The Journal of Mind and Behavior
Winter 1986, Volume 7, Number 1
Pages 37–62
ISSN 0271-0137

Understanding Surprise-Ending Stories: Long-Term Memory Schemas Versus Schema-Independent Content Elements

Asghar Iran-Nejad

The University of Michigan

This paper discusses two approaches to the way people understand surprise-ending stories. One story grammar approach, called the *structural-affect* theory (Brewer and Lichtenstein, 1981), implies that the comprehension of the surprise-ending story, like that of its no-surprise version, occurs when the sequence of events in the story matches the sequence of events in a single underlying script. According to this view, the surprise-ending story and its no-surprise version are alternative surface structure representations of the same underlying event structure. The second approach, called the *functional-cognitive* approach, assumes that surprise-ending stories, unlike their no-surprise versions which are comprehended in terms of a single schema, create and uphold two incompatible global schemata. As a result, any theory dealing with the comprehension of surprise-ending stories is faced with the problem of global schema change, that is, with the problem of how surprise-ending stories can create and uphold two incompatible schemata, one immediately after another. It is concluded that only the functional-cognitive theory can provide a coherent picture of what is involved in the comprehension of surprise-ending stories. The implications of these issues for structural and functional theories, in general, are discussed.

Research on stories has concentrated for the main part on their formal structural characteristics. The most common structural approach to story comprehension and analysis, known as story grammar (Mandlar and Johnson, 1977; Rumelhart, 1975; Stein and Glenn, 1979; Thorndyke, 1977), assumes that there exist long-term memory structures that enable readers to distinguish strings of sentences that constitute stories from those that do not, in the same fashion that recent sentence grammarians (Chomsky, 1965) have accounted for language comprehenders' ability to distinguish strings of words that constitute sentences from those that do not (see Rumelhart, 1975).

Recently, the story grammar approach has generated much controversy (e.g.,

Preparation of the manuscript was supported in part by a National Institute of Mental Health social psychology grant (MH15801) to the University of Michigan. Requests for reprints should be sent to Asghar Iran-Nejad, Ph.D., Department of Psychology, University of Michigan, 580 Union Drive, Ann Arbor, Michigan 48109. We wish to thank Melvin Manis for his valuable comments on an earlier draft of this paper.

Black and Wilensky, 1979; Frisch and Perlis, 1981; Mandler and Johnson, 1980), rendering, as Wilensky (1983) put it, "the mistake in the analogy to sentence grammars . . . now . . . obvious" (p. 582). But, the implications of the issues raised have seldom been examined in sufficient detail to show exactly how the story grammar approach might fail in specific areas related to story comprehension and appreciation. Furthermore, with the exception of Wilensky's (1983) theory, aiming primarily at what constitutes a story (Wilensky, 1983, p. 591), no alternative approach of comparable generality has been proposed based on a set of assumptions different from those underlying current story grammars.

The first objective of the present paper is to show how, when examined closely, the only existing story grammar approach to the comprehension and analysis of surprise-ending stories, Brewer and Lichtenstein's (1981, 1982a, 1982b) *structural-affect* theory, is unable to deal with what might be the only unique aspect of the comprehension of the surprise-ending story, that it involves global schema change. An alternative functional-cognitive theory will then be discussed, and it will be shown how such a theory can provide a coherent account of the way surprise-ending stories are comprehended. Structural theories discuss story comprehension in terms of long-term memory scripts (Brewer and Lichtenstein, 1981; Schank and Abelson, 1977; Woll and Graesser, 1982) or schemas (Brewer and Nakamura, 1984; Minsky, 1975; Rumelhart, 1975, 1980). The functional approach maintains that there exist no long-term memory schemas, and that what makes comprehension possible is the work of schema-independent, self-organizing, content elements that create, re-create, and uphold transient mental schemas. The implications of these approaches for a general theory of global schema change will be discussed.

Structural-Affect Theory

This theory was proposed as an account of the psychological processes related to the particular subclass of narratives known as stories (Brewer and Lichtenstein, 1982a, p. 480). In particular, following a recent provocative observation made by Kintsch (1980) that "when reading a story, entertainment rather than information acquisition appears to be the dominant motive" (Kintsch, 1980, p. 88), the purpose of Brewer and Lichtenstein's (1981, 1982a) theory was "to examine some of the fundamental structural properties that lead to enjoyment" (1982a, p. 480). Brewer and Lichtenstein assumed that surprise is one of the basic affective responses that causes enjoyment in stories, and used a story grammar approach to investigate how stories surprise readers.

