent–Child Collaborative Explanations: Methods of Identification and Analysis

Maureen A. Callanan
University of California, Santa Cruz

Jeff Shrager
Xerox Palo Alto Research Center

Joyce L. Moore
Stanford University

In this article we describe methods for observing, identifying, and analyzing explanations as they arise in everyday discourse between young children and their parents. By studying these explanations, our research addresses two questions about children’s developing understanding of the world: (a) How do children develop skill in producing and understanding explanations in conversation? and (b) How do children use these skills to learn about causal events in the world? Our aims in this article are to describe the methodological challenges we face in this research, to discuss ways that we have tried to meet those challenges, and to provide some examples of the conclusions we have been able to draw using this methodology.

Adults are able to give explanations for what they and others do and for events in the world around them. Such explanations usually go beyond what can be perceived, and often beyond the events themselves, to bring in aspects like function, mechanism, intention, and motivation. The psychological study of explanation has generally been concerned with adult explanations of social or scientific phenomena (Antaki, 1988; Chi, Bassok, Lewis, Rie-

Requests for reprints should be sent to Maureen A. Callanan, University of California, Santa Cruz, Clark Kerr Hall, Santa Cruz, CA 95064.
mann, & Glaser, 1989; Heider, 1958; Kuhn, 1977; Nisbett & Ross, 1980; Schank, 1986), but the study of explanation is also of interest to developmental psychologists concerned with the origins of conceptual knowledge and conversational skill.

In our research we focus on two questions: (a) How do children develop skill in producing and understanding explanations in conversation? and (b) How do children use these skills to learn about causal events in the world? To answer our first question, we focus on the structure of participation (i.e., who initiates and who completes the explanation), and to answer the second question we focus on the content of what is said (i.e., what type of causality is expressed in the explanation). We take a sociocultural perspective on cognitive development, following the ideas of Vygotsky (1962, 1978) as well as current theorists, such as Rogoff (1990), Tharp and Gallimore (1988), Cole (1985), and Wertsch (1985). This perspective leads us to consider children’s participation and collaboration in explanatory conversations as an ideal setting in which to study the development of explanation skill. Comparing children’s participation in collaborative explanations at different ages allows us to document the pattern of changes in how children learn to understand and produce explanations. Further, the pattern of parents’ contributions to these conversations allows us to assess possible mechanisms by which parents’ explanations may serve as a guide for children in learning this complex skill. Our theoretical emphasis on the importance of the social context in which children learn and understand explanation results in several methodological requirements. In particular, the methodology we employ must allow us to examine children’s participation in explanations as they occur in the context of everyday activities. Further, we must be able to assess the collaborative roles of parents and children in these conversations to document developmental changes in these patterns and to consider possible mechanisms of change. In this article, we concentrate on the methodology we have developed to address our questions about the development of explanation.

The methodology we have used to address our questions about explanation is what Bakeman and Gottman (1986) call “systematic observation.” The goals are to observe behavior in natural contexts, to identify the behaviors of interest using a detailed coding scheme, and to train observers so that they demonstrate a reasonable level of agreement in their coding of the same behaviors. This type of observation and coding of interaction has a long history in psychological research, as well as in ethology and other related disciplines. In our particular case, the methodology involves videotaped recording of parent–child interaction followed by detailed coding of the aspects of the discourse that are identified as explanatory conversations. We find this method to be a valuable one for addressing our questions because it permits an analysis of explanations as they occur in natural contexts. In this sense, the method can be contrasted with experimental techniques wherein children are brought into unfamiliar settings and questioned about their
understanding of phenomena that may or may not be of interest to them. At the same time, we are persuaded that systematic observation, with its requirement of interobserver agreement, helps to reduce concerns that the observations result from a particular observer's biases or expectations. We do not suggest that observer biases can be eliminated or that observer agreement is equivalent to accuracy, but measures of agreement among observers can be interpreted as evidence that what is coded reflects some level of consensus among members of a community of speakers.

Although this type of systematic observation meets the methodological requirements of addressing our questions about explanation, it also presents several challenges for the researcher, most of which revolve around the problem of identifying explanations from the stream of natural discourse. Our aims in this article are to describe the methodological challenges we face in this research, to discuss ways that we have tried to meet those challenges, and to provide some examples of the conclusions that we have been able to draw using this methodology. This methodology is useful for any researcher who wishes to identify particular patterns of talk in discourse; for this reason we expect our challenges and solutions to inform research beyond the study of explanation. In the first section, we clarify what we mean by explanation and provide a more detailed discussion of the two conceptual questions that guide our work. In the second section, we describe several methodological challenges along with our solutions, and in the third section, we draw conclusions about the conceptual and methodological implications of this work.

WHAT ARE EXPLANATIONS AND HOW ARE THEY LEARNED BY CHILDREN?

Defining terms such as explanation and cause is a complex task, and different researchers have used different criteria to define these phenomena. For example, Barbieri, Colavita, and Scheuer (1990) write that “an explanation is offered to a partner to clarify something which might be obscure or ambiguous” (p. 246). They include “what” explanations (i.e., the meanings of words, naming of objects), “why” explanations (i.e., causal and purposive expressions), and “how” explanations (i.e., descriptions of processes), whether or not they are explicitly marked. Donaldson and Elliot (1990) use a narrower definition, considering primarily causal explanations for events: “Explanation extends our understandings of the world, by moving beyond simple observation of events to the causal links underpinning them” (p. 26). Antaki and Fielding (1981) consider primarily causal explanations about behavior: “... ordinary explanations are taken as interpretations of behavior, ranging from unconscious appraisal to considered and polished argument” (p. 27). Finally, as Draper (1988) points out: “... in everyday life, almost anything may, in the right circumstances, count as an explanation” (p. 16).
Given these variations in definition, and given our goal of interobserver agreement, it is important to be explicit about what we mean by explanations in our work. Because our work is motivated by an interest in children's causal understanding, we focus on explanations that provide causes or reasons as opposed to other types of explanations. In other words, we do not include the "what" explanations described by Barbieri et al. (1990), because those are noncausal explanations for what words mean (e.g., the answer to the question "what does 'fresh air' mean?"). There are, however, several kinds of explanations that provide reasons. We have delineated three types of explanations that we consider in this article. Prior Cause explanations are those that provide a direct cause that occurred prior to the event to be explained (e.g., "He's crying because Susie hit him."). In contrast, purposive explanations focus more on the consequences of events by providing a function or purpose for a behavior (e.g., "She pushed the car so it would roll down the hill."). Finally, interpretive explanations provide a reason for believing something to be true (e.g., "It must be raining because the patio is wet.").

