

3 Scripts

3.1 Introduction

How do people organize all the knowledge they must have in order to understand? How do people know what behavior is appropriate for a particular situation? To put it more concretely, how do you know that, in a restaurant, the waitress will get you the food you ask for whereas if you ask her for a pair of shoes, or you ask her for food on a bus she will react as if you had done something odd?

People know how to act appropriately because they have knowledge about the world they live in. What is the nature and form of that knowledge? How is it organized? When is it brought to bear? How is it accessed? What portions of that knowledge are thought about and used, and under what circumstances?

We recognize two classes of knowledge that people bring to bear during the understanding process: general knowledge and specific knowledge. General knowledge enables a person to understand and interpret another person's actions simply because the other person is a human being with certain standard needs who lives in a world which has certain standard methods of getting those needs fulfilled. Thus, if someone asks you for a glass of water, you need not ask why he wants it. Even if he later uses it for a nonstandard but clear purpose - say he throws it in somebody's face and steals that person's watch - you have no trouble interpreting his actions. It is easy to understand what his plan was, and why he needed the water. We may never have observed such a sequence before, but our general knowledge about people and the world they live in allows us to interpret the events we see.

We use specific knowledge to interpret and participate in events we have been through many times. Specific detailed knowledge about a situation allows us to do less processing and wondering about frequently experienced events. We need not ask why somebody wants to see our ticket when we enter a theater, or why one should be quiet, or how long it is appropriate to sit in one's seat. Knowledge of specific situations such as theaters allows us to interpret the remarks that people make about theaters. Consider how difficult it would be to interpret 'Second aisle on your right' without the detailed knowledge about theaters that the patron and the usher both have. It would be rather odd to respond 'What about the second aisle on my right?' or 'Where is my seat?' or 'Is this how I get into the theater?' The usher simply takes the ticket and, assuming you understand and have specific knowledge about theatres, utters his otherwise cryptic remark without any verbal input from you.

The remainder of this chapter deals with the nature and form of such specific knowledge. We shall discuss issues related to general knowledge in Chapter 4.

With stories as well as with isolated utterances, human readers seem to have no trouble in rapidly extracting the features of the situation intended for emphasis by the writer. Consider, for example, the sentence:

- 1 While giving his order to the waiter at Mamma Leone's one evening, Spillane was approached by the owner, a notorious Mafia figure.

The 'while'-clause functions to set the Leone's restaurant context with its huge store of generalized and specific world knowledge. Nevertheless, the reader does not slow down to work out who 'the

'waiter' is or how Spillane came to be talking to him, but quickly notes that Spillane is probably at a table, in the act of ordering, in a well-known Italian restaurant.

Such specific knowledge exists in detail for every mentally competent person in the world with respect to every standard situation that he has been in many times. What form does such knowledge take?

We established in Chapter 2 that the directed inference process results in a connected causal chain of events. This causal chain is useful for representing any sequential flow of events. Since certain sequences of events frequently occur in a specific order we must postulate that people have developed special mechanisms to deal with them. That is, there are certain groupings of causal chains that exist in the form of large conceptual units.

We would anticipate that two special mechanisms are needed. First, we must be able to refer to a frequent event sequence in a sketchy manner. An event sequence with ten steps in it may be identifiable from just the first and last of those events. That means we need a special inference capability that can do more than the one described in Chapter 2. It would be a tedious and, most likely, unending process, to try to recover every missing event in a causal chain. So, the first special mechanism must be able to recognize that a script – a standard event sequence – has been mentioned.

Second, we need a mechanism for recovering steps that have been left out of a causal chain. Some of these steps may be needed to understand a given event sequence. We call this mechanism a script applier. It fills in the causal chain between two seemingly unrelated events by referring to the script recognized by the first special mechanism.

These two understanding mechanisms have their counterparts in the generation of language. When someone decides to tell a story that references a script, he recognizes that he need not (and because he would otherwise be considered rather boring, should not) mention every detail of his story. He can safely assume that his listener is familiar with the referenced script and will understand the story as long as certain crucial items are mentioned.

Let us look at some simple stories to see how this can be done:

- 2 John went to a restaurant. He asked the waitress for coq au vin.
He paid the check and left.
- 3 John got on a bus. He fell asleep. He woke up in New York.

4 John was the quarterback. As time ran down, he threw a 60-yard pass into the end zone. His team won the game.

5 John went to Bill's birthday party. Bill opened his presents. John ate the cake and left.

These stories are understandable because they make reference to frequently occurring scripts. Much more than the three lines given in each story is understood by someone listening to it. A story understander must fill in the parts of each story that were left out. A story understander can do this by implicitly or explicitly referring to the referenced script.

Consider stories (6) and (7):

6 John went in to a restaurant. He saw a waitress. He went home.

7 John was walking on the street. He thought of cabbages. He picked up a shoe horn.

The connectivity of stories (6) and (7) is altogether different from that of stories (2)-(5). Stories (2)-(5) make reference to a script. Story (6) seems to reference a script but never quite gets there. By this we mean that the point or main goal of the script cannot safely be inferred. Did John eat or didn't he? You can't tell from this story. That is, in story (6) the events seem disconnected because of uncertainty that the referenced script should actually be instantiated. Story (7) does not reference a script and in any case it makes little sense. Stories need not reference scripts to make sense. Consider story (8):

- 8a John wanted a newspaper.
- b He found one on the street.
- c He read it.

Although (8) does not reference a script it is understandable. The events in it can be easily connected to each other with information readily obtainable from the story. In order to connect (a) to (b) it is necessary only to hypothesize 'John saw and picked up the newspaper.' One of these conditions is given by the story explicitly and the other is readily inferable. They do not violate necessary conditions or other conditions of the story itself (as discussed in Chapter 2). It is possible to connect (b) to (c) by the inferences that 'find' results in 'have', and 'have' enables 'read'.

Such simple connectability is present in (2)-(5) only by virtue of the existence of appropriate scripts. Contrast Story (2) with Story (9):

- 2 John went to a restaurant. He asked the waitress for coq au vin.

9 John went to a park. He asked the midget for a mouse. He picked up the box and left.

In Story (9) we are unprepared for the reference to 'the' midget rather than 'a' midget and 'the' box rather than 'a' box. Further, we are incapable of connecting the last two lines of the story, without a great deal of effort. Story 9 allows us no reference to a standard situation in which midgets, mouses, boxes and parks relate. The story is not understandable, simply by virtue of the fact that we have no world knowledge that serves to connect its pieces. If there were a standard 'mouse buying script' that averred that only midgets in parks sold mice which were always packed in boxes, then we would be able to apply that script to Story 9 and connect the pieces of the story. What scripts do, then, is to provide connectivity.

In Story 2, which is superficially quite similar to Story 9, we get a great deal of connectivity. We are not surprised when 'the' waitress or 'the' check are mentioned. We understand exactly the relationship between asking for coq au vin and paying the check. Further, we assume that John ate coq au vin, that he waited a while before being served, that he looked at a menu, and so on. All this information is brought up by the restaurant script. Further, it is brought up by a particular part or track of the restaurant script, namely the kind of restaurant in which one orders coq au vin. This 'fancy restaurant track' of the restaurant script includes within it the possibility of a maitre d', a wine steward, tablecloths, paying with credit cards, fancy desserts and so on.

