

# A Descriptive Model of Question Asking During Story Acquisition Interviews

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## Abstract

In this paper, we provide a taxonomy of the processes which people use to generate questions for a type of interviewing task. Specifically, we analyze "story acquisition interviews" in which the interviewer is a knowledge engineer who asks questions of a domain expert to acquire material for a conversational hypermedia system. Such interviews have proven to be surprisingly difficult to conduct successfully. We have identified a number of "local" strategies which successful interviewers use to develop coherent, interesting sequences of questions and we have positioned these strategies within a model which describes the global interviewing process. This descriptive model is an initial step towards a methodology prescribing how to perform these interviews effectively.

## Introduction

It has been argued (Chafe, 79; Schank, 77) that conversational coherence is a function of memory organization. That is, how information is connected in memory determines the course of what a person will say in a conversation. This presupposes that as information is acquired, it is organized in memory relative to other pieces of information whose content it elaborates. A connection is likely to be made if a new piece of information answers an important question raised by an existing piece.

Our research is concerned with the practical construction of such memories, in hypermedia form, for use as knowledge-rich aids to problem solving. The organization of our ASK Systems (Ferguson, et al, 1992) represents an attempt to replicate (aspects of) the organization of an expert's memory that might underlie a coherent conversation about complex problem solving. At the Institute for the Learning Sciences, we have built a series of ASK systems in domains as diverse as trust bank consulting, industrial development, recent American history, and social services for Mexican immigrants. Their goal is to enable users to ask and get answers to their questions as they arise and to interact with their users in a way which realizes the most important benefits of a conversation with an expert mentor.

Building ASK Systems enables us to study the mechanics of how human memory might acquire and index information. The problem of acquiring new information has two components: how to determine which information to

acquire next and how to index new information once it is acquired. In constructing ASK systems, we use interviewing to acquire cases and human indexers to index them. The indexing process has been reported on elsewhere (Bareiss & Osgood, 93). Here we discuss the problem of how to choose which cases to try to acquire.

This problem is particularly important for those who build hypermedia KBSs. Because such systems are not autonomous, they cannot be run directly on sample problems to check whether they contain the "right" knowledge. Consequently those who practice this kind of informal knowledge capture (e.g., in hypermedia) must be especially concerned with whether they have asked the right questions during knowledge acquisition.

To gather the knowledge which ASK systems require, we interview "storytellers" (i.e., domain experts) and videotape their answers. When performing these interviews, we must anticipate the topics and courses of conversation that will interest users. How well we do this largely determines the quality and utility of the resulting ASK system. Running a successful interview is difficult. Successful interviewers typically know a substantial amount about both the subject matter under discussion and the process of interviewing itself. During the interview, they need to manage multiple simultaneous demands including tracking the structure of the interview, brainstorming for fruitful avenues to pursue, and maintaining their relationship with the interviewee. Unfortunately, we have discovered that most interviewers find it difficult to consistently conduct interviews successfully.

We have undertaken an analysis of successful story acquisition interviews so that we may better understand, teach, and improve the process of building ASK systems. Our first step has been to examine which types of topics are discussed in these interviews, which questions interviewers ask about them, and what strategies interviewers use to generate good questions. To date, we have analyzed over 20 hours of interviews, comprising over 500 question-answer cycles. Our eventual goal is to understand the interviewing process well enough to build a prescriptive model of how to perform story acquisition interviews.

This paper summarizes our taxonomy of interviewing strategies in the context of a single, illustrative interview.<sup>1</sup>

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<sup>1</sup> Other researchers have studied question-asking (Lehnert, 1978; Graesser et al, 1991; Kass, 1991). These researchers have

This interview was performed for the Trans-ASK system, which captures the experience of officers responsible for planning and coordinating military transportation during Desert Shield and Desert Storm (D/S/S) (Bareiss and Osgood, 93). Trans-ASK contains over 21 hours of video segmented into short clips which provide answers to over 12,000 questions. The storyteller was a Division Transportation Officer in the US Army during D/S/S. Prior to the interview, he knew little more than that he was to be questioned about transportation planning during D/S/S. The interviewer had significant experience in performing story-acquisition interviews and, though not a practitioner in the target domain, was familiar with it and had performed approximately ten prior interviews in it. The interviewer knew little more about the storyteller than that he was a Division Transportation Officer and so would speak from the perspective of someone who was a "customer" of the transportation planners.