Despite deep differences in the meanings of these different types of explanation, causal language (e.g., "because," "so," "why") is often used in all three types. Adult speakers understand these three types of explanations; we are interested in how children learn to distinguish the three modes of explanation underlying these surface similarities.

As we mentioned earlier, there are two aspects of explanation that children are likely to learn by participating in explanatory conversations. First, we argue that children’s participation in co-constructing explanations for everyday events is an important activity from which they learn about what counts as explanation in their culture. Explanations have a form and content that is generally agreed upon by the members of particular communities, and certain sorts of explanation are called for in certain situations (Kuhn, 1977). Because the nature of explanation varies for different cultural groups and historical times, learning what counts as explanatory talk is part of membership in a community of practice (Hood, Fiess, & Aron, 1982; Jordan, 1989; Lave & Wenger, 1991). A great deal of research focuses on how children and parents co-construct meaning within the context of everyday activities (Adams & Bullock, 1986; Callanan, 1991; Rogoff, 1990; Tharp & Gallimore, 1988; Vygotsky, 1978). However, little is known about how preschool children’s explanatory skills develop in these everyday situations. We are interested in the social context in which preschool children and their

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1These interpretive explanations are similar to the explanations that Draper (1988), following Toulmin (1958), calls "warrants for belief"; they are also related to Piaget's (1928) "logical" explanations, and Donaldson's (1986) "deductive" explanations. Although some analyses do not see these interpretive explanations as causal (e.g., Draper, 1988), we interpret each of the three types as providing a different kind of reason or cause. In the example given in the text, saying that the patio is wet does not explain why it is raining, but it does explain why the speaker believes that it is raining.
parents co-construct causal explanations and in the extent to which parents guide children's participation in explanatory talk. Second, the study of children's explanations may be a window on how young children learn about the world (Carey, 1985; Piaget, 1926). Causal explanations have been the particular focus of several studies of children's language in laboratory settings (Bullock, Gelman, & Baillargeon, 1982; Donaldson, 1986; Gelman & Kremer, 1991). This research indicates that by the age of 3 or 4 years, children can engage in relatively intricate explanations of some causal events, whereas other aspects of explanation continue to develop even up to the age of 10 years. By studying the content of children's and parents' spontaneous explanations, we may gain insight into children's intuitive theories about the physical and social world as well as the process by which they test and revise these theories.

CHALLENGES IN SYSTEMATIC OBSERVATION
OF EXPLANATION

The study of the development of children's understanding and production of causal explanations presents some complex and challenging methodological problems. Variants of these problems are faced by any researcher who wishes to analyze patterns of discourse in natural settings. In this section of the article, we describe the four major challenges we have faced and discuss the ways in which we have dealt with these challenges. The challenges we discuss are (a) how to capture explanations as they arise in natural settings, (b) how to identify explanations reliably and separate them out from the stream of speech, (c) how to analyze the collaborative structure of explanations, and (d) how to identify the subcategories of explanations that express different modes of causality.

Explanations in Everyday Settings

Capturing explanations as they arise spontaneously can be accomplished in several ways. Semistructured interviews are one way to elicit and explore explanations (Draper, 1988; D. Kuhn, 1991; Piaget, 1926). We are interested in the nature of the explanations that children participate in during conversations with parents, however, and did not want to include an experimenter as a third party to these conversations. Another methodology that captures explanations as they occur is the diary methodology, in which parents record the explanations that occur. This technique is useful for rare phenomena that are hard to capture in laboratory settings (Dale, Bates, Reznick, & Morisset, 1989; Nelson & Ross, 1980). Callanan and Oakes (1992), for example, conducted a diary study in which parents were asked to record children's questions about "how things work" and "why things happen," and the expla-
nations that followed in discourse. Callanan and Oakes's data show that preschool children ask complex causal questions and hear causal explanations about a wide range of content domains. Because diary data can be collected over a period of weeks, this approach helps to solve the problem that explanations may occur infrequently within a short space of time. However, the diary approach is limited by what parents remember or choose to report. To explore the details of how question–explanation episodes unfold, and to know exactly what is said by both parents and children, we need a more complete and objective record. The complexity of explanations in natural language makes it impossible for an observer to code explanations as they occur. Our goal of capturing causal explanations in conversation, then, requires the use of audiotape or videotape recordings of children’s interactions with parents.

Several studies have investigated very young children’s expressions of causality using such recordings of natural activities. Hood and Bloom (1979), for example, found that linguistic expressions of causality appear between the ages of 2 and 3 years in the audiotaped speech samples of the eight children they studied. Dunn, Brown, Slomkowski, Tesla, and Youngblade (1991) looked at individual differences in the amount of causal talk between mothers and 33-month-old children in audiotaped conversations of 50 families. In this study, mother–child causal talk was correlated with the children’s performance on an explanation task at age 40 months. Barbieri et al. (1990) explored causal explanations given by 3-year-olds to one another during videotaped play sessions (see also Isaacs, 1933). In all of these studies, naturalistic observation of young children’s speech documents the emergence of children’s ability to produce causal explanations by age 3. Less is known about developmental changes in children’s participation in explanatory conversations beyond its initial emergence. In our work, then, we extend this research by analyzing explanations in videotaped recordings of parents’ conversations with children ranging from approximately 2½ to 5 years of age.