Thus the restaurant script must contain a tremendous amount of information that encompasses the enormous variability of what can occur in a restaurant. There must also be a 'fast food restaurant' track, a cafeteria track, etc. in the restaurant script, that includes the entering, ordering and paying scenes, but has a different set of possibilities than the fancy restaurant. In the 'fast food track', paying can occur immediately after ordering and before eating; eating may occur inside or outside the restaurant; the person who takes the order must be approached by the patron rather than going to where the patron is seated.

The presence of such tracks in the restaurant script is indicated by the understandability of stories that make use of those tracks. For example, consider Story (10):

10 John went into the restaurant. John ordered a Big Mac. He paid for it and found a nice park to eat in.

This story is understandable precisely because it calls up the track of the restaurant script that states that you don't have to be inside a fast food restaurant to eat there. However, if a reader does not understand that 'Big Mac' calls up the fast food track, he will have difficulty understanding the story. That is, the same story, with 'coq au vin' substituted for 'Big Mac', would seem rather odd. A story with this substitution would in principle be understandable, but the lack of applicability of available scripts would make it harder (and take more time) for a hearer to understand.

Thus while it is possible to understand a story without using a script, scripts are an important part of story understanding. What they do is let you leave out the boring details when you are talking or writing, and fill them in when you are listening or reading.

We shall now describe a script in more definite terms. A script is a structure that describes appropriate sequences of events in a particular context. A script is made up of slots and requirements about what can fill those slots. The structure is an interconnected whole, and what is in one slot affects what can be in another. Scripts handle stylized everyday situations. They are not subject to much change, nor do they provide the apparatus for handling totally novel situations. Thus, a script is a predetermined, stereotyped sequence of actions that defines a well-known situation. Scripts allow for new references to objects within them just as if these objects had been previously mentioned; objects within a script may take 'the' without explicit introduction because the script itself has already implicitly introduced them.

Stories (2)-(5) all make use of scripts. There are scripts for eating in a restaurant, riding a bus, watching and playing a football game, participating in a birthday party, and so on. These scripts are responsible for filling in the obvious information that has been left out of a story. Of course, it is obvious only to those understanders who actually know and can use the script. For example, these questions might be asked of hearers immediately after respective stories (2)-(5) with the full expectation of an accurate and fast reply.

Q1 What did John eat?

Q2 Where did the bus go?

Q3 What happened to the pass John threw?

Q4 Where did the presents come from?

Every script has associated with it a number of roles. When a script is called for use, i.e., 'instantiated' by a story, the actors in the story

assume the roles within the instantiated script. If no actor has been specifically mentioned when a particular script is instantiated, his presence is nonetheless assumed and a default unnamed actor is used in his place. All this happens whenever a script is called up. This explains the use of the definite article in reference to 'the waitress'. She has been implicitly mentioned before by the initial instantiation of the script. (Roles are discussed at greater length in Chapter 6.)

A script must be written from one particular role's point of view. A customer sees a restaurant one way, a cook sees it another way. Scripts from many perspectives are combined to form what might be considered the 'whole view' of the restaurant. Such a 'whole view' is rarely, if ever, needed or called up in actual understanding, although it might well constitute what we may consider to be one's 'concept' of a restaurant.

We have built, at Yale, a computer program called SAM ('Script Applier Mechanism') that understands simple stories about script-based situations. It is described in detail in Chapter 8. Much of what we have to say here about script application has been influenced by our experience with that program. It has been tested most extensively with stories about restaurants. Let us consider the restaurant script in detail.

3.2 The Restaurant Script

The following is a sketch of one track of the restaurant script (the coffee shop track) from the point of view of the customer. Since the particular verbs that might best describe each action may not always fit in a given story that calls up a script, the actions of a script are described in terms of the underlying events that take place. The primitive ACT is the core of each event in the chain of events being effected. One of the scenes (ordering) is given below with a good deal of optional detail. The options to the right provide a single coherent path through the scene; shortcuts and loops are indicated on the left.

Script: RESTAURANT

Track: Coffee Shop

Props: Tables

Menu

F-Food

Check

Money

Roles: S-Customer

W-Waiter

C-Cook

M-Cashier

O-Owner

Entry conditions: S is hungry.

Results: S has less money

S has money.

O has more money

S is not hungry

S is pleased (optional)

Scene 1: Entering

S **PTRANS** S into restaurantS **ATTEND** eyes to tablesS **MBUILD** where to sitS **PTRANS** S to tableS **MOVE** S to sitting position

Scene 2: Ordering

(menu on table) (W brings menu) (S asks for menu)

S **PTRANS** menu to SS **MTRANS** signal to WW **PTRANS** W to tableS **MTRANS** 'need menu' to WW **PTRANS** W to menuW **PTRANS** W to tableW **ATRANS** menu to SS **MTRANS** food list to CP(S)* S **MBUILD** choice of FS **MTRANS** signal to WW **PTRANS** W to tableS **MTRANS** 'I want F' to WW **PTRANS** W to CW **MTRANS** (ATRANS F) to CC **MTRANS** 'no F' to WW **PTRANS** W to SW **MTRANS** 'no F' to S

(go back to *) or

(go to Scene 4 at no pay path)

C **DO** (prepare F script)

to Scene 3

Scene 3: Eating

C ATRANS F to W**W ATRANS F to S****S INGEST F**

(Optionally return to Scene 2 to order more;
otherwise go to Scene 4)

Scene 4: Exiting

S MTRANS to W

(W ATRANS check to S)

W MOVE (write check)**W PTRANS W to S****W ATRANS check to S****S ATRANS tip to W****S PTRANS S to M****S ATRANS money to M**

(no pay path): **S PTRANS S to out of restaurant**

Scene 2 may seem very detailed. In fact we have left out considerable detail and possible options in each of the scenes. We have left out whole scenes (the 'wait to be seated by the hostess' scene, for example). Everybody who has been to a restaurant often enough is aware of many more details and can use them if the occasion arises.

Human listeners have available another kind of information which we will not systematically treat, namely imagery (mainly visual) associated with each action in the sequence. Often, descriptive visual information is given in a story, but even if it is not, the listener hearing about a restaurant will typically call to mind impressions of the shapes, colors, relative positions and other properties of objects implicitly or explicitly present in the scene: tables, tablecloths, how the waiter or waitress is dressed, how the food looks (and smells), the check, the cash register, etc. With each action a 'vignette' containing auxiliary information is stored. The nature of the information in images has been the subject of much controversy (Pylyshyn, 1973; Kosslyn and Pomerantz, 1977), and we do not wish to stir up this hornet's nest here.