The interviewer asked 40 questions during this interview, which lasted just under two hours. Below we analyze the first 11 questions. These questions, being early in the interview, are somewhat more general and less technical than those that followed. We will present these questions in 6 sections, each of which introduces and describes one or more distinct interviewing processes. These processes are sufficient to account not only for how the interviewer generates the rest of the questions in this interview, but also for how other interviewers generated questions in a range of other interviews we have studied.

## 2. Processes for Generating Questions

### 2.1. Jump-starting

**Jump-starting** is the process of introducing previously unmentioned topics into the interview. Jump-starting is a common process in story acquisition interviews. In a sample of over 100 questions, about 40% were jump-start questions.

#	Question Text	Synopsis of Answer
1	Tell me about your military career.	The storyteller gives a brief chronology
2	What did you do during D/S/S?	I served as a Division Transportation Officer

In this interview, the interviewer opens with a standard jump-starting ploy — he invites the storyteller to summarize his career. The question serves two important purposes: it gives the interviewer some background to work with, and it gives the storyteller an easy topic with which to begin. The interviewer uses another standard ploy in the second question — he asks about the storyteller's involvement in the event around which the ASK system is being constructed. Both of these questions are particularly appropriate given that the interviewer knows little about the storyteller at this point.

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focused primarily on what questions people ask, not on strategies for selecting which question to ask next.

Experienced interviewers have a repertoire of standard tactics for jump-starting which they are able to adapt to a variety of interviews. Some of these are domain independent, as these typical jump-starting questions show:

- "What questions do you frequently get asked?"
- "What are your job responsibilities?"
- "Who are your primary contacts when you perform the task we are discussing?"

Other jump-starts require specific domain knowledge which interviewers gather as they learn more about the system they are building. Interviewers commonly maintain two lists across interviews: one for specific events (for example, the decision during D/S/S to rush Thanksgiving turkeys to soldiers in Saudi Arabia) and the other for specific issues (for example, how a transportation planner can get accurate information about what material needs to be moved). These lists provide specific, proven "cached questions" which the interviewer can tap simply by taking them off of the list. For interviews late in the process, most of the conversation can profitably be filled by addressing such questions.

### 2.2. Link traversal and mining

**Link traversal** is the process of starting with a base topic and selecting a single, closely-related follow-up topic. Like jump-starting, link traversal is a common process in story acquisition interviews. In the corpus of questions we analyzed, another 40% were link traversal questions.<sup>2</sup>

#	Question Text	Synopsis of Answer
3	As D/S/S unfolded, how did it look from your point-of-view?	When it began it was business as usual. We were on training exercises.
4	What changed when Saddam invaded?	We went on deployment status. What had previously been a paper game was taken more seriously.
5	Could you give me more detail?	We didn't have time to plan
6	What were differences with previous exercises?	No time to react. The planning was mission-driven, not cost-driven.
7	What problems did you have?	Getting information. Knowing what scenario to plan for.

Here, the interviewer asks a series of link traversal questions off of a fixed base topic. With the exception of

<sup>2</sup> Approximately 20% of questions were neither jump-start nor link traversal questions. These questions were split between repeat questions (which asked about the previous topic again) and agenda questions (which were about the *structure* of the interview rather than its *content* per se. The interviewer typically used agenda questions to get the story-teller's opinion about whether a topic was worth pursuing). There were also a few questions which did not fall neatly into any of these categories.

Question 5, each of the questions in this series would make sense as an immediate follow-up to Question 2 (“What did you do during D/S/S?”). This process of repeatedly mining a fixed base topic is central to story acquisition interviews for two reasons. First, as these questions demonstrate, mining often leads the storyteller to relate interesting responses. Second, mining gathers the linked knowledge required to build an ASK system.

In successful ASK systems, the user can find the question that is currently on his or her mind in the questions the system offers. However, the system cannot offer these questions unless it has answers to them. Hence, the interviewer must be able to anticipate, on the fly, which questions users may have about a topic. Mining provides a method for generating these questions.

It is difficult for interviewers to systematically mine a topic. While most people can generate a few follow-up questions which make sense at a given point in conversation, few can reliably bring to mind a broad range of possible link traversal questions. ASK systems are based on a model of conversational coherence which provides interviewers with a framework for mining. This model assumes that there are only a few general categories of follow-up information that represent natural continuations of the conversation rather than a major topic shift (Bareiss & Osgood, 93; Schank, 77). The “Conversational Associative Categories” (CACs) employed in Trans-ASK are:

- Context: the big picture within which a piece of information fits.
- Specifics: an example of a general principle or details of a situation.
- Causes/Earlier Events: how a situation developed.
- Results/Later Events: the outcome of a situation.
- Analogies: similar situations from other contexts or from the experiences of other experts
- Alternatives: different approaches to take in a situation or different expert opinions.
- Opportunities: advice about things to capitalize on in a situation.
- Warnings: advice about things that can go wrong.