According to Brewer and Lichtenstein (1981), in order to account for surprise and other basic affective responses in stories, it is necessary to distinguish between two sequential structural levels. At one level, there is what they called the *event structure*. This is the abstract underlying sequence of events cor-

responding to the notion of deep structure in sentence grammars; here narrative events are arranged, in long-term memory, in the order one expects them to normally occur in the real world. The second sequential structure, the *discourse structure*, is the order in which narrative events are presented in the (surface) form of a particular story. Brewer and Lichtenstein (1981) argued that "this distinction between the event and discourse structures provides advantages that the distinction between abstract structure and surface structure provides for sentences" (p. 365).

According to the structural-affect theory, whether or not surprise occurs in the reader depends on the way the particular sequence of events in the story—the discourse structure—matches against the abstract sequence of events in the underlying event structure. Perhaps the simplest way to illustrate this is to note that corresponding no-surprise and surprise-ending stories are paraphrases of one another; they differ in the surface structure but not in the underlying script—they are "differently organized versions of the same event structure" (Brewer and Lichtenstein, 1982a, p. 363). In the no-surprise story, individual events occur in the order predicted by the underlying event structure. In the surprise-ending story, on the other hand, a significant underlying event or expository information is omitted from where it is expected to happen early in the story. Then later, "when something occurs that is a consequence of the missing information, the reader will not have been anticipating it and will be surprised" (Brewer and Lichtenstein, 1981, p. 366).

Consider, for instance, the butler-did-it narrative script (Brewer and Lichtenstein, 1981). In the underlying event structure, there are events (1) *The butler put poison in the wine* (the critical initiating event), (2) *The butler carried the wine to Lord Higginbotham*, (3) *Lord Higginbotham drank the wine*, and (4) *Lord Higginbotham fell over dead* (the critical outcome or ending information). In the no-surprise discourse version, these events are presented in the story in the above event structure order. Therefore, the instantiation of the slot for the critical initiating event—(1) above—gives away the critical outcome event—(4) above—and, as a result, the reader will not be surprised when this outcome occurs at the end. In the surprise discourse version, the particular critical initiating event (poisoning the wine) is omitted. As a result, when the particular outcome (the death of the master) finally occurs, it surprises the reader.

The Phenomenal Experience of Surprise

So far the structural-affect theory has not specified exactly how the slot-event matching processes relating the string of sentences in the story to a single underlying script can cause the phenomenal experience of surprise in the reader. But the following possibility is consistent with both the structural-

affect theory and the more general probabilistic models of schema-input interaction (Rumelhart, 1977). Early in the story and prior to the surprise, the abstract underlying script (e.g., the poisoning-of-the-master script) is retrieved from long-term memory and is matched against the events as they occur one after another. As particular events instantiate the slots of the operative script, the probability of the ending outcome remains low until the reader reaches the abstract slot for the outcome-relevant initiating event (e.g., poisoning-of-the-wine). Then, if the story contains the particular outcome-relevant information, the corresponding slot gets instantiated and the probability of the outcome goes up and remains high until the outcome finally occurs, causing no surprise. If, on the other hand, the outcome-relevant event is omitted from the story, the probability of the outcome will continue to remain low throughout the story and, to that extent, the reader will be surprised when the outcome finally occurs. In this fashion, the structural-affect theory can be used to explain the phenomenal experience of surprise in stories in terms of changes in the *probability* of the story outcome.

It has been claimed that there are inherent constraints on traditional structural theories—those depending exclusively on pre-existing abstract structures to guide the process of top-down or bottom-up comprehension—that render them incapable of dealing with both affect and unexpected information (Iran-Nejad, Clore, and Vondruska, 1984; Lehnert, 1981). Brewer and Lichtenstein's structural-affect theory, therefore, represents a critical stage in the evaluation of the story grammar approach in a domain where structural theories have been claimed to be most severely deficient. There is currently no evidence on just how severe or inherent a constraint is imposed on structural-affect theory by the (tacit) assumption that no more than the knowledge of the sequential order of events is needed from readers' background knowledge to explain the comprehension of surprising information.

Empirical Evidence

Two studies (Brewer and Lichtenstein, 1981, 1982b) have reported evidence in support of the structural-affect theory. Brewer and Lichtenstein (1981) manipulated the sequence of outcome-relevant events in stories and showed that surprise does indeed occur in the manner prescribed by the theory. One of their stories was about a man driving home from work. The surprise-ending version was designed to end in an unforeshadowed critical outcome. As the man reached home and was closing the door of the house behind him, he saw his car explode into a fountain of flames in the driveway. Unknown to the reader, the Mob had planted a bomb in his car. Surprisingness ratings showed that story versions that contained unforeshadowed outcomes such as the above surprised the subjects at the point this outcome was presented.