The restaurant script is a giant causal chain. Although the details have been left out, each action in the above script results in conditions that enable the next to occur. To perform the next act in the sequence, the previous acts must be completed satisfactorily. If they cannot be completed the hitches must be dealt with. Perhaps a new action not prescribed in the straightforward version of the script will be generated in order to get things moving again. This 'prescriptive' behavior, to be discussed later, is an important additional component of scripts. Script preconditions are another important part of the causal sequence in scripts. In the restaurant script, for example, we must inquire whether the main actor has money. If we have no evidence to the contrary, we proceed normally. Otherwise, we must find out if the main actor knows he has no money. If the answer is negative, we must predict that an interference will arise when the main actor tries to pay his bill; otherwise we must predict that the main actor may try to leave without paying. Such predictive powers are often used in understanding. Events with strong future implications are 'kept in mind' – like Charniak's (1972) 'demons' – so that they can resolve later inferential ambiguities.

In a text, new script information is interpreted in terms of its place in one of the paths within the script. Thus in story (2):

- 2 John went to a restaurant. He asked the waitress for coq au vin.
He paid the check and left.

The first sentence describes the first action in scene 1 of the restaurant script. Sentence 2 refers to the crucial action of scene 2, and sentence 3 to the last two actions of scene 4. The final interpretation of story (2) would contain a chain through the restaurant script that included all the principal actions (or MAINCONS, for main conceptualizations) needed to connect the events.

MAINCONS are determined by their importance in a scene. For every scene there is at least one MAINCON. In scene 2 above, the MAINCON is the customer stating his order (**MTRANS** 'I want F to W'). If a scene is 'instantiated' its MAINCON must have happened.

Most real stories that deal with scripts relate events that are unusual with respect to a standard script. The problem in script application then, besides deciding how much of a script to infer, is to know how to tie together events that are not directly in the script.

Consider story (11):

- 11 John went to a restaurant. He ordered a hamburger. It was cold when the waitress brought it. He left her a very small tip.

In story (11) the first two sentences describe actions in scenes 1 and 2. Part of the third sentence is in the script as an action of scene 3, but there is also the information that the hamburger is cold. The fourth sentence ('He left her a very small tip') is a modification of the '**S ATRANS** tip to **W**' action of scene 4. The modifier, 'very small' is presumably related to the unexpected information about the 'cold hamburger'. Even an unknowledgable script applier, checking story (11) against the standard restaurant script, could come up with the low-level hypothesis that the small size of the tip must have something to do with the temperature of the hamburger, since these two items of information are the only deviations from the script.

But we do not want our processor to lack knowledge. In slightly more complex examples, adequate understanding requires attention to the nature of deviations from the script. A smart processor can infer from a cold hamburger that the **INGEST** in scene 3 will not lead to the result of **S** having pleasure. The concept of a very small tip can be stored with the restaurant script as a reaction to the violation of pleasure. Thus the processor might even infer that a cold hamburger was unsatisfactory by working backwards from its understanding of a small tip. This might be necessary if the food description were ambiguous in desirability, say, a 'very rare steak', rather than a 'cold hamburger'.

3.3 Script Application

To define when a script should be called into play, script headers are necessary. The headers for the restaurant script are concepts having to do with hunger, restaurants, and so on in the context of a plan of action for getting fed. Obviously contexts must be restricted to avoid calling up the restaurant script for sentences that use the word 'restaurant' as a place ('Fuel oil was delivered to the restaurant').

Even if a proper header is encountered, however, it may not be appropriate to call up all the details of a script or even its MAINCONS. This is because script references in stories are often to 'fleeting scripts'.

- 12 John took a bus to New York.
In New York he went to a museum.
Then he took a train home.

In this example, the names of scripts are mentioned and it is presumed that each script proceeded normally. (Alternatively, it is possible that some abnormal things happened which were considered unworthy of narration by the author of the story. This alternative makes no practical difference except in very special cases.) There is a serious question about what 'proceeded normally' means in terms of what really is stored in the long-term memory of an understanding system.

Here we have the three explicitly stated scripts, **BUS**, **MUSEUM-GOING**, and **TRAIN**. (From this point, we shall indicate a script name by a \$ in front of the name; thus **\$BUS** indicates the bus script). It is unlikely that people would fill in the default paths of each of these scripts if exposed to story (12). What is more likely is that they simply remember that the script occurred by establishing a pointer to the entire script. In this manner, the information about the script is available if needed, but memory is not cluttered with gratuitous detail. The story can be stored as a sequence of three pointers.

For a script to be non-fleeting, two of its lines must occur, a header and one other line. When a header is found, requests (as in Riesbeck's (1975) parsing system) are called up that connect possible inputs with events within the script. If such an input is found, then the script is 'instantiated'; that is, a copy of some of its general details is made, with slots filled in by the known properties of the story at hand. The role references are concretized. For example, a reference to 'the bus driver' results in the creation of a token with a pointer to the script role Driver. General information about specific roles such as Driver is stored under role themes, (see Chapter 6) and can be accessed if a role person undertakes some action not already in the script.

The nature of instantiated detail depends upon the story event(s) found after the header is found. Consider this story:

- 13 John went to a restaurant.
He ordered chicken.
He left a large tip.

The action of ordering calls in the ordering scene of the restaurant script. Since the entering scene lies on the path to ordering, we assume that its main conceptualization has taken place. Then the MAINCONS between ordering and tipping are assumed, as well as

the final exit. Consequently our understanding system will treat example (13) as if it had actually been:

14 John went to a restaurant.

He sat down.

He read a menu.

He ordered chicken.

He ate the chicken.

He left a large tip.

He paid the check.

He left the restaurant.

That is, we fill in, as if we had actually heard them, the events on the default path of the applied script, as long as we are simply filling in the steps between explicitly stated points. Thus, in order to get from 'entering' to 'ordering', it is safe to assume 'sitting' and 'reading'. In order to get from 'ordering' to 'tipping' it is safe to assume 'eating'. Since 'tipping' is a prelude to 'paying' and 'leaving', we also assume 'leaving'. We do not want to assume too many steps when we are told of events that are far apart in the script. Thus, the story, 'John went to a restaurant. He left a large tip.', is considered odd. Do we want to assume that he ate? It is highly likely that John did eat in this story. Nonetheless, we might not want to simply assume it.

So, the rules for dealing with instantiated scripts are directly related to how many steps are left out. Essentially, instantiated scripts are those that make explicit one or more specific steps in the script itself. It is then our job to fill in the surrounding steps that ought to be explicitly inferred and treat them as if they were said.

The rules for activating a script are dependent on certain key concepts or conceptualizations when found in certain contexts. The restaurant context should not be called up simply because an input sentence refers to 'restaurant', but this is not to say that access to the script should be completely suppressed, because script-related information may be useful in later stages of understanding. For example, in 'I met a bus driver in the restaurant', remembering that one of the persons in the story has a role in the bus script may be crucial for interpreting what he might say or do afterwards. (Such role information is discussed further in Chapter 6.)

The conceptualizations which invoke a script are its headers. These headers come in four varieties, which are classified on the basis of how strongly they predict that the associated context will in fact be instantiated.