These eight categories provide a guide to the kinds of questions that a user is likely to raise when viewing a clip. To thoroughly mine a topic, interviewers often review the CACs mentally, thinking about whether they should ask a specific question about the current topic from the perspective of each one.<sup>3</sup>

### 2.3. Chaining

Interviewers employ a number of strategies to follow-up on an answer. In Question 5 above, the interview simply asks the storyteller to talk more. Most follow-up strategies are more sophisticated. Chaining is the strategy of following

<sup>3</sup> Several early interviews were performed by teams in which each member had the responsibility of generating questions for a particular CAC. We discontinued this practice because the presence of sizable interviewing teams tended to make storytellers nervous.

up on the storyteller’s answers by using link traversal questions.

#	Question Text	Synopsis of Answer
8	How did you get your questions answered?	We used the Good Old Boy Network (GOBN), then verified through formal channels

One could imagine that the interviewer came to this interview prepared with an agenda which listed the previous section’s questions in order. Even Question 5, which is a follow-up, could have been on this agenda since it is so generic.

Question 8 is different. In asking it, the interviewer has adopted part of the storyteller’s answer to Question 7 as his base topic – the problems storyteller experienced in getting information. Like the questions in the previous set (with the exception of Question 5), Question 8 is a link traversal question like those in the previous set. However, it does not maintain the interviewer’s previous focus on a fixed base topic. Chaining places a requirement on the interviewer that jump-starting and mining do not — it requires that the interviewer actually understand and respond to the details of the storyteller’s responses. To ask the eighth question, the interviewer must weigh what they storyteller said, decide that obtaining information was an important problem, and generate a link traversal question on the fly.

### 2.4. Proposing possibilities

Proposing possibilities is the process of devising specific probes for the storyteller either by making assertions or by inserting potential answers into general questions.

#	Question Text	Synopsis of Answer
9	Why didn't you use JOPES to answer your questions?	We did not have access to it.

Consider the relationship between Question 8 and Question 9. Question 8 is general. The interviewer makes Question 9 more specific by incorporating into it one possible answer to Question 8, specifically JOPES, a known means of obtaining military planning information.

Question 9 requires the interviewer to have significant domain knowledge. At the time he asked this question, the interviewer believed that the JOPES (the centralized information system for joint military planning) provided a universally accessible repository of information for creating and executing transportation plans. When he asked Question 8, the interviewer expected the storyteller to mention JOPES. Because he did not, the interviewer specifically asked about it, essentially telling the storyteller what he had expected. Though a powerful technique, proposing possibilities is difficult because it requires the interviewer to have extensive knowledge and usually this knowledge must be specific to the storyteller’s domain.

Proposing specific possibilities is important to successful interviews because it helps compensate for a weakness in

how people remember their experiences. People often find it difficult to remember specific events or details in response to general questions. So, storytellers often find it difficult to recall interesting first-person experiences when asked high-level, open-ended questions like “What problems did you face?” They give better answers when prompted with more specific questions such as “Did you have problems finding out when your planes were scheduled to arrive because the people who were supposed to tell you did not know themselves?”

Interviewers need not always phrase their probes as questions, nor do need they “tell the truth.” Successful interviewers sometimes get lively responses by simply asserting hypothetically that the storyteller must have acted in some particular way in some situation (i.e., “So, at that point, you must have called your commander.”). Interviewers also find it valuable to propose possible misconceptions that they believe users of the ASK system might have. This last form of proposing possibilities is extremely knowledge intensive, requiring the interviewer to know not only the domain, but also characteristics of the intended users of the system.<sup>4</sup>

## 2.5. Recognizing hotspots

**Recognizing hotspots** is the process of using knowledge to determine whether the current topic bears special interest.

#	Question Text	Synopsis of Answer
10	Who in the user's organization does see JOPES?	The corps level and above.

One common way that an interviewer determines a topic is interesting is by having an expectation failure (Schank, 82). The interviewer asks Question 10 because he is surprised by the storyteller's response to Question 9. Up to this point, he believed that JOPES was universally used by everyone involved in military transportation. This turned out to be false. Expectation failures are a sign that a topic is worth pursuing, particularly if the target user of the system will have a level of knowledge comparable to the interviewer. What surprises the interviewer will often surprise the end user as well.