In other words, as predicted by structural-affect theory, the omission of a discrete initiating event (i.e., planting a bomb) surprised the reader when the outcome of this event (the explosion) occurred at the end. Similar results have been reported in Brewer and Lichtenstein (1982b) and in Iran-Nejad (1983).

There is some evidence suggesting that the degree of surprisingness of the story outcome may not be a function of the order of discrete outcome-relevant story events per se. For instance, in one study, introducing the outcome-relevant event early in the story failed to reduce the degree of surprisingness of the story outcome (Iran-Nejad, 1984). Subjects read a story about a nurse, Marilyn, who left the hospital where she worked after one late night shift (Thurmond, 1978). On the way home, she noticed that she was about to run out of gas. She remembered the sudden surge in attacks in the area and went to her usual gas station for gas. When she was about to leave, the attendant, Gabriel, asked her to go inside his office to see a birthday gift. She reluctantly went with him. Once inside, he locked the door and took a gun out of the drawer. Finally, subjects read that she "yielded to the pressure of Gabriel's rough hand on her shoulder pushing her to the floor." The story stem (i.e., the pre-surprise portion) ended with a sentence stating that "before closing her eyes, she saw him glimpse out of the window with the gun clutched in his hand." Then, subjects read the unforeshadowed ending: Gabriel told Marilyn, "Sorry I had to scare you like that; I was scared myself when I saw that dude on the floor in the back of your car." Subjects rated this surprise-ending version as highly surprising. However, another group of subjects read a second version exactly like the first except that the latter also introduced, early in the stem, the critical ending-relevant information. Right before Marilyn went to the gas station, "she felt she could hear somebody breathing behind her in the car" and "she even felt breath on the back of her neck." The results showed that this second story version was rated as no less surprising than the first version, and both of the above versions were rated as significantly more surprising than a control no-surprise version, in which she ended up in the hospital. Giving away the ending-relevant information failed to reduce the degree of surprisingness of the ending. Iran-Nejad (1984) argued that the contribution of the pre-surprise portion of the story to the experience of surprise is perhaps determined by the information that is *present* in it and not by what is *absent* from it.

In a second experiment, Iran-Nejad (1984) obtained data suggesting that the surprise-ending story, rather than instantiating a single underlying script, creates and upholds two incompatible global schemata, one before the surprise and one after it. Subjects read two versions of the Marilyn story. One group read the surprise-ending version, consisting of the stem which implied that someone might be hiding in the car, and the maniac-in-the-car ending.

The second group read the no-surprise version, consisting of the same stem and the ending in which Marilyn woke up on a hospital bed. Both groups then rated inference statements derived a priori from the information in the stem. Some of the statements were consistent with the pre-surprise global schema (e.g., (1) *Gabriel threatened Marilyn with a gun*) and some were consistent with a global schema thematically opposing the pre-surprise schema (e.g., (2) *Gabriel protected Marilyn with a gun*). The results showed that subjects in the no-surprise condition, that were expected to use only one global schema—the pre-surprise schema—rated statements like (1) as consistent with the story and those like (2) as inconsistent with it, indicating that these subjects made their judgments based on the pre-surprise schema. Subjects who read the surprise-ending version showed the opposite pattern. They rated (1) as inconsistent with the story and (2) as consistent with it, suggesting that they based their judgments not on the schema they presumably used prior to the surprise but on one opposite to it—which they formed in response to the maniac-in-the-car ending information.

Structural-Affect Theory and Global Schema Change

Assuming that the comprehension of surprise-ending stories does involve global schema change, to what extent can the mental structures and processes postulated by structural-affect theory explain it, a posteriori. The structural-affect theory is based on the following concepts: (a) an underlying surprise event structure, (b) a surface surprise discourse structure, (c) a surface no-surprise discourse structure, (d) a significant initiating outcome-relevant event, (e) and an ending-outcome or conclusion. Furthermore, consistent with the theory, it can be assumed that three script-guided processing operations relate the underlying event structure—(a) above—to either of the two alternative discourse structure versions—(b) or (c) above. The underlying script contains slots that can get *instantiated* by particular discourse events; it can *generate default assumptions* if information is not explicitly stated in the discourse; and it can *accommodate* to input information (e.g., replace earlier default assumptions by new ones) if this information cannot fit the ongoing slot expectations. Now, slot instantiation, default generation, and accommodation are *within-script*, as opposed to between-script, processes; they are all guided by the operative script; and they are responsible for the way discrete text elements are matched against discrete script slots in a typical (i.e., no-surprise) or atypical (i.e., surprising) fashion. Given the above within-script processes, it is not obvious a priori how a single surprise-ending story can create and uphold two incompatible global schemata, one immediately after another. In other words, between-schema processes must direct the mind from one global schema to another thematically incompatible with it but, as it

is, the structural-affect theory is not equipped with such processes.