The first type is called a Precondition Header (PH) because it triggers the script reference on the basis of a main script precondition being mentioned in the text. For example, the sentence 'John was hungry' is a PH for the restaurant script because it is the goal condition for the MAINCON (**INGEST** food), which is normally assumed to be true when the script is instantiated. A story understander having access to both scripts and plans would make the prediction (a relatively weak one, to be sure) that the restaurant context would come up because this script is known to be a common means of implementing a plan of action for getting fed. A related PH would be an actual statement of the goal the script is normally assumed to achieve, or one from which the goal could easily be inferred. In 'John wanted a Big Mac', or 'John wanted some Italian food', the inference chain to the script precondition is straightforward. Knowledge about the existence of an Italian food subtrack of the restaurant script would make the PH prediction about the probable invocation of that script even more forceful.

A second type of Header making stronger predictions than a PH about the associated context is called an Instrumental Header (IH). An IH commonly comes up in inputs which refer to two or more contexts, of which at least one can be interpreted as a 'instrumental' for the others. For example, in 'John took the subway to the restaurant', both the subway and restaurant contexts would be predicted, since subsequent inputs about either make perfectly good sense. Here, the reference to the restaurant is anticipatory, and the subway is a recognized instrumental means of reaching locales in which more important script goals can be expected to be achieved. In turn, we understand that the restaurant script is in some sense instrumental to the business context in a sentence like 'John went to a business lunch'. An important function of scripts is to provide the background in which more planful activities are carried out.

The notion of a time-place locale for situations leads to the third and most strongly predictive type of header, the Locale Header (LH). Many situations are known to have a 'residence', a place or building where they characteristically go on. Indeed, many organizations have distinctively designed buildings (for example, McDonald's Golden Arches) which signal their script to the public. When an understander reads that an actor is in the proximity of such a residence, or better yet, inside the residence, expectations about the occurrence of the script are correspondingly reinforced. Examples of LH are 'John went to the soccer field' or 'John went

into the Museum of Modern Art'. It is important to note that LH's need not be complete sentences: certain kinds of prepositional phrases ('At Leone's, John ordered a hot dog', 'On the bus, John's pocket was picked') are often used as a shorthand to define locale. Sentences like these can usually be paraphrased as a temporal clause of the form 'When X was at locale Y' attached to the main conceptualization.

The conceptual pattern that is being looked for here is X be **LOC**(script header). This pattern also occurs in places where we do not want to invoke a script. For example in (15):

- 15 The delivery man brought fifteen boxes of doughnuts to the restaurant. He went inside and spoke to the manager.

Clearly, the delivery man is in the restaurant here, but we do not want to predict that he will now eat (although he might). In (15), we call up the **\$DELIVERY** script first. While the restaurant script can be a subpart of a larger script (such as **\$TRIP**) it must be marked as not being capable of being subsumed by **\$DELIVERY**. This marking calls off the restaurant script initially, but keeps open expectations for subsequent calls to the restaurant script. Thus if we see another scene of the script (e.g., if the delivery man sits down and orders) we must be prepared to initiate the full restaurant script. Thus, script headers can be suppressed by certain contexts.

The fourth kind of header is the Internal Conceptualization Header (ICH). Any conceptualization or role from a script may occur in a text. It will sometimes call the script up and sometimes it will not. The most obvious cases of these alternatives are when a role name (such as waitress) is used in the locale of the role or away from the role (as in 'I went out with a waitress').

A problem occurs when we have a story such as (16):

- 16 John went to visit his friend Mary who was a waitress. While he was waiting for her, he ordered a hamburger.

The reference to restaurant here is only by inference. However, that inference is enough to set up a possible expectation for the activities of the restaurant script. As we said earlier, two items are really necessary to be certain a script has been invoked. Here, the second item is a conceptualization internal to the script. Its recognition comes from the mention of waitress, plus the recognition of the conceptual sense of 'order' (i.e., the restaurant sense). Only with these two key concepts in context can the script be called.

3.4 Interferences and Distractions

Suppose that a script has been instantiated, and then a sentence comes along which does not relate to anything in the script:

- 17 John went to a restaurant.
He ordered veal scallopini.
The weather was rather poor.

There is no way in which the instantiated script helps the understanding of the third sentence. That unexpected sentence refers to a new topic which might be another script or might not. In any case, the computer or human understander must simply wait to see what comes next.

Often a sentence which does not seem to fit anything directly in an instantiated script can be related to the script indirectly.

- 18 John went to a restaurant.
He sat down and signaled the waitress.
He got mad.
He left.

In the story above, we must be careful not to assume all of the events on the default path of the restaurant script. The sentence 'He sat down and signaled the waitress' leads us to assume the default entering scene and the beginning of the ordering scene. But on seeing 'He got mad' we must stop processing the script in the normal fashion. At this point we must find out what could have made John mad – was it something within the scriptal context, or in some new context? The answer is inferred via a simple rule about anger, namely that it is ordinarily caused by something some other person either did or did not do. We immediately look at the script to see if some action is called for on the part of another person at this point in the script. The answer is that a waitress should come to John at this point. So we can assume that this did not happen, and that this is why John got mad and left. It is important to remember the point in the script where the exit took place. We do not want to infer the rest of the default path of the script (i.e., that he paid the check before leaving).

The above inference is a weak one. John may have gotten mad about something else. But text is usually presented so as to be understood correctly. That is, people don't intentionally mislead in stories of this kind. If something non-standard had occurred it probably would have been mentioned explicitly. In filling out scripts, we are relatively safe with weak inferences precisely because it is usual for non-standard occurrences to be explicitly mentioned.

In order to relate an unexpected sentence to an instantiated script we need to know what kinds of events can cause detours or abrupt endings in scripts. We recognize two broad classes of such events: interferences and distractions. Interferences are states or actions which prevent the normal continuation of a script. There are two types of interferences: obstacles, where some enabling condition for an impending action is missing, and errors, where an action is completed with an unexpected and inappropriate result.

The actor encountering an obstacle may respond by taking corrective action to try to produce the missing enabling condition. Such corrective actions we call prescriptions. Alternatively, the actor may give up, either immediately or after one or more prescriptions fail, and exit from the scene. The actor encountering an error is in a different situation. The usual correctives are loops – repetitions of the action to try to get it to come out right. Often a prescription must accompany the loop. For example, when the waitress brings you a hot dog after you order a hamburger, it is unreasonable merely to order a hamburger again as if nothing had happened. If the error is to be fixed, the standard prescription would be to explain to the waitress (or perhaps argue with her) that you did not order the hot dog. Alternatively, the actor may tolerate an error and proceed through the script anyway. Thus if the waitress brings the wrong order, the customer might either send it back and reorder, or accept the substitute or trade with a friend. Bad errors may of course present obstacles, so that the next action is not even enabled, e.g., if the waitress brings an empty casserole, then the option of eating anyway is removed.

Beyond responding instrumentally to an obstacle or error an actor may often also respond emotionally. He may express frustration, sadness, or anger at obstacles. After certain errors, he may be indignant, after others, amused. These emotional states are all reactions to interferences. They may be intense enough on occasion to abort the initial goal(s) of the script, as when the disgusted customer loses his appetite, and/or they may initiate derivative goals (e.g., punishing the guilty role person, say, by leaving the waitress a very small tip as in story (11)).