Expectation failures are not the only way that interviewers determine that a topic is interesting, but the other ways are similarly dependent on the interviewer being knowledgeable. Interviewers find meta-knowledge about the targeted users and purpose of the end system particularly useful in determining interestingness. For example, knowing that Trans-ASK's users had graduated from joint officers training school, the Trans-ASK interviewers knew not to dwell on explaining terminology or the military's organizational structure. However, knowing that the users would almost certainly be new to military transportation and hence would need to quickly form organizational ties, the interviewers did ask storytellers to focus on this process.

<sup>4</sup> Good interviewers often strive to “play-act” the end user, adopting their goals and level of sophistication.

## 2.6. Backtracking

**Backtracking** is the simplest of the processes we describe. It is the process of returning to a topic previously discussed.

#	Question Text	Synopsis of Answer
11	What information did you get from your command, and what did you go outside for?	Command — operational data, Outside — supporting data.

Here, the interviewer has decided that Question 10 represents sufficient discussion of JOPES with this storyteller (who actually did not use it). So, he closes that topic and backtracks to the previously active topic — how to get information.

Backtracking plays a central role in story acquisition interviews because conversations tend to proceed depth-first. When an interesting subtopic is introduced, it is natural to chain to it even if the parent topic is not exhausted. It would seem odd in a conversation to put interesting subtopics “on the shelf” until the parent topic is thoroughly investigated. However, interviewers often have difficulty managing the process of backtracking because it is memory-intensive. In our analyses of interviews, we have noticed that even experienced interviewers often forget to return to promising parent topics when the discussion of subtopics grows lengthy.

## 2.7 Gambit-walking

While our analysis has described how interviewers generate individual questions, it has so far ignored the global structure of the interview. We propose that interviewers use **conversational gambits** to structure their interviews and to determine the order in which they ask questions. Conversational gambits are organizational structures that indicate how to string together a series of questions to pursue a specified lead question in more depth. They may be thought of as sketchy plans for how to pursue pieces of an interview. Gambits may be nested so that one gambit provides an interview's overall structure and another gambit determines the treatment of some topic within it.

One common gambit involves mapping over the elements in a structured set of topics. For example, in an interview for Taxops (a system built at ILS to capture the expertise of tax accountants (Slator & Riesbeck, 91)), the interviewer organized the conversation around the progression of projects in the storyteller's career. A second common gambit is based on setting up, enacting, and evaluating a role-playing exercise. In several interviews for Trans-ASK, the interviewer adopted the role of someone who depended on the storyteller's services. In other interviews we studied, interviewers have played roles such as manager, competitor, and assistant.

The current interview involved only two gambits. One provided the top-level organization for the interview as a whole:<sup>5</sup>

- Lead Question: What does the storyteller have to say?
- Subquestions:
  - What is the storyteller's background?
  - What was the storyteller's experience during the event of note?
  - What is the storyteller's opinion of questions which remain open from previous interviews?
  - What does the storyteller have to say in wrapping up?

The second gambit provided a method for elaborating the first gambit, specifically its second element — asking about the storyteller's experience during D/S/S. This more specific gambit covered a significant portion of the interview, spanning all 11 of the questions analyzed above. It consisted of three components:

- Lead Question: What was the storyteller's experience during the event of note?
- Subquestions:
  - What was the storyteller's job?
  - What problems did the storyteller face doing his job?
  - How did the storyteller handle these problems?

Different gambits require different knowledge from the interviewer. Some do not require much knowledge at all, such as when an interviewer asks for a chronology of projects then walks through it project by project. Others require domain-independent process knowledge. For example, an interviewer might classify one of the storyteller's responsibilities as a diagnostic task and use a generic model of diagnosis to structure his questions (cf. Wielinga et al, 92).<sup>6</sup> Yet others might require significant, specific domain knowledge, such as when the interviewer organizes his questions around his knowledge of the specific problems encountered by other groups when they interact with the storyteller's organization.

## 2.8. Wrapping up: The meta-process of strategy formulation

Our analysis has introduced a number of different interviewing processes which operate at different levels. Figure 1 summarizes the overall organization of these processes, showing how each nests within the global decision process an interviewer uses to choose his or her next question. This global process consists of three stages:

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<sup>5</sup> This elements of this structure can be seen by looking at the flow of questions of the complete interview.