Similarly, the more static relations, as opposed to the above processing operations, postulated by structural-affect theory are also script-driven or within-script connections. First, the relationship between the withheld ending-relevant event and the abstract script is a slot-instance relation, the underlying surprise event structure must contain an abstract slot into which the particular discourse event can fit if it is presented in the story (see Brewer and Lichtenstein, 1982a, p. 480). Secondly, the relationship between the underlying script and the particular final outcome in the story ending is also a slot-instance relation. And, finally, the relationship between the to-be-withheld event and the ending outcome is ordinarily a cause-effect relation. For instance, in the poisoning-of-the-master script, the poisoning-of-the-wine event causes the death-of-the-master outcome. This last relationship is particularly critical, as far as the structural-affect theory is concerned, since it constitutes the basis for the a priori determination of what it is that must be withheld to make a story-ending surprising. Once again, it is not clear how script-driven relations in terms of a single underlying structure can direct the mind from one global schema to another.

This rather detailed analysis of the relational and processing components of structural-affect theory substantiates the recent concerns that story grammar approaches such as the present one are unable to deal with information that does not conform to script-driven relations and does not obey script-guided processes. This is especially true since the pre-surprise schema must provide the context for the comprehension of surprising information and the subsequent creation of the post-surprise schema, precluding the possibility of discarding one schema and replacing it with another from long-term memory in an all-or-none fashion. The structural-affect theory gives no clues at all about how the pre-surprise schema can provide the context for the comprehension of surprising information, information which is inconsistent with the pre-surprise schema itself and which is meaningful only in terms of a schema incompatible with the pre-surprise schema.

It is, of course, possible to deny altogether that genuine between-schema change occurs. For instance, incompatible schemata can always be connected by within-schemata relations and operations in terms of more abstract superschemas. Then, when the operative schema cannot assimilate certain input information, as seems to be the case with surprising information, comprehension processes could merely shift to some higher level of abstraction to find a within-schema connection in terms of a more abstract superschema. Once such a high-level connection is found, it can serve as a bridge supporting a shift from one lower-level schema to another incompatible with it. The hierarchical tree structure that this type of schema change requires is a major component of structural story grammar, and structural schema theories in general. However, researchers concerned with process models of narrative

comprehension have not always found them particularly satisfactory. Lehnert (1981), for instance, pointed out that "a hierarchical story grammar simply cannot be general enough to capture large variations in plot structures" (p. 329). In other words, one cannot assume that, once the hierarchical path to an abstract superordinate connection is traversed, descending along an alternative path leads to a ready-made post-surprise schema. In any event, as far as the problem of how change can occur from one schema to another is concerned, this option is, in principle, clearly open to structural schema theories.

Finally, rather than questioning the possibility of genuine schema change, one might argue that there are two types of surprise-ending stories: those whose comprehension involves two incompatible schemata and those that are comprehended in terms of a single underlying structure. It could then be argued that the structural-affect theory was designed to deal only with the second type of stories. Whether or not there are surprise-ending stories that are comprehended only in terms of within-schema processes and relations is an empirical issue. For instance, the hypothesis that the comprehension of surprise-ending stories involves two thematically opposite schemata implies that some of the examples provided by Brewer and Lichtenstein to illustrate the structural-affect theory do not quite fit the pattern for surprise-ending stories.

Consider the following example from Brewer and Lichtenstein (1982a): "'Charles got up from the chair. He walked slowly toward the window. The window broke and Charles fell dead. The sound of a shot echoed in the distance'" (p. 480). Brewer and Lichtenstein argued that this is a surprise discourse structure because the critical event, a sniper is within range of Charles' window, has been omitted. Note that given the early events (i.e., Charles getting up, walking toward the window, the window breaking, and Charles dying), the probability of the ending event (i.e., the sound of a shot echoing in the distance) is virtually zero—perhaps the old man's heart gave up when the window broke. However, the functional-cognitive theory implies that the ending event in this example should not be surprising at all because the early events fail to suggest a coherent pre-surprise schema.

Brewer and Lichtenstein's (1981) other main example (i.e., the butler pouring the wine, taking it to Lord Higginbotham, Lord Higginbotham drinking it, and Lord Higginbotham dying) does fit the surprise-ending story pattern; but, according to the alternative theory, this is primarily because the early sequence of events causes a pre-surprise entertainment-of-the-master schema, which then changes into the post-surprise poisoning-of-the-master schema.