In looking for parent–child explanations, we wished to strike a balance between the control that is necessary to make across-subject and across-age comparisons and the naturalness of the setting in which the parent and child are interacting. To accomplish this, we used a common activity for all of the parent–child dyads. We videotaped 36 parents reading a wordless storybook, titled The Snowman (Briggs, 1978), with their 3-, 4-, or 5-year-old children in their own homes.5 Subjects were contacted through preschools or by word of mouth. The sample was somewhat limited in terms of socioeconomic status and ethnicity; although there was some diversity in ethnic background, the families were mostly White, middle-class, and well educated.

5We refer to the three age groups as 3-, 4-, and 5-year-olds for convenience. The mean ages were 2 years, 11 months for the youngest group, 3 years, 10 months for the middle group, and 4 years, 10 months for the oldest group.
The Snowman is 30 pages in length. Each page contains a number of
colored pencil drawings. Briefly, the story is about a little boy who builds a
snowman. After going to bed, the boy wakes up in the middle of the night and
sees that the snowman has come to life. The boy and snowman have various
adventures in the boy’s house. The snowman appears to be afraid of hot
things in the house, such as the fire, the stove, the radiator, and hot water. He
is attracted to cold things (e.g., the freezer). He seems puzzled by the
television and electric lights and a picture of flowers. Next they go outside
to the snowman’s world. The snowman takes the boy by the hand and they
fly over the snowy world. When the sun starts to come up, the snowman
brings the boy home to bed. In the morning the snowman has melted, leaving
only his hat and scarf, and the coals that were his eyes and buttons.

There are no words in the body of the book. Thus, reading The Snowman
involves producing and justifying the entire story, rather than simply reading
it from printed text. This may make it more likely that parents and children
will produce explanations (see also Barbieri & Devescovi, 1985; Michell &
Another aspect of the book that may encourage explanation is that it involves
behaviors that can be explained by unobservable emotional or motivational
states. For example, the snowman recoils from the fire, which can be ex-
plained by his desire not to melt. Because the children we studied lived in
California, many of them had not seen snow. Thus, we expected to find a
significant amount of explanation in the parent–child reading of The Snow-
man, both in terms of physical and mental phenomena and their interaction
and in terms of the parents’ justifications for their interpretation of the story.

Once the videotapes of the reading sessions were transcribed, the next
step was to identify those episodes within which explanatory talk occurred.
We next discuss the challenges involved in this step of the research process.

Reliably Identifying Explanations and Explanation
Episodes

In an earlier section we listed the variety of definitions for explanation that
appear in the literature. Even with a clear definition of what an explanation
should look like, however, the complexity of real-time discourse presents
further ambiguity about which utterances are components of explanations.
Coders must first identify that there is an explanation present and then
decide on the boundaries and components of the explanation. Because of the
ambiguities in how to identify explanations, we believe it is important to
obtain statistical measures of interobserver agreement on what to include in
the corpus of explanations as well as on how to categorize those explanations
(Bakeman & Gottman, 1986). Our solutions to these challenges have been
(a) to specify rules for identifying the three major parts of each explanation:
the topic to be explained, the reason or cause, and a causal connective or keyword; and (b) to distinguish between explanation episodes and the individual explanations within them.

We used a "team" method to obtain interrater reliability on the identification of explanation episodes. Two teams of coders (with two people on each team) made independent judgments about the components of explanations for 25% of the transcripts. It is more typical in this type of research to compare the judgments of two individual coders. The team method evolved because there were often alternative ways of viewing an explanation episode and because the coders felt that it was important to discuss the alternatives with another person before being confident about a judgment. In all cases, the coders watched the videotapes and read the transcripts simultaneously while coding. There were no discussions between teams until each team had completed their coding. The two teams agreed on 92% of the boundaries for the explanation episodes. All disagreements in the reliability transcripts were resolved through discussion. Each of the remaining transcripts was coded by one of the teams (two people working together), and every questionable case (i.e., situations in which the two team members did not agree or did not feel confident about their judgment) was discussed with at least one other coder before a final decision was made. In this section, we first discuss our decision to use causal keywords as identifying markers and next discuss our methods for identifying the topic and reason components of explanation episodes, especially in cases in which multiple topics and reasons occur within the same episode.

Causal keywords. In the initial stages of our work, we found that it was relatively easy to obtain agreement on where explanations occurred if we relied on the causal keywords “why,” “because,” “so,” and “how come.” On the other hand, achieving agreement about what counts as a causal explanation was quite difficult for utterances in which no causal connective appeared. Many previous studies have not reported such agreement or reliability measures on this first step of deciding what to include in the corpus of explanations (although they often do report obtaining reliability on how these explanations were subsequently categorized). Although there is no established way to identify causal explanations that do not contain causal connectives, the presence of a causal connective results in a causal statement, even in the speech of very young children (Bloom & Capatides, 1987; Hood & Bloom, 1979). Thus, we have taken a conservative approach in this research, including only those causal explanations that do contain causal keywords (such as “because” and “so”), as in the examples that follow:

Example 1 (2 years, 9 months):
Parent: Here he's waving goodbye cause they're gonna go outside
Example 2 (4 years, 9 months):
Child: Well, the candle is bad for him.
Parent: Why?
Child: Because it can make him melt.

Example 3 (3 years):
Parent: The snowman sees a picture of flowers and he frowns. Because flowers mean summertime and the snowman comes in the wintertime. So he doesn’t like flowers.

In contrast, consider the following three examples that we did not include in our analysis because they do not contain causal connectives:

Example 4 (2 years, 11 months):
Parent: I think he melted. When it gets warm after you’ve built a snowman, the snow begins to melt. And pretty soon the snowman goes from being very tall to being very, very short. And he just melts away.

Example 5 (2 years):
Parent: They found a box full of light and the snowman jumped in. The snowman likes lights.

Example 6 (4 years, 9 months):
Parent: Uh, hmm, they’re coal. They’re things you can make hot but, nope, they’re not hot yet. They’re in the coal shed. See they’re outside the house in the snow.