<sup>6</sup> We found that "standard" abstract models are not always helpful. Before beginning our interviews for the Trans-ASK system, we learned a formal, abstract model of the Crisis Action Planning process which was developed by experts. During interviews, however, practitioners could not relate what they actually did day-to-day to the formal model.

the interviewer selects a new gambit or continues with the current one, then selects a topic about which to formulate a question, and finally formulates a question. By "formulating a question," we specifically mean the process of constructing an interview question that the interviewer wishes to ask of the storyteller.

These processes require differing levels of three resources from the interviewer: domain knowledge, interviewing strategies, and short-term memory to keep track of the details of suspended topics. Novice interviewers in new domains are at an obvious disadvantage. They are "along for the ride," going where the storyteller takes them. They lack the interviewing strategies to guide the conversation through paths that typically produce good results and often the domain knowledge to focus on topics that are likely to be central in the ASK system. Expert interviewers, even when in a new domain, are less at the mercy of the storyteller and can often draw useful information from storytellers who may not have the perspective or the patience to deal with a novice.

By enumerating the strategies expert interviewers use, we hope to improve the quality of the interviewing process.<sup>7</sup> Starting with the descriptive model proposed here, our goal is to formalize an interviewing methodology. Our next step will be to extend the model to encompass how successful interviewers choose when to apply particular interviewing strategies.

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<sup>7</sup> We have also used the taxonomy of strategies presented here as the basis for a prototype "Interviewer's Assistant," a computer program which helps interviewers manage the flow of the interview and suggests questions for them to ask.

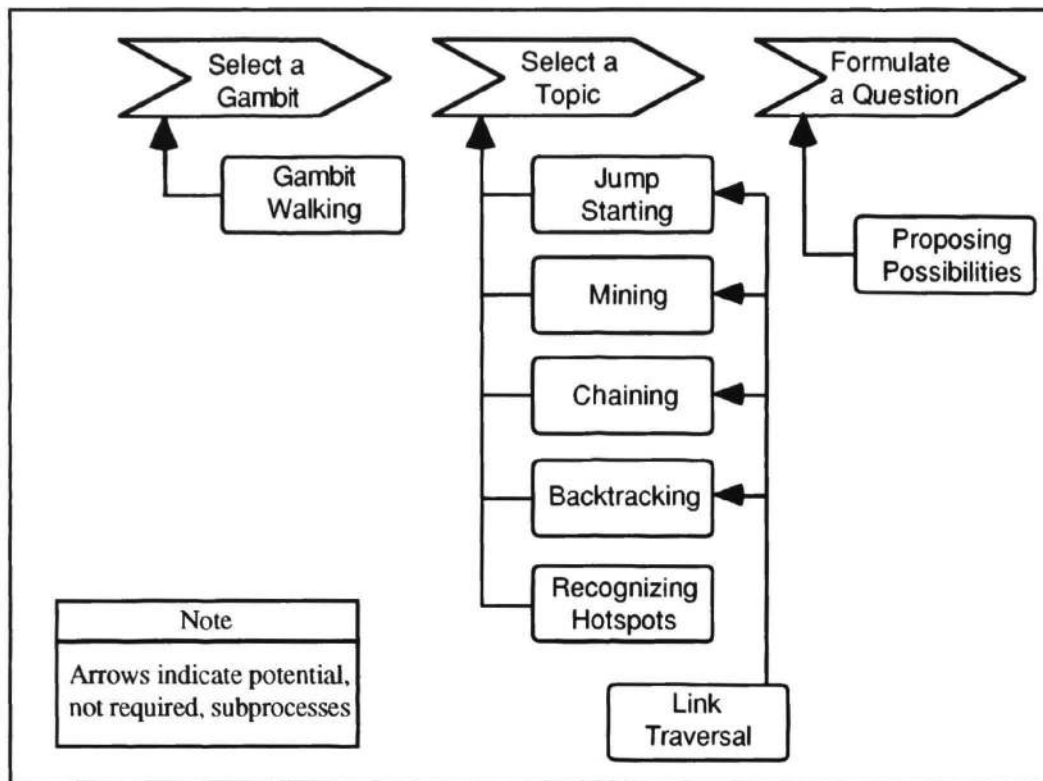


Figure 1: The Global Organization of the Interviewing Processes

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