The Role of Content

Perhaps a potentially more devastating limitation of the structural-affect theory, than being inadequately equipped to deal with qualitative schema

change, is the assumption that no more than the sequential structure of discrete narrative events—the underlying event structure—is needed from the reader's background knowledge to characterize the comprehension of surprise-ending stories. For instance, the theory makes no provisions at all for any role played by content. The main reason for this seems to be historical. As noted earlier, the structural-affect theory is an extension to story affect of the story grammar approach, which is itself an extension of recent theories of syntax (Chomsky, 1965) to the comprehension of story discourse (Rumelhart, 1975). It is, therefore, not surprising if the structural-affect theory is led to account for surprise exclusively in terms of the instantiation of the abstract sequential structure of events, at the expense of content, in the same fashion that its linguistics predecessors accounted for the language comprehender's intuitions about sentences exclusively in terms of abstract syntactic structures, at the expense of meaning. However, content and meaning seem to play a critical role in causing surprise. Consider, for instance, the poisoning-of-the-master narrative script. If in a particular story one changes the protagonist to Superman, then the no-surprise discourse version (i.e., the butler putting the poison in the wine, taking it to Superman, Superman drinking it, and Superman dying) will be likely to cause surprise.

The Functional-Cognitive Approach

Schema-Independent Determinants of Mental Functioning

Structural theories assume that in order for comprehension to take place there must exist ready-made innate or acquired long-term memory structures. At the time of reading, these structures are retrieved and instantiated. According to structural theory, script-guided processes and script-driven relations play the primary, if not the exclusive, role in top-down or bottom-up mental functioning. Without such processes and relations no comprehension can take place: "Perceivers pick up only what they have schemata for and willy-nilly ignore the rest" (Neisser, 1976, p. 80). Clearly, few authors hold such an extreme view of the role of schemata in mental functioning; but it is also true that schema theories have made no attempts at specifying schema-independent mechanisms. In structural theories, content plays a completely passive role in mental functioning: it simply fills the slots of the operative script.

The fundamental assumptions of the functional-cognitive theory are in stark contrast with those of the structural-affect approach. In general, it is the schema-independent sources that play the primary role. Not only are these sources responsible for the creation and upholding of mental schemata, but also for the emergent biasing control exerted by the created schema itself on

its component elements. In other words, in the functional approach, schemata are not assumed; they must be explained in terms of schema-independent sources (Iran-Nejad, Clore, and Vondruska, 1984; Iran-Nejad and Ortony, 1984, 1985).

One functional assumption is that mental structures are transient patterns—no long-term memory schemas exist. This means that every mental structure must be created afresh every time it appears mentally and that, once created, mental schemata can be maintained if and only if they continue to be actively upheld by schema-independent sources. As Bartlett (1932) once put it, schemata can exist only if they "are actively *doing* something all the time" (Bartlett, 1932, p. 201). Interestingly, Bartlett (1932), who is often cited in the context of structural theories, stated that his approach was based on the "study of the conditions of organic and mental functions, rather than . . . [on] an analysis of mental structures" (p. 304).

Another fundamental functional assumption is that the ultimate loci of schema-independent sources are what might be loosely referred to as *content elements*. The main characteristic of such long-term memory elements, as opposed to long-term memory schemata, is that they possess functional properties that render them autonomous and self-organizing[1]. These functional properties enable content elements to create and uphold an indefinite number of mental structures at different times without requiring any one element to be permanently monopolized by any one structure. Thus, during reading, discrete text elements activate discrete content elements; and, as more self-organizing content elements get activated, they organize and combine to create and uphold a transient global schema.

Not only can schema-independent functional properties enable content elements to organize and combine but also to unorganize and uncombine under certain conditions. Recall that schema-independent functional properties are responsible for the biasing control that the global schema imposes on the very elements that are upholding it. Uncombination enables individual autonomous elements to regain their freedom from the shackles of this biasing control. In other words, content elements upholding a global schema continue to dance, so to speak, to the organizational tune of the schema that they are upholding. Uncombination disrupts the tune, lifts structural bias, and sets individual content elements momentarily free of schema influence.