Some readers may have strong intuitions about the expression of causality in these fragments, but others may see them as renditions of the facts of the world without any explicit statement of causal connection. Although requiring connectives does not result in an exhaustive set of explanation episodes, it does give us a complete subset of episodes for which we can be relatively certain that expressions of causality were intended. Although this solution is very conservative, we consider it only temporary. In future work we hope to determine ways to analyze episodes without keywords that may contain expressions of causality. At this time, however, we hesitate to draw conclusions from “explanations” without causal keywords that cannot be reliably identified by independent coders. Further, the subset of explanations that contains keywords is a theoretically interesting one because it allows us to address children’s understanding and production of explanations that are explicitly marked as such.

One reason that the causal keywords are so helpful in identifying explanations is that words such as “why” and “because” essentially always mark causal utterances. The word “so” can, however, be used in several different
ways, as outlined, for example, by Schiffrin (1987). Despite this complexity, as a result of our analysis, we are confident that we can identify those cases of “so” that express causality. The noncausal uses of “so” are very straightforward for coders to find, as in sentences like “He’s so big” or “You have to do it like so.” There is, however, another use of “so” that is more difficult to distinguish from the causal uses we wish to capture. Especially in narrative settings, “so” is very often used as a *continuity* marker. Consider the occurrences of “so” indicated in this segment:

Example 7 (4 years, 9 months):

P: *So* he rolls a snowball, and he rolls it bigger and bigger and makes a tall hill and then his mom says: “Come on in! You've got to have some breakfast before you play all day.” *So* then he goes back out and he makes it bigger and taller. It gets to be *so* tall he gets a stool. And then he puts a head on top. He says: “Hm, that, that snowman needs something. Mom, can I have a hat and scarf?” *So* then he goes and puts it on him.

The first two occurrences of “so” in this segment could be paraphrased as “next,” and seem to function to continue the narrative. Schiffrin (1987) argues that in these cases “so” marks causal relations at a more “global level of discourse” (p. 203). In other words, the second use of “so” does not mark a direct cause–effect relation, but it may mark a global causal connection between the next event and all of the events that have led up to it in the narrative. We decided to code only the uses of “so” that mark causal connections directly (i.e., “local” markers in Schiffrin’s terms). In this example, then, only the fourth “so” was coded as causal in our scheme: “He says: ‘Hm, that, that snowman needs something. Mom, can I have a hat and scarf?’ *So* then he goes and puts it on him.” (Note that the third “so” in this example is a clear noncausal case.) Even with this seemingly difficult distinction between “so” as a causal marker and as a continuity (or global causal) marker, we found extremely high agreement among observers in identifying those instances of “so” that are considered causal in our coding scheme. This first step in identifying explanations in discourse, then, is relatively straightforward.

**Delineating the parts of the explanation episode.** Once the causal keywords had signaled the presence of an explanation episode, the next steps for our coders were to decide where the episode begins and ends and to identify the reasons and topics within the episode. As is clear from the examples presented thus far, explanation episodes sometimes consist of single explanations, with a topic, reason, and keyword. In Example 1 mentioned earlier, for example, the topic (or thing to be explained) is “he’s waving goodbye,” the keyword is “cause,” and the reason (sometimes called the *causal antecedent* or the explanation per se) is “they’re gonna go outside.” In Example 2, there are two keywords: “why” and “because,” but just
one topic ("the candle is bad for him") and one reason ("it can make him melt"). Whereas delineating the topic and reason was very easy for these two examples, many of the episodes we identified contained multiple keywords and, hence, multiple explanations. Two specific challenges we faced were identifying reasons and topics in (a) episodes with overlapping explanations and (b) incomplete or ambiguous utterances. We now present some examples to illustrate how our coding scheme helped us decide on the components of these more complex but very realistic explanation episodes.

Many of the episodes we identified have multiple explanations embedded within the same episode. To disentangle overlapping explanations, we defined each explanation as being a topic-reason pair. Coders made judgments about the topics and reasons that were paired with one another. The result is that we have information about each individual explanation as well as about the way they are combined to form explanation episodes. The following example is a complex explanation episode in which a parent explains a scene from the book to her 3-year-old child:

Example 8 (3 years):
Parent: Snowman's afraid of the fire because it's hot. And it'll melt him.
'Cause the snow is like ice, and it'll melt when it gets near hot things.

For coding purposes, we located four explanations within this episode:

1: The snowman is afraid of the fire because it's hot.
2: The snowman is afraid of the fire because it'll melt him.
3: It'll melt him because the snow is like ice.
4: It'll melt him because (the snow) will melt when it gets near hot things.

Part of the complexity in Example 8 comes from the fact that multiple reasons are given for the same topic. For example, "it's hot" and "it'll melt him" are presented as two causes for the snowman's being afraid of the fire. Connectives such as "and" and "but" often helped us to identify multiple reasons as in this example.

Overlapping explanations also resulted when the same phrase served as both a reason for one explanation and as the topic for another. Consider the following example:

Example 9 (3 years, 11 months):
Child: The sun.
Parent: And why is he worried that, when the sun is coming up? Cause what's gonna happen as the sun comes up?
Child: He's gonna melt.
Parent: Uh-oh. So that's why he's scared. So he's, takes off again.
In this example, the phrase “he’s scared” is the topic to be explained in one explanation (“He’s gonna melt so that’s why he’s scared”) and the causal antecedent of another explanation (“He’s scared so he takes off again.”). In addition, the clause “He’s gonna melt” is the reason or causal antecedent of two explanations, paraphrased as: “He’s worried because he’s gonna melt” and “He’s gonna melt so that’s why he’s scared.” In general, our system of identifying topics, reasons, and keywords enabled us to agree on the structure of explanation episodes, even those that were very complex and that contained contributions by both parents and children.

Another challenge in identifying the components of explanations resulted from parents’ and children’s use of ungrammatical speech or partial sentences. Example 10 demonstrates this phenomenon, which is a frequent occurrence in natural speech.

Example 10 (4 years, 11 months):
[Child waves an arm back and forth, then covers face with both arms. Then, C pushes face into Parent’s arm, then sits, looking straight ahead.]