Distractions are unexpected states or actions which initiate new goals for the actor, carrying him temporarily or permanently out of the script. By their nature, distractions are not tied to a particular script – any number of things can distract a customer in a restaurant, for example. It is possible for some event to be both an inter-

ference and a distraction, such as the waitress dropping the soup, which fails to complete the **ATRANS** of soup to the customer, and which may initiate a new goal of getting the customer's clothes dry.

The above concepts provide a set of questions which a processor can ask when it encounters an unexpected input within a script:

- a Does it specify or imply the absence of an enablement for an impending script action? (Obstacle)
- b Does it specify or imply that a completed action was done in an unusual manner, or to an object other than the one(s) instantiated in the script? (Error)
- c Does it specify an action which can be understood as the corrective resolution of an interference? (Prescription) This question would be activated when an obstacle is inferred from or described directly in the text.
- d Does it specify or imply the repetition of a previous action? (Loop) This is activated when an error is inferred from or described directly in the text.
- e Does it specify or imply emotional expression by the actor, likely to have been caused by an interference? (Reaction)
- f Does it specify or imply that the actor will have a new goal that has nothing to do with the original script? (Distraction)
- g Does it specify or imply the motivated abandonment of the script by the main actor? (Abandonment)

If any of the questions a – f are answered in the affirmative, then a detour is established within the script. New expectations will now guide the processing of subsequent inputs. A detour path will be followed until the original script either is reentered or abandoned. Scriptal deviations can thus be handled in a well-structured way.

The identification of inputs as obstacles, errors, etc., often depends upon having scripts available as points of reference. If we were not in a script, we might not recognize certain states as interferences, or if we did, we still might not know with what they were interfering. Compare, for example, the two stories:

- 19 John went to a restaurant.
He sat down.
He discovered he didn't have his magnifying glass.
- 20 John went for a walk.
He turned into Main St.
He discovered he didn't have his magnifying glass.

In story (19), it is easy to understand that the magnifying glass might be important because the menu is expected to arrive next. In story (20) we have no clear idea about the significance of the magnifying glass. 'A walk' does not specify enough of a sequence of events to be a script (unless we know John's personal habits). With no anticipated next event, we have no information on why the magnifier might be used.

The detour categories a-f tend to occur in certain standard patterns. One common type of sequence involves successful resolution of an interference:

(Obstacle) – (Prescription) – (Success),
or (Error) – (Loop) – (Success)

These success sequences return processing to the script at the point of the previously blocked action, in the case of an obstacle, or following the previously flawed action, in the case of an error. The category 'Success' may often be implicit, but sometimes it is explicitly marked, and we need to recognize it if it occurs. Consider an elaboration of story (19):

- 21 John went to a restaurant.
He sat down.
He discovered he didn't have his magnifying glass.
He asked the waitress to read him the menu.
She agreed.

The obstacle in the third sentence by inference relates to the action '**S MTRANS food list to CP(s)**' in the Ordering Scene. The normal instrumental action for this is **ATTEND**ing eyes to the menu, and sometimes this **ATTEND** in turn has an instrumental action, namely **GRASP**ing the magnifying glass in proper position. The enablement of having the glass is here missing. The customer chooses a prescription of a type which is of general utility, namely asking someone else to produce a result difficult to produce oneself. (Prescriptions, like medicines, are sometimes general in their applicability, sometimes specific.) The waitress agrees to his request, returning processing to the script with the action '**W MTRANS food list to CP(S)**' anticipated as a substitute for '**S MTRANS food list to CP(S)**'.

It was of course possible for the customer to choose to restore the missing enablement rather than to modify the act to be enabled. (These two distinct categories are both generally pertinent in overcoming obstacles.) The fourth sentence might have been, 'He borrowed a magnifying glass from his old friend Moody at the next

table', or even, 'He went home to get it.' These prescriptions return processing to the original action, '**S MTRANS food list to S**', although the going home alternative has the interesting property that the customer leaves the restaurant. We of course should expect him to return, and it is only by understanding the nature of detour paths that it is possible to realize that leaving the restaurant does not here terminate the script.

Some Obstacle-Prescription pairs are so common that they may come to be recognized as a path of the script itself. In the Ordering scene if **S** needs a menu but it is not on the table and the waitress doesn't spontaneously bring it, then we have an Obstacle – the enabling menu for knowing the food list is missing. An obvious prescription is to signal the waitress to bring a menu. Anyone who has eaten with any frequency in restaurants knows that this ordinarily works. Therefore it is unnecessary and somewhat odd to use alternative prescriptions – say, searching by yourself for where the menus are kept – unless the primary prescription fails.

Later on in the ordering scene there is a common Error-Loop pair. If the customer orders something which is not available, then from the point of view of the restaurant, he has made an error. The loop which is initiated, namely ordering something else, is virtually unavoidable. Thus we treat it as part of the main script.

Every act in the restaurant (or any other) script is potentially subject to obstacles and errors, each of which suggests its own appropriate prescriptions or loops. A few of these will occur with sufficient frequency that a person repeatedly exposed to the script situation will learn them along with the rest of the script. This is the major way in which scripts grow. In time, he may learn a sizeable number of alternative script paths which were once detours, even to the point of having prescriptive sub-branches to follow if there are anticipated interferences to prescriptions themselves. Indeed, occupational role members must have very elaborate scripts from their situational point of view, e.g., a trial lawyer's conception of the court-room script. Occasional or new participants in the same situation, or those knowing it only from hearsay, naturally have much simpler scripts. In a child's early experiences in restaurants, for example, there is no appreciation of many of the details we have listed, such as the waitress bringing the check. (Some aspects of a child's learning of scripts are discussed in Chapter 9.) To the extent that experiences in certain situations are different, then, different scripts would be appropriate. When we refer to 'the' restaurant script, therefore, we are relying on those stereotyped details which are culturally consensual.

Returning to our discussion of detours, another common sequence is a chain of attempts to remove a stubborn obstacle:

(Obstacle) – (Prescription) – (Failure) – (Prescription) – (Failure)...

This chain terminates either in a final success, or in a last straw (Failure) – (Abandonment) sequence. In the latter case, control does not return to the script, of course, because the script is terminated.

Failures are prone to elicit emotional reactions, albeit emotional reactions also occur in direct response to obstacles and errors. Reactions in turn may or may not interrupt the instrumental sequence. Thus we might have either:

(Obstacle) – (Prescription) – (Failure) – (Reaction)
(Prescription)...
or

(Obstacle) – (Prescription) – (Failure) – (Reaction) – (Distraction)

The (Reaction) – (Distraction) pair is meant to express those cases where the actor is carried away by his anger, annoyance, etc., initiating some nonscriptual action as a consequence.

Distractions need not occur only as a result of emotional reactions. Indeed, distractions can come from many sources. If the distracting events play out their course within the location of the situational script, then it is likely that control will return to the script at the point it was interrupted. The restaurant script may be said to be 'in abeyance' in the middle of the following story, for example:

- 22 John was eating in a restaurant.
Suddenly a thief tried to run off with several coats.
The manager tackled the thief.
The police came and arrested the man.
John paid the check and left.