The functional schema itself differs fundamentally from the structural schema. Structural schemata are generally conceived as abstract long-term

[1]More detailed discussions of functionally autonomous and self-organizing elements may be found in Iran-Nejad, Clore, and Vondruska (1984) and Iran-Nejad and Ortony (1984). For the purpose of the present paper, however, it will be seen that even in its most general form the idea that content elements are self-organizing contributes substantially to alternative ways of conceptualizing such difficult issues as schema change and automaticity.

frames consisting of discrete (event) slots (or variables) bound by discrete associative links. If some of the slots or connections decay, the fragments still belong to the same schema just as when dinosaur bone fragments decay, the remaining pieces still belong to the same structure (Neisser, 1967, p. 285). Similarly, if a critical component event is withheld, the (underlying event) structure will still remain the same. The functional schema, on the other hand, while being created by discrete elements, is itself emergent and nondiscrete—it is a global continuous pattern with localized discrete microsystems upholding it (Iran-Nejad and Ortony, 1984; Katchalsky, Rowland, and Blumenthal, 1974). In this sense, the global schema is analogous to a pattern of light generated by a constellation of (discrete) color-coded lightbulbs. In a functional schema, therefore, if a (critical) component is omitted, the global pattern will no longer remain the same, in the same fashion that if, for instance, the green lightbulbs are turned off the resulting light pattern will no longer have the same color.

So far, the microsystems creating and upholding the global ongoing schema have been referred to as *content elements*. It must be noted, however, that the use of the term *content* in this phrase is not intended to imply that the elements themselves are content objects. The relationship between the whole and its self-organizing content elements is like the relationship between a chemical compound and its component atoms. As John Stuart Mill (1843/1965) put it, "the complex idea, formed by blending together of several simpler ones, should . . . be said to *result from*, or be *generated by*, the simple ideas, not to *consist* of them" (p. 29). As used here, the relationship between the content and *content* elements is analogous to the relationship between the light and *light*bulbs.

Schema Creation and Change

Given the above assumptions, it can be readily specified how a single surprise-ending story can support two incompatible schemata. Prior to the surprise and as the story unfolds, more and more discrete text elements sequentially activate a large number of self-organizing long-term memory elements. Once activated, these elements organize and combine to create and uphold a coherent pre-surprise global schema inconsistent with the surprising information. Then the surprising information occurs and, being incompatible with the schema, it momentarily globally unorganizes the pre-surprise content elements, rendering the transient pre-surprise global schema nonexistent. This aschematic state of momentary content unorganization causes the phenomenal experience of raw (i.e., unresolved) surprise. The aschematic state also means that the content elements that were upholding the pre-surprise schema are now suddenly free from the shackles of its structural bias. As a result, the functionally autonomous and self-organizing elements momentarily

reorganize themselves, in light of the content elements activated by the surprising information, into the post-surprise global schema.

As an example, we will consider how the poisoning-of-the-master story is comprehended. During the early part of the story, text elements representing the events pouring the wine, taking it to the master, and the master drinking it activate discrete content elements that will then combine to create and uphold a coherent entertainment-of-the-master pre-surprise schema. The content elements involved in supporting this global schema are those generating such images and ideas as *wine color, wine taste, enjoyment, loyal butler, wealth, healthy master,* and so on, unified into a single schema. Then, when the surprising information occurs, new self-organizing content elements are introduced (e.g., those creating the idea of death) that are incompatible with the entertainment-of-the-master global schema. As a result, the pre-surprise schema cannot suddenly be upheld and the self-organizing content elements creating it become unorganized—the transient functional relations disintegrate. The pre-surprise schema disappears and the phenomenal experience of raw surprise occurs in the reader. This sets the conditions for (a) the instantaneous combination of two sets of self-organizing long-term memory elements (i.e., the unorganized pre-surprise content elements and the content elements activated by the surprising information), (b) the resolution of the surprise, and (c) the sudden emergence of the post-surprise poisoning-of-the-master schema.

Inference

One of the critical functions of long-term memory structures in structural schema theories is that they provide the basis for going beyond the information explicitly given in the text of the story—for making default assumptions or inferences. The functional-cognitive theory claims that no long-term memory structures exist. Rather, inferences are content-generated—they emerge out of the combination of content elements, in the same fashion, to use an analogy, that properties of substances emerge out of the combination of their constituent elements.

Consider, for instance, the poisoning-of-the-master narrative. In this story, the surprise-ending sequence of events (i.e., the butler pouring the wine, taking it to the master, the master drinking it, and the master dying) implies that the wine may have been poisoned, although poison is not mentioned anywhere. Where does the idea of poison come from? The structural-affect theory implies that this idea is stored in the slot for the outcome-relevant event in the underlying poisoning-of-the-master structure and can, therefore, be produced by default when not stated explicitly. The abstract underlying structure is activated early in the story and, as the story unfolds, all its slots get instantiated prior to the surprise except the poisoning-of-the-wine slot.

Since this slot is related to the (death-of-the-master) outcome, it produces the concept of poison by default as soon as the unforeshadowed outcome occurs.