1  P: Is that how people sleep through the night?
2  C: No.
3  P: They don’t?
4  C: Unh-unh.
5  P: Do people change their positions when they sleep during the night, do they roll over sometimes?
6  C: Yeah, cause, cause they don’t, cause when it gets um, um, um, what do you call it, um, uh/
7  P: Morning? Dark?
8  C: Cause, cause when it gets hot on the pillows=
9  P: =Oh.
10 C: And they’re um, they they wanna go on the cold side, and the when it’s hot/
11 P: Mm-hmm.
12 C: On that side, they roll over to the other side.
13 P: Yeah.
14 C: And they keep doing that.
15 P: That’s right. Change your position to get more comfortable?
16 C: Uh-huh.

The keyword “cause” occurs in turns 6 and 8 of this example, but the child’s false starts and hesitations make it quite difficult to discern what constitutes either the topic to be explained or the reasons given. Our coding resulted in one explanation that takes place between turn 5 and turn 16, and that might be summarized as follows: “People change their positions when they sleep because it gets hot on the pillows and they want to go on the cold side in order to get more comfortable.” This explanation is developed over 12 conversational turns, and the content is contributed by both the parent (turns
5 and 15) and the child (turns 6, 8, 10, and 12). Summarizing the conversation as we have done here obviously loses some of the richness of the discourse in which it was constructed. Our collaboration scheme, described later, allows us to preserve part of this richness; in particular, the scheme identifies ways that explanations are jointly produced by both mother and child.

Even for explanations that occur within a single conversational turn, there are sometimes ambiguities in speech that make it difficult to identify topics and reasons. Example 11 is an illustration of this problem:

Example 11 (3 years):
P: Now, it looks like his mom’s giving him a snack, cause she says, “You’re working so hard out there, you need something to eat.”

The explanation in this segment can be paraphrased in a number of ways:

1. His mom’s giving him a snack because he is working so hard out there and needs something to eat.
2. His mom’s giving him a snack because of the act of her saying: “You’re working so hard out there, you need something to eat.”
3. The reason that I (the reader) think that his mom is giving him a snack is that she is saying: “You’re working so hard out there, you need something to eat.”

One problem in deciding how to code this example is that a phrase such as “it looks like” can be seen either as an integral part of the explanation or as a hedge that has a conversational role outside of the explanation’s content. Mental terms are often used in a similarly ambiguous way as in the following example:

Example 12 (3 years):
P: The snowman got scared.
C: Why?
P: Cause I think it was hot. He didn’t wanna get hot.

Is the parent’s thinking central to the snowman’s becoming scared? In this case, we judged that it was not and therefore considered the reason to be “it was hot.” However, if we interpret the child’s “Why?” question as “Why do you think that the snowman got scared?” then the parent’s thoughts become relevant. The decision whether an explanation is about a physical state of the world or about a person’s thoughts and intentions has important theoretical consequences. Several recent arguments focus on children’s relative attention to psychological and physical causes for events (Barbieri et al., 1990; Dunn, 1992; Hood & Bloom, 1979). These examples show that it is not always straightforward to determine whether a particular piece of discourse
emphasizes psychological or physical causes. In many cases, the two kinds of causality are intertwined in parents' and children's explanations.

In general, however, despite the complexity of natural discourse, our coding scheme allowed us to identify the boundaries and components of explanation episodes with a very high level of agreement between teams. We next went on to analyze the structure and content of the explanation episodes.

Assessing Collaborative Structure in Explanation Episodes

Once the explanations were identified, they were then coded along various dimensions that allowed us to explore developmental differences in the ways that explanation episodes are produced. We mention only two such schemes here for illustration. First, we were interested in exploring the relative contributions of parent and child to each explanation episode. Therefore, we coded each episode as a unit in terms of its collaboration structure. Second, we were interested in the mode of explanation expressed by parents and children at different ages. This coding scheme has to do with both the meaning of the explanation and the order in which cause and effect are mentioned. We discuss this scheme in the next section.

In our work, we are particularly interested in the developmental changes in explanation that occur during the preschool years (between 2½ and 5 years) and in how the contributions of parent and child to explanation change during these years. To understand how explanatory skill arises, we must explore interactive discourse between the child and his or her parents. Beyond providing details of the explanations that are produced, videotape data allow us to analyze the collaborative structure of explanation. Many psychological approaches to explanation, such as studies of social attribution judgments, have ignored the interactive nature of explanation (see especially the critiques of Antaki, 1988; Barbieri et al., 1990). Barbieri et al. (1990), in their study of explanations among 3-year-old peers, emphasize the interactivity of explanation, arguing that "If we want to understand the early origins of explanations we need to study them not for what they say about children's cognitive processes, but for their use and function in interaction." (p. 270). Although we are in strong agreement that the social aspects of explanation are crucial, we remain sanguine about the cognitive importance of explanations. In our view, explanations may serve a number of functions, including regulatory functions, information-giving functions, and conversational functions. Following Vygotsky (1978; see also Bruner, 1983; Cole, 1985; Rogoff, 1990; Tharp & Gallimore, 1988; Wertsch, 1985), we see cognition as developing hand-in-hand with social functioning. Rather than excluding one or the other, our goal is to study their interdependence.

Social context approaches to development emphasize the role of parents
and other adult members of the community in children's learning, following Vygotsky's (1978) notions about how meaning is constructed within social situations. This literature led us to predict a transfer of responsibility pattern by which children's contributions to explanatory conversations would increase as parents' contributions decreased (Rogoff, 1990). For example, we predicted that parents of younger children would be more likely to ask questions to draw children into the explanation process, whereas older children would contribute to explanations on their own without parents' prompting.

The collaboration scheme allowed us to preserve information about how the explanation was constructed in discourse by coding each episode in terms of how the episode began (with a question or a statement), who initiated the episode (parent or child), and who completed the episode (parent, child, or joint). Interrater reliability by Cohen's kappa (Cohen, 1960) was .84 for how the episode was initiated, .88 for who initiated the episode, and .86 for who completed the episode; the kappa statistic is a preferred measure of interrater agreement because it takes chance agreements into account (Bakeman & Gottman, 1986). This coding scheme and the results of its analysis are discussed in detail in Callanan and Shrager (1993).