With a script held in abeyance, the problem is to postpone the requests that were looking for completion of the script that was started (here, *restaurant*). That is, once the distraction scene starts we really do not expect the *restaurant* script to continue until the substory has ended. Nonetheless, it could continue at any point and requests to handle those inputs must be around.

A peculiar problem, though, is that the distraction subplot may take the main actor out of the restaurant (or other script locus), and

there is no telling whether or not he will return. One of the authors well remembers a personal experience at a modest restaurant with three friends some years ago. One of our group was not too hungry, and he asked the waiter just for a plate to share some of our spaghetti. The waiter said this would cost \$.25 (a princely sum in those days), and we considered this an unreasonable pretension for such a humble place. Indignant, we decided to cancel our orders and leave. However, the waiter maintained that since the cook was already making the food, we were responsible for paying the bill. Now we were really mad, and we refused to pay. Thereupon he telephoned the police and we were led a block away to the station house and held on \$200 bail. We were charged with failure to pay our obligation of \$5.50, and were threatened with a night in jail. This sobered us, but we still did not want to surrender meekly to the restaurant manager who was standing by awaiting action. Did we return to the restaurant?... Well, yes and no. We solved our problem by asking if we could have the food as a take-out order. That was agreed, and we went happily home with no extra plate and no extra charge.

Such a 'realistic' story involves the interaction of three scripts in abeyance at once (**\$RESTAURANT**, **\$PETTY CLAIM**, and **\$JAIL HOUSE**), with an unexpected resolution of the interferences in all three.

3.5 Script Interactions

There are several ways in which more than one script can be active at once. In the previous section, we discussed the possibility of a 'script in abeyance', with a distracting script occurring within its boundaries. Another possibility is that the second script does more than merely distract from the first, but actually interferes, preventing the occurrence of normal actions:

- 23 John was eating in a dining car. The train stopped short. John's soup spilled.

The first sentence activates two scripts simultaneously, \$RESTAURANT and \$TRAIN (One could postulate a dining car script that we

would expect someone who eats on dining cars to have. If we had that script here, these problems would not occur for this example).

When two scripts are active at once they compete for incoming items of information. Sometimes the events that fit in one affect the events of the other. The second sentence of (23) is clearly part of the train script. However, it causes a problem that doesn't usually occur in the restaurant script, namely that the table moved suddenly. We cannot expect the restaurant script to contain information about what to do or even what happens when a table moves suddenly. The third sentence (John's soup spilled) must be handled by means other than a script. This is done easily enough (in principle) by inferring the physical effects of a sudden train stop, and knowing that soup spills when moved abruptly. The problem here is the serious effect this sentence has on the restaurant script. It is as if the waiter has done something wrong, such as bringing the wrong order. That is, the customer can, at this point, ask for a replacement. A next sentence such as 'John called the waiter' would have to be handled as an Error-Loop detour path within the restaurant script. Remember that in this example two scripts are active at the same time. Any new item is potentially in either one. Here this means handling the spilling soup as an inference from the train moving and sending information to the instantiated restaurant script that the food is now no good (and perhaps that the customer is now wet). Such new inputs trigger detour paths in the restaurant script that are capable of handling them even though the impetus for them came from outside the script itself.

24 John was wooing his girlfriend in the restaurant.

He asked her for the salt.

Then he asked her for her hand.

In example (24), a similar problem occurs. Here again we have two scripts (**\$ROMANCER** and **\$RESTAURANT**) active at the same time. The next inputs don't affect each other, but which new input belongs to which script? The problem in this example is obviously not too serious and is quite a bit like semantic ambiguity in the disambiguation of isolated sentences. Resolution is possible as long as there is enough information in the script applier about the requirements of the two scripts. A serious problem occurs when a new event could occur in either of the two scripts. For example, suppose we had 'He asked her for money'. This might fit a path in the wooing script (as in 'he is after her for her money'), or it might be part of the restaurant script (as in the path that handles what to do if you discover you can't pay). This is a case of ambiguity within scripts

which we call Scriptal Ambiguity. Often, other knowledge (for example, about John's personal character) will help disambiguate such sentences. If not, future inputs usually will.

An amusing kind of scriptal ambiguity occurs when the players think they are in different scripts, or when two players in a single script each have two different roles, one real and the second a figment of the other person's imagination – as in the following anecdote:

25 A traveling salesman found himself spending the night at home with his wife when one of his trips was unexpectedly canceled. The two of them were sound asleep, when in the middle of the night there was a loud knock at the front door. The wife woke up with a start and cried out, 'Oh, my God! It's my husband!' Whereupon the husband leapt from the bed, ran across the room, and jumped out the window.

If we regard husband-surprising-wife's-lover as a script, then we can readily understand this anecdote as the husband seeming to the wife to be her secret lover, and the wife seeming to the husband to be the spouse of the jealous husband outside. For a script application mechanism to appreciate this duality, it would have to infer one version of the script from the wife's point of view, and a second from the husband's. It would have to understand, in other words, that there can be a script in someone's mind – a personal script – which is at variance with the actual or situational script because of systematic distorting factors.

Of course, in order to really understand the joke in story (25), the listener must apply a rule about personal scripts, namely that in order for a personal script to override serious discrepancies with reality, it must have been very well practiced by the individual. Thus we infer that both husband and wife are well versed in adultery. We will have more to say about personal scripts in Section 3.6.

The concurrent activation of more than one script creates rather complex problems. A slightly less troublesome type of script interaction arises at the boundary where one script leaves off and another begins. Consider this example.

26 John was robbed on the train.

At the restaurant he couldn't pay the check.

In this example, the robbery is an unpredicted event in the train script. The new event does not affect the normal completion of the train script, so we simply have a pointer to the train script (since it is a fleeting script) and a pointer to a robbery script embedded within

it. However, when the next line of the story is seen, it is affected by the earlier robbery script. This is noticed by the entry conditions on a script. In order to perform a role in a script, certain conditions must be met. To take a train ride, one must be able to get to the station and into the train (i.e., the doors of the train must be open at the appropriate time). Further, one must either have a ticket or the money to purchase one (in which case someone must be selling a ticket and one must be able to find him). The entry conditions for a customer in a restaurant are similar to those for a train. Obviously an important entry condition for restaurants is that the customer have the means to pay the check. When a script is begun, it is necessary to check the entry conditions. If an entry condition has been violated it must be noticed immediately upon instantiating the script or when a pointer to that script is created. So in (26), the robbery, from which one must infer John has no money, violates one of the entry conditions of the next script to be activated. This violation sets up an expectation for the no-pay path of the restaurant script with a link back to the robbery as the reason for taking this path of the script.

A final script interaction type concerns indeterminacy in script-endings.

27 Yesterday John was in New York.

He went to a restaurant.

He ate a large lobster.

Then he bought a watch.