The functional-cognitive theory must explain how the idea of poison arises out of the combination of post-surprise content elements, based on their schema-independent, self-organizing properties. In order to see how this can occur, we must first consider where the post-surprise content elements come from. First, as argued earlier, the majority of these elements are already active—those that were upholding the pre-surprise schema. Among these are elements creating pre-surprise content components such as *normal wine, enjoyment, loyal butler, living master.* These elements contribute to such post-surprise content components as *abnormal wine, suffering, disloyal butler, dead master.* More specifically, it is assumed that although pre-surprise content components (e.g., enjoyment) and their corresponding post-surprise content components (e.g., suffering) are mutually incompatible at the subjective level, they nevertheless share in self-organizing content elements at the pre-subjective level (see Iran-Nejad and Ortony, 1984). The pre-subjective content can contribute elements to a qualitatively different post-surprise schema because it becomes unorganized in response to the schema-inconsistent surprising information, and the bias on the elements exerted by the pre-surprise schema is momentarily lifted. The pre-surprise self-organizing elements, then, "shake off" the qualitative properties (or the "color" of) the pre-surprise global schema, reorganize themselves, and adopt the "color" of the post-surprise schema. Another set of content elements contributing to the post-surprise schema is activated by the discrete text elements of the surprising information. Finally, the very acts of unorganization and re-organization can activate an additional set of content elements (Iran-Nejad and Ortony, 1984).

One can assume, therefore, that the idea of poison emerges because, for instance, the pre-surprise content component *usual wine* reorganizes, adopts the color of the post-surprise schema, becomes *unusual wine,* and combines with other pre-surprise content elements to create the more complex idea *Lord Higginbotham drank unusual wine.* This complex idea further combines with content elements activated by the surprising information *Lord Higginbotham fell over dead,* generating the inference that the master drank *deadly* or *poisoned* wine. In sum, the functional-cognitive theory implies that various functionally independent and self-organizing content elements combine to create the post-surprise schema and its components without the involvement of any pre-existing long-term memory blueprints.

Contributing Sources and their Functions

A unique characteristic of the functional-cognitive approach is that it provides a detailed account of the various dynamic sources that contribute to

the mental functioning that leads to the experience of surprise and the comprehension of surprising information. The most basic among these sources is what has been called discrete content elements. According to the functional-cognitive theory, rather than passively filling the slots of long-term memory frames, content elements create and uphold the pre-surprise schema by assuming a particular pre-surprise organization according to their schema-independent self-organizing properties; they serve as the most direct cause of the experience of raw surprise when they become momentarily unorganized; and they create and uphold the post-surprise schema.

The second indispensable source is the pre-surprise schema itself. The functional-cognitive theory distinguishes between pre-subjective (i.e., unorganized, aschematic) content elements and the subjective (i.e., mental) global schema. The claim that the global schema emerges out of a particular organization of self-organizing content elements does not mean that the schema itself plays no unique role once it is created. In fact, the content elements upholding the global schema and the global schema itself seem to possess opposing functional properties. First, the global schema must be incompatible with the surprising information while the content elements upholding it must be consistent with the content elements activated by the surprising information. No surprise can occur if the pre-surprise schema and the incoming information are compatible; and surprise cannot be resolved if the content elements upholding the pre-surprise schema and those activated by the surprising information are incompatible. If the functional-cognitive theory is correct, these two sets of elements must later create and uphold the post-surprise schema. This means that the schema, while emerging out of organized content elements, is not the same as organized content per se. The critical difference is that content elements are discrete; whereas the schema is emergent and nondiscrete; the set of active content elements is different from the global schema it creates in the same way, by analogy, that a burning constellation of color-coded lightbulbs is different from the global non-discrete pattern of light that it generates.

Another critical role played by the emergent pre-surprise schema is that, once created, it serves to sustain the activity of individual content elements that create and uphold it—it exerts structural bias, so to speak, on its own component elements. Without the influence of such schema bias, elements that become activated tend to be forgotten, because they cannot enter into any particular organization. This claim finds support in the body of evidence showing that the memory for organized material is better than that for unorganized material (e.g., Brent, 1969; Lachman and Dooling, 1968; Mandler and Johnson, 1976). Finally, the surprising information plays its role in that (a) it serves to unorganize the pre-surprise content elements—hence, causing

surprise—and (b) it introduces additional content elements that are required to resolve the surprise and create the post-surprise schema.