Contrary to our predictions about transfer of responsibility, our results show that the most common type of explanation episodes were those that were both initiated and completed by parents. Most of the parent-initiated explanations began with statements regardless of the age of the child. Children's participation in explanation episodes did, however, change as a function of age. Although children produced very few complete explanations (i.e., both initiated and completed by the child), they did participate in joint episodes, and more importantly, children of different ages participated in explanation episodes in different ways. When 3-year-olds initiated explanation episodes, it was most often with single-word "why" questions. However, 4- and 5-year-olds were likely to initiate episodes with causal statements as well as questions. Although we do not have precise measures of children's understanding of explanations at different ages, we take children's participation in explanatory discourse with their parents as evidence for their understanding and skill (Dunn, 1992). Thus, despite the fact that parents are not "fine-tuning" their contributions to children's age level, children's contributions indicate increased sophistication with age. One possible explanation for this pattern of results is that parents' complete models of explanations may provide enough information for children to learn to produce and understand explanations. In other words, parents may not need to provide conscious guidance or to deliberately fine-tune their speech to their child's level. Instead, children may learn merely by observing and participating in the adult community of practice. This is consistent with several studies of apprenticeship learning in adults, such as Lave and Wenger's (1991) study on tailors and Jordan's (1989) work on traditional midwives. In future work we hope to explore this analogy in more depth.
Parents' and Children's Expressions of Different Types of Causality

Finally, we were interested in the modes of causality expressed in children's and parents' explanations. What counts as an explanation is partly a matter of socialization into a culture or community of practice (Hood, Fiess, & Aron, 1982). Kuhn (1977) and Gould (1983) point out, for example, that there have been shifts throughout the history of Western science in terms of which of Aristotle's modes of explanation are considered appropriate. Aristotle claimed that any event has four different causes: efficient causes, which are the immediate prior causes (the action of the sculptor causes a statue to come to exist); material causes, which involve the substance of the thing to be explained (the marble is the material cause of a statue); formal causes (the plan for the finished statue); and final causes, or purposes (the statue results in an increased number of beautiful objects in Greece). Kuhn and Gould characterize modern Western science as focusing on formal causes (or laws) and efficient causes. Final cause or purpose was once thought to be equally important, but came into disrepute as a scientific mode of explanation in the 17th century. In everyday language, however, purposes are often mentioned as reasons for events (e.g., "Madeline is in the hospital so she can get her appendix out"). Despite the preferences of modern scientists, we know little about which modes of explanation children and parents use in forming collaborative explanations, or about how preferences for different modes develop.

The three modes of explanation that we coded in our study partially overlap with Aristotle's modes: (a) Prior cause explanations, which are those in which an event or state of the world is explained as causing another event or state to occur, are very similar to Aristotle's efficient cause. An example would be "The snowman doesn't like the fire because it's hot." (b) Purpose explanations, which are those in which an event is explained in terms of other events that causally follow from it, are very similar to Aristotle's final cause. An example would be "He's eating fast so he can go back outside and play." (c) Interpretive explanations are those in which an explanation is given in terms of the speaker's decision-making process. An example would be "It's morning because there's the sun" (i.e., The reason that I think it's morning is that I can see the sun coming up). Our interpretive explanations do not map onto Aristotle's scheme, but they are related to the other two modes in interesting ways. In early research on children's understanding of causality, some researchers suggested that preschoolers could not distinguish cause and effect and that they confuse the order of cause and effect in speech. Piaget (1928), for example, found that preschool children asked to complete the sentence "The man fell off his bicycle because...," were likely to answer with a consequence ("he broke his arm") rather than with a cause ("he ran into a tree"). Rather than being confused, however, we believe that these children may have been giving another kind of explanation (see also
Donaldson, 1986). Rather than explaining the cause of the boy's fall, they may have been explaining the evidence they used to infer that he must have fallen. In our terminology, this is an interpretive explanation rather than the prior cause type of explanation that Piaget had expected. Little is known about how children learn to distinguish these different modes of explanation as they hear them used in conversation. It is particularly interesting to ask how these different modes are expressed in causal language and whether children have any difficulty learning to identify particular modes.

As Donaldson (1986) and Hood and Bloom (1979) have pointed out, the order of cause and effect varies depending on the type of sentence being produced. Causal statements with "because" are expressed in an effect-cause order ("I'm happy because it's a beautiful day"), but causal statements with "so" often have a cause-effect order ("He's late so he's racing down the street"). Both of these kinds of causal statements reflect the prior cause mode of causality. If we were to consider only the prior cause mode, we might predict that children should learn the correct order of cause and effect (or topic and reason) by noticing the correlation between clause order and connective in parents' speech (because = effect-cause; so = cause-effect). However, this correlation does not hold up well for the other two modes of explanation; one violates the correlation between clause order and connective, and the other gives a reason for an interpretation rather than for the event that is mentioned. First, in the "purposive" mode of causality, "so" appears with effect-cause order, as in "He's running so he can catch the bus." Second, in the "interpretive" mode, although the effect-cause (or topic-reason) order is the same as in prior cause explanations, the meaning of the relation is quite different. For example, in "It must be nighttime because he's putting on his pajamas," putting on pajamas cannot literally cause it to be nighttime, but we can know it's nighttime because the boy is putting on his pajamas (see Draper's, 1988, warrant for belief and Donaldson's, 1986, deductive explanation).