In (27) we have the problem of recognizing when an active script has been ended and a new script has begun. Once the restaurant script has been instantiated in (27), we expect it to be ended in normal fashion. When a new input comes in that does not normally fit in that script without an ending being perceived, we have a problem. If the new input is something which is unexpected but could possibly occur in a restaurant, (i.e., is a Distraction), should the restaurant script end? If the new input were, 'The waitress did a dance', we would have no reason to end the restaurant script since this could occur in a restaurant, and would not be likely to initiate a customer reaction leading to a **PTRANS** from the restaurant. The restaurant script would simply be held in abeyance. In the example given in (27), ('Then he bought a watch') we have something that can normally be handled by a script, but that takes place in watch stores and not restaurants. We have to assume that the restaurant script has ended and infer 'He left the restaurant'. This would cause all the normal MAINCONS of the restaurant script to be inferred. The

watch-buying event thus serves double duty: it activates a new script at the same time it terminates an instantiated old one. We call this a 'script-ending script'.

Of course, it is conceivable that one could buy a watch in a restaurant. Because of this possibility, with script ending scripts we still keep the requests active from the original script. Thus, if we next encounter 'Then he paid the check', if we have marked our previous inference with a lack of certainty, we can undo what we have inferred and place the 'watch' event inside the restuarant script as a Distraction.

The problem of script-ending scripts is a difficult one, partially because it occurs frequently, and partially because one can never be certain that the right decision has been made. Time span seems to play a role in the decision process too. For example, if 'Then he bought a watch' were (a) 'He bought a watch' or (b) 'He bought a watch an hour later' we have different solutions. In (a) we would probably assume that John was still in the restaurant and in (b) we would feel more certain that the restaurant script was ended because of the time gap.

3.6 Types of Scripts

So far we have examined situational scripts in which 1) the situation is specified; 2) the several players have interlocking roles to follow, and 3) the players share an understanding of what is supposed to happen. The waitress typically does what the customer expects, and the customer typically does what the waitress expects. There is great social economy when both parties know the script because neither party need invest effort deciding what the actions of the other mean and how appropriately to respond. Indeed, it is characteristic of institutionalized public situations with defined goals (the customer eating, the restaurant making money) that the social interactions be stylized. This is one reason why scripts are so common, and so helpful in understanding.

Suppose, however, that one of the parties wants to direct the interaction into channels other than those defined by the situational

script. He may have some Personal Script which he is following, over and above the actions needed to conform to the situational script. The customer for example, may have the goal of making a date with the waitress. If he has pursued such a goal often, then the actions involved may (for him) be very stylized and scriptal. The main path might involve friendly conversation, casual kidding, finding out if she is unattached, displaying interest, and asking when she gets off work. The waitress might or might not respond in the anticipated way. She might be friendly, but misinterpret the motive for the customer's friendly overtures. She might remain aloof and business-like. She might play hard to get.

Personal scripts do not behave in the stylized fashion of situational scripts. All the participants in personal scripts are not necessarily aware of their participation. The seducee, say, or the victim of a swindle is often not aware until the very end of the enactment of the actor's personal script of their participation in it. The personal script exists solely in the mind of its main actor. It consists of a sequence of possible actions that will lead to a desired goal. It is different from a plan (to be discussed in Chapter 4) in that there is no planning involved for the actor in a personal script. He is participating in a sequence of events much like other sequences he has used many times before. He could teach his method to anyone who wanted to know it. There is very little planning involved because he has done this personal script repeatedly.

There is, of course, no limit to the mental projections a person can bring to a situation in the hope of attaining some goal. These are frequently not script-like, but suited *ad hoc* appropriately to the particular situation. If the customer says to the waitress, 'If you see a tall man with a walrus mustache later this evening, a Mr. Robinson, please tell him that John and Mary found his umbrella', we don't want to try to interpret this request as part of a script. It is unique to this particular situation. Indeed, even if this customer for some reason often says such things to waitresses as part of a peculiar personal script, an understanding system would have great difficulty perceiving this without intimate knowledge of the mental world of this customer. From the standpoint of an artificial intelligence system, therefore, the useful personal scripts to store are those which are common to many individuals, and can therefore be conjectured for new characters in a story. There are many such common personal scripts. They tend to have the character of roles or parts which people assume as the occasion arises, for example, **\$FLATTERER**, **\$JEALOUS SPOUSE**, **\$GOOD SAMARITAN**, etc., or stealthy occupations like **\$PICKPOCKET** or **\$SPY**.

Personal scripts are usually but not always goal-oriented. A personal script also might be followed as a matter of ritual (e.g., **\$PRAYER**), or as an elaborated emotional and behavioral reaction following a situational outcome. An example of the latter would be the **\$JILTED LOVER** who (say) discovers he has been jilted, disbelieves it, confirms it, is furious at his rival, curses all women, feels depressed, gets drunk, and throws himself in the river. This non-goal-oriented type is not quite as interesting from an artificial intelligence point of view as the goal-oriented type, because other individuals do not 'get into the act'. The personal script can be very personal indeed.

Clinical psychologists tend to be interested in very personal scripts. These are the stuff of neuroses, especially when they are activated inappropriately and create interferences in the ongoing social behavior of the individual. Behavior governed by unconscious motivation stems from a script hidden from an individual's conscious self. It is not our task in this volume to pursue such matters, other than to note the potential relevance of the script concept, properly explicated, to the demystification of neurotic behavior. Indeed, a school of clinical psychologists – the 'transactional school' – has already used the term 'script' for use in the analysis of behavior (cf. Steiner, 1975) although their use of it is looser than ours. In any case, we will not try to deal with idiosyncratic or unconscious personal scripts. The knowledge needed to handle their occurrences is too specialized and unparsimonious and is of little use in predicting and understanding actions at the level at which we are interested. Suppose we encounter a story like (28):

28 Mary's friends offered heroin to her. She shot up.

Here the simplest answer to the question, 'Why did Mary shoot up heroin?' is that she wanted to (or that it was her habit), and the next simplest is that her friends persuaded her. Without very specialized additional context, we would not likely assume (say), that she did it because as a child she hated her overbearing older sisters, and now she lets her peers talk her into bad behavior in the hopes that they will all be caught and punished, thus getting even with the sisters and also expressing her own guilt for hating them. This could conceivably be correct, but it is so much explanation based on so little substance that, like syndicated newspaper columns offering psychiatric advice, it puts one off as being gratuitous. Our policy in developing a theory of knowledge structures is to get as far as we can with fairly simple and general constructs.

With personal scripts, then, we would in practice restrict our attention to the most common readily inferred type. Often, personal scripts are used in otherwise novel situations, where there are no other scripts around. Interesting interactions occur when more than one script type is around at a time. Here we simply sketch some possible interactions and their properties.

a One actor with a concealed personal script within a situational script.

This is a very common type of interaction. One actor behaves with stylized duplicity, maintaining a public front while pursuing a personal motive. Persistent toadying to superiors in hope of a promotion, the affectation of virtues by political candidates, the rapid-fire friendly conversation of reporters, salesman, con artists and spies – these are all potential examples.

This type of script interaction is different in an important respect from most of the types discussed in previous sections. Here if a story understander is aware of the personal script, he is set to expect certain interferences during the progress of the situational script. This is in contrast to stories such as (16), (21) – (23), (27), in which unexpected or accidental events arise without prior warning. With prior knowledge of a personal script, the understander can prime appropriate questions or requests of both non-scriptal and scriptal input.

b Two or more actors with competing concealed personal scripts within a situational script.