If children hear all three modes of explanation in parents' speech, the important point is that the keywords themselves cannot be clues about the order of the clauses or the mode of explanation expressed. In exploring the use of these modes of explanation in conversation, we do not mean to imply that children or parents recognize the different modes. Our question, instead, is about how children can learn about explanation by listening to adult speech. Both "because" and "so" can be used with different modes of explanation, so even if young children can identify the causal keywords, it could be very difficult for them to pick out the cause and the effect from the stream of speech. Further, "why" questions can be answered with any of the three modes. For example, "Why is it snowing?" could be responded to by saying "Because there was moisture in the clouds" (prior cause), "So the boy can build a snowman" (purposive), or "Because it's all white on the ground" (interpretive). The data on how often the different modes are used by parents and children could, however, help resolve the problem of how children deal
with this complexity. If it turns out, for example, that parents and children limit their causal explanations to one of these modes (at least at the time when children are just learning to produce explanations), then the task could be significantly simplified for the child.

Interrater reliability was assessed by having two teams of coders code 25% of the transcripts; Cohen’s kappa was .92 for this coding scheme. We now discuss some of the difficulty in categorizing explanations into the three modes and then report on some of the results of this coding scheme.

Categorizing prior-cause, purposive, and interpretive explanations. Our coders faced several difficulties in distinguishing among the different types of explanations. Although we do not claim that parents and children are conscious of these distinctions, we do believe that their use of the different explanation types suggests implicit understanding of how cause and effect relations can be expressed in language.

The distinction between purposive and prior cause explanations that contain the word “so” is usually straightforward. For example, consider the following examples:

Example 13 (2 years, 9 months):
P: He’s taking the snowman to the store to a big freezer so the snowman can get in and he won’t melt.

Example 14 (3 years):
P: The punching ball hit him so he got hurt a little bit and the boy’s helping him.

As mentioned earlier, in purposive explanations, “so” can usually be paraphrased as “in order that” or “so that.” In prior cause explanations, “so” can usually be paraphrased as “therefore.” In Example 13, then, the “so” is purposive, because the explanation can be paraphrased as “He’s taking the snowman to the store to a big freezer in order that the snowman can get in and he won’t melt.” In Example 14, the “so” is causal, because it can be paraphrased as “The punching ball hit him, therefore, he got hurt a little bit and the boy’s helping him.” In most cases this distinction is quite clear. There are some cases that are ambiguous, however. Consider this explanation:

Example 15 (3 years, 11 months):
P: Mm-hmm. They blew up some balloons and they’re, they’re throwing them into the flashlight so they look pretty in the light.

This could be summarized as: “They’re throwing the balloons into the flashlight so that they will look pretty” (purposive), or “they’re throwing the balloons into the flashlight, and therefore they look pretty” (prior cause).
this particular case, our coders relied on intonation cues as well as the plausibility of the two interpretations and judged that this example should be coded as a purposive explanation.

Interpretive explanations are interesting in that their structure is so similar to prior cause explanations, but the content is quite different. Donaldson (1986) calls these deductive explanations and argues that they can be thought of as answers to the question “How do you know ...?”, as in this example:

Example 16 (4 years, 9 months):
C: How do you know it’s Daddy’s teeth? (false teeth in a container of water)
P: Well, cause this is Daddy’s room.

The following three examples are also interpretive explanations.

Example 17 (3 years):
P: It’s probably dark out, huh, because he’s getting ready for bed.

Example 18 (2 years, 11 months):
P: He melted, see that was what the snowman used to be, there. Cause you can see his hat.

Example 19 (3 years):
P: Which door is this? Oh, it’s the kitchen. Cause there’s a stove and some jars.

These parents are giving reasons for their interpretations of what is happening, not causes for the events themselves. The fact that you can see his hat in Example 18, for example, is not likely to literally be a cause for the snowman’s melting. Despite its form, Example 17 is not a sensible answer to the question “Why is it dark out?”, but it is an answer to the question “How do you know it’s dark out?”. Donaldson (1986) argues that these explanations may account for some reports that young children invert cause and effect. If Example 17 were taken out of context, for example, you might think that the speaker has confused the direction of cause and effect and intended to say “He’s getting ready for bed because it’s getting dark out.” Taken in context, however, it is clear that this parent is explaining the inference that night is coming on in the story, with evidence from the boy’s pictured actions.

Modes of causality in children’s and parents’ explanations. Our preliminary analysis of the use of prior cause, purposive, and interpretive explanations indicates that the predominant mode used by parents and children is prior cause. On average, over 80% of the explanations at all three ages were coded as prior cause, whereas roughly 5% were purposive and
1% were interpretive. These data suggest that, in line with the preferences of modern scientists, modern parents and children favor something akin to Aristotle's efficient cause in the explanations they produce. Perhaps, then, children do have a simpler data base of explanation types with which to work. With mainly prior cause explanations, children may learn the typical association between clause order and connective type and use this to begin to understand how causal relations can be expressed in language. In fact, Hood and Bloom's (1979) data with 2-year-olds suggest that, despite some early systematic errors, children quickly learn to produce "because" statements in effect-cause order and "so" statements in cause-effect order.

Because of our interest in how children come to understand and produce different kinds of explanations, we asked whether the percentages changed as a function of children's age. When we looked at parents' explanations separately, we found that prior cause explanations seemed to decrease with children's age. Prior cause explanations were 88%, 79%, and 67% of the parents' explanations to 3-, 4-, and 5-year-olds, respectively. At the same time, parents' purposive and interpretive explanations increased with the age of the child. The average percentage of purposive explanations increased from 3% for parents of 3-year-olds to roughly 10% for parents of 4- and 5-year-olds. The average percentage of interpretive explanations was 10% for parents of 3-year-olds, 11% for parents of 4-year-olds, and 23% for parents of 5-year-olds. By comparison, the percentage of children's explanations and joint explanations did not change in these ways; jointly constructed purposive and interpretive explanations were rare at all ages. Only a few children constructed their own complete explanations (a 3-year-old, three 4-year-olds, and five 5-year-olds); among these, only two children produced purposive explanations, and two children produced interpretive explanations.

These preliminary results suggest a developmental pattern in which children are exposed to a greater variety of types of explanations as they get older. Our data also suggest that purposive and interpretive explanations may appear relatively late in development. There are some relevant data in the literature, and in general these data are consistent with our suggestion about interpretive explanations but inconsistent with our suggestion about purposive explanations. With regard to interpretive explanations, Donaldson (1986) found that even children as old as 5, 8, and 10 years continued to have difficulty when asked to produce interpretive explanations. With regard to purposive explanations, however, Hood and Bloom (1979) found that seven of the eight toddlers they studied used "so" to mean "so that" prior to using "so" to mean "therefore." Further research, especially studies that track the same families over a period of years, should shed light on these issues.
CONCLUSIONS

Explanation is recognized as important to the study of both adults’ and children’s cognition. In our work we are attempting to characterize the nature of explanations that appear in everyday parent–child discourse, both as a description of what children and parents are producing at different ages, and as a way to analyze the situations in which children learn about explanation in everyday life. As we have collected, coded, and analyzed these data, we have encountered many methodological challenges, some of which we have described in this article.

We have discussed some of the complexity of identifying explanations from the everyday stream of speech, as well as the methodological tools we have used to be able to capture some aspects of this complexity in our coding schemes. Many of the decisions we have made in this research could not have been made prior to collecting the data and looking at the videotapes and transcripts; this is because we did not know the range of phenomena until we saw the discourse unfold. Decisions about using keywords, about how to draw boundaries around explanations, and about which parts of the discourse are intended to be causally related were made as part of the process of developing our scheme for identifying explanations. Decisions about whether a particularly difficult “so” is noncausal, prior causal, or purposive grew out of discussions about difficult cases among the members of the coding team. We used several kinds of cues in this process, including aspects of the storybook context and the intonations of the speakers. The process of developing a reliable coding scheme is long and painstaking, as anyone who codes discourse knows (see Bakeman & Gottman, 1986), but it is a part of the research process that is often left out of journal reports. One goal of this article was to provide some detail about this process, some challenges we faced, and some possible ways to resolve them.

A few words might be said about our choice of videotaped recording as a basic methodology for studying parent–child conversations. There are well-known limitations to this technique that cannot be resolved here. In particular, it is difficult to choose situations to videotape that can be shown to be representative of everyday behavior, and it is difficult to know the impact of the camera on the behavior of the subjects (but see Jordan & Henderson, 1995). However, there are distinct advantages of videotape over other kinds of observational recording that we would argue outweigh the possible problems. In judging the meaning of explanations, we often found it essential to use recordings of intonation, facial expressions, and gestures. Merely understanding what the youngest children were saying was also often aided by using the video image. Because none of this information would have been available from transcripts alone or from audiotape recordings, we find videotape recording to be preferable.
As we have mentioned in several parts of this article, we see an interesting analogy between the task of the researcher who tries to identify and analyze explanations in discourse and the task of the child who learns about explanations through social interaction and conversation. We must quickly point out that we of course do not mean to suggest that children are consciously and analytically looking for explanations in the way that our coders do. Rather, it is possible that the challenges we have encountered in identifying explanations and in categorizing them one way or another may reflect distinctions that children must work out at some level. Even though we have included in our initial analysis only those explanations that are marked by causal connectives, there are many distinctions in these data to which children must become attuned. Some of the cues by which we were able to obtain reliability in identifying causal explanations might be also utilized by children in determining what parts of the discourse are causal, and the problem cases that we encountered may tell us a great deal about what children must learn about explanation.

There is, of course, much more complexity to explanation than we have uncovered here. In future work we hope to pursue the analysis of explanations that are not marked by keywords and to look at developmental changes in the explanations that occur in the same dyad over time. In addition, we plan to analyze explanations that occur in different settings and with different family populations. The book-reading setting may elicit different types of explanations than would other settings (Eisenberg, 1991; Nelson, 1985; Rogoff, 1990). We have videotaped the same families while engaging in a cooking task (see Shrager & Callanan, 1991), and we are conducting an analysis of the explanations produced in that setting. White, middle-class, U.S. families may also engage in different kinds of explanations than families of other socioeconomic groups, ethnicities, and cultures (Eisenberg, 1991; Laosa & Henderson, 1991; Rogoff, 1990; Sigel, Stinson, & Flaughter, 1991). Before a complete theory of children's explanations can be developed, we must look at explanatory discourse in a wide range of activities and family settings.

In his discussion of everyday explanation, Draper (1988) expressed pessimism about the analysis of explanations in contexts such as ours. We close by responding to his concerns. First, he argues that keyword counts miss a significant number of explanations. We do not disagree with him here, but we have taken the approach of trying to understand the structure of those explanations that contain keywords as a first step. In fact, our data have borne out the more subtle point that Draper makes about keywords: There is no easy connection between a particular keyword and a particular type of explanation. Second, Draper is pessimistic about whether it is possible or helpful to obtain true reliability in identifying and analyzing explanations. We are more optimistic. It is our experience that coders often agree on the meaning of language in context provided they have enough information about the context. The reason for this is that coders are also members of the
language community and are able to understand explanations in everyday conversation. Using a coding scheme does not imply that there is only one way to interpret an explanation; there will always be disagreements and unclear cases. But there are also conventional ways to use language to express ideas.

This brings us to a final point. Draper (1988) argues that it is very difficult for researchers to understand explanations in which the participants (the parent and child in our case) know one another better than the experimenter knows either of them. He suggests that even if raters agree on an interpretation for an explanation, it is not necessarily the one that was meant by the speaker. It is our experience as coders of explanation that there are indeed many possible meanings for some explanations. It may well be that the child is better able than we are to choose the intended meaning of their parent's explanation. However, the participants in an explanation do not have direct access to one another's intentions, only to what is said. We are interested in how children come to learn and use the conventional ways of talking that are accepted by their community. A crucial component of this approach is to see whether the explanations that arise in discourse can be unpacked and understood by someone who does not yet share a great deal of common knowledge with the parent, as is the case for both child and coder. We believe that analysis of the categories of explanations, as well as the boundary cases, will allow us to explore patterns of parent–child discourse and to lay the foundation for a theory of how young children's knowledge of explanation develops within social context.

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