This is an extension of the previous type. It might involve spy and counterspy, or a group of dishonorable thieves in a bank robbery, or any number of other situations of competition and double-cross. Here again the interesting questions for the understander are how the protagonists manage their double roles, and whether either or both of them develops awareness of the other's hidden agenda. The complexities of monitoring the input are much greater than in the previous case, but there are no new conceptual features.

c One or more actors with personal scripts whose nature is known by the other actors.

We have discussed the possibility that a personal script be concealed, but it is not unusual for a personal script even to be known in advance by other players. There are many stylized interactions in which one or both parties know the other to be dissembling, as in polite social invitations known not to be intended. Quite often if the deceit is relatively harmless, the knowing victim will pretend not to

know, in order to save the face of the other. This is what Goffman (1959) calls the 'face work' of everyday social interaction. Rather complicated patterns of social misrepresentation (both script-like and non-script-like) can occur, and it is not our purpose here to try to trace these. At this stage in the development of script concepts, perhaps we can hope only to cope with very obvious personal-situational script interactions where foreknowledge or discovery of the other's personal script leads immediately to a prescribed action. For example, if a dope peddler discovers that some people acting like customers are in reality members of the dope squad, he will avoid the incriminating rendezvous.

There is one further type of script we recognize, namely the INSTRUMENTAL SCRIPT. Instrumental scripts are quite like situational scripts in structure, that is, they describe prescribed sequences of actions. However, the kinds of actions they describe, the variability of the ordering, and the use of the script in understanding, differs. Examples of instrumental scripts are **\$LIGHTING A CIGARETTE, \$STARTING A CAR, \$WORKING A KEYPUNCH, \$FRYING AN EGG**. There is little variability with instrumental scripts. The order of events is very rigid, and each and every one of the events in the script must be done. There are obviously an extremely large number of instrumental scripts. Every cookbook contains hundreds of them.

There are, of course, situational scripts, in which the variability is about the same as some instrumental scripts. In the coffee shop track of the restaurant script there is little possibility for actions varying. In fact, there is probably more possible variability in frying an egg. The crucial differences between instrumental and situational scripts are with respect to the number of actors, and the overall intention or goal of the script.

Usually, situational scripts take multiple actors, while instrumental scripts have only one participant. Things can and do happen in a situational script that are not expected and are often the point of any story that invokes situational script. For example, a fight in a restaurant is of interest because of its unusualness. The restaurant is just so much context for the story. Barring a bomb going off, we don't expect stories about 'what happened while I was starting my car'. The actions in instrumental scripts are fixed and uninteresting for the most part. Unusual or other interesting events do not usually take place with instrumental scripts as their context. In an instrumental script, nearly the only thing that can be related within it is the failure of the intended goal and what was done to correct it. This

is usually itself a standard prescription. There are only a few things to do when a car doesn't start and they are part of the script as well.

Making the distinction between situational and instrumental scripts enables us to make some choices that facilitate processing. When we instantiate a situational script, we must set up prediction mechanisms that will: be able to handle definite references to characters that have not yet been mentioned (e.g., the waitress); be able to infer the presence of important (or goal) scenes that have not been instantiated (e.g., 'eating' in a restaurant); find the appropriate detour path for unexpected inputs. Most importantly, mechanisms of memory must be set up to remember the unexpected events of the situational script together with the explicit and inferred MAIN-CONS.

An instrumental script has available to it much of this apparatus, but it is unreasonable to bring it to the fore every time that an instrumental script is referenced. We simply don't expect that 'I fried an egg' is the beginning of a story about an interesting thing that happened in the process of egg frying. To bring powerful prediction mechanisms to bear at this point would be a mistake.

Perhaps more important is our treatment of these two script types after they have been processed. We have stated what we would like to remember after having made use of a situational script. What is the analogy with instrumental scripts? It is not unreasonable to expect that, except under very unusual circumstances, we would want to forget the details of an instrumental script and remember only the goal. In fact, it is not implausible to even forget the script entirely, to save memory space and processing time. The reason that this can be done is that an instrumental script can always be rediscovered. If someone is smoking a cigarette, it must have gotten lighted somehow. If, for some reason we ever need to use this fact, it can be inferred and found as easily as if we had been told it.

The three script types described in this chapter can occur together in a juxtaposition that might include them all. For example, John could take Mary to dinner at a restaurant, doing various instrumental scripts along the way (lighting her cigarette, starting the car). However, during the meal he is affecting the personal script of **ROMANCER**. This affects his behavior every now and then, in what he says, how he walks, what wine he orders, but probably not in that he orders or pays the check (situational) or how he cuts his meat (instrumental).

3.7 Script-based Understanding

By subscribing to a script-based theory of understanding, we are making some strong claims about the nature of the understanding process. In order to understand the actions that are going on in a given situation, a person must have been in that situation before. That is, understanding is knowledge-based. The actions of others make sense only insofar as they are part of a stored pattern of actions that have been previously experienced. Deviations from the standard pattern are handled with some difficulty.

To illustrate this, consider the following example that recently happened to one of us. I received a phone call from an old friend who lives about 100 miles north of me. He said 'Hi, I'm on I-91'. (The highway that connects our respective cities.) I asked him if he would like to drop by and he said he would. I then asked him where he was exactly so I'd know when to expect him. He answered 'Well let's see, oh there's a sign coming up, it says, wait a minute, Wallingford next, uh, oh there it is, exit 14'. At this point I was totally baffled. I had visions of my friend having lost connection with reality. My 'telephoning before visiting' script did not have room in it for uncertainty about one's location that could be resolved by signs 'coming up'. It took me a while to realize that my friend, being a gadget-oriented person, had a phone installed in his car. What we had was the telephone script mixed with the driving script, a mix that I was quite unfamiliar with.

Of course, people can adapt to situations with which they do not have previous experience. This adaptability comes from knowledge of plans and goals discussed in Chapters 4 and 5. However, even there the point remains the same. People need a great deal of knowledge in order to understand. That knowledge can be of two kinds: specific and general. Scripts are intended to account for the specific knowledge that people have. Most of understanding is script-based.

Understanding then, is a process by which people match what they see and hear to pre-stored groupings of actions that they have already experienced. New information is understood in terms of old information. By this view, man is seen as a processor that only understands what it has previously understood. Our script-based program, SAM, works this way. It thus can be faulted on the basis that anything that it understands was preprogrammed into it in gory detail. We will meet other bases for understanding, but we view human understanding as heavily script-based. A human understan-

der comes equipped with thousands of scripts. He uses these scripts almost without thinking.

We will discuss how scripts are acquired in Chapter 9. A simple example will suffice here. One of us (RS) recently bought a new car. My daughter Hana (age 4) was with me when we bought it and asked if I was going to get a new key chain. I asked her what she meant. She replied that when we had gotten our old car in Rhode Island (where it had arrived off the boat 2 years earlier) I had bought a new key chain. This was her only experience with getting a car and already the events in it were a script for her. When you get a new car you get a new key chain. If people are building scripts at such an early age, it seems easy to imagine that the number they possess is great.