In this fashion, the functional-cognitive theory can explain how a single surprise-ending story can create and uphold two incompatible global schemata. More specifically, the theory implies that the content elements that the story activates prior to the surprise and the content elements that are activated by the surprising ending are compatible. This is how what is learned prior to the surprise can contribute to the comprehension of the surprising information. On the other hand, the pre-surprise global schema and the surprising information are incompatible and, as a result, can interact to cause the phenomenal experience of surprise. Similarly, the pre-surprise and post-surprise global schemata are incompatible in that they impose opposite subjective interpretations on what is learned prior to the surprise.

Some Empirical Evidence

As argued earlier, structural schema theories provide no a priori basis for conceptualizing how a single surprise-ending story can support two incompatible global schemata, one immediately after another. First, they offer no clues about what dynamic operations can change an ongoing schema to a subsequent incompatible one. Secondly, they make no provisions for how schema-unrelated information can be held in memory long enough to be used later, or about how information related to the pre-surprise schema can be used in relation to an incompatible post-surprise schema. An additional problem is to specify what it is that makes two schemas mutually incompatible.

One might assume that two schemas are unrelated if they do not share components and are similar to the extent that they do. But what makes schemas incompatible? Schemas could be incompatible to the extent that they contained diametrically different components; but this would suggest that incompatible schemas are more different (or farther apart) than unrelated schemas, which is clearly wrong. Another possibility is to view incompatibility as a basic relation at the level of components. For instance, McClelland and Rumelhart (1981; Rumelhart and McClelland, 1982) proposed a hierarchical network model in which excitatory and inhibitory connections, representing consistent and inconsistent relations, were assumed to be operative at all levels. Activation-inhibition relations may account for functional incompatibility at the level of neural hardware, but their generalizibility to incompatible structures at the level of complex mental phenomena is questionable.

Incompatibility can also be conceptualized in terms of nonassociative opponent processes (Hering, 1897; Hurvich and Jameson, 1957; Solomon and Corbit, 1974). Opponent-process theory and functional theory are similar in that they both postulate two antagonistic modes of functioning (Iran-Nejad

and Ortony, 1984). They differ in that the functional model implies that the two mutually exclusive modes of functioning arise from moment by moment cohering or incohering functional interaction among neuronal microsystems, and not from past experience. The functional model also implies that cohering and incohering modes of functioning are responsible for such presumably antagonistic experiences as curiosity versus fear, suspense versus anxiety, or interest versus aversion; but antagonistic modes of functioning cannot by themselves account for the incompatibility between particular coherent mental units such as black versus white, love versus hate, or good versus bad. According to the functional model, a different type of mutual exclusion is responsible for incompatibility of the latter kind.

The opponent-process model assumes that two incompatible structures can exist simultaneously, one in a state of activation and one in a state of inhibition ready to emerge upon sudden termination of the active state, in the same fashion that in color vision sudden loss of stimulation in terms of one color can result in a perceptual after-image of the opponent color. The functional approach implies that the post-termination state emerges not because it already exists but because the self-organizing content elements upholding the state just terminated must, being already active, reorganize themselves into a new state, much in the same way as the content elements upholding the pre-surprise schema reorganize themselves into the post-surprise schema. Thus, the opponent-process model implies that two mental states are perceived as incompatible because they are two separate states joined by opponent activation-inhibition processes. The functional approach implies that two subjectively different mental states (i.e., two mental states perceived as qualitatively different in experience) are also perceived as incompatible to the extent that they cannot exist simultaneously because content elements that must uphold one are also necessary for the creation of the other. This is the type of mutual exclusion that is responsible for incompatibility between two coherent mental states. In this way, the functional approach makes the counterintuitive prediction that two different schemas are incompatible to the extent that they share elements.

The opponent-process theory implies that two incompatible mental states (e.g., pre- and post-surprise schemata) must be supported by different components because the two states must be able to exist simultaneously (the different-components hypothesis). This means that, when one state is operative, its content components are available and the content components of its opponent state are unavailable, because they are in a state of inhibition. Therefore, one might argue that a single surprise ending story upholds two incompatible schemas because it can activate two separate sets of content idea units, one supporting the pre-surprise schema and one supporting its opponent post-surprise schema. It follows that if two separate groups of

subjects read and recalled the no-surprise and surprise-ending versions of the same story, one group should be likely to recall one of the two sets of content elements but not the other and vice versa. The functional hypothesis implies that basically the same set of content idea units supports both schemata and, therefore, subjects reading the no-surprise and surprise-ending versions of the same story would be likely to recall the same set of idea units (the same-components hypothesis).

Recently, we have conducted two experiments that supported the same-components hypothesis. Different groups of subjects read the no-surprise and the surprise-ending versions of the Marilyn story. In one experiment, subjects read the story, completed a 10-minute math test, and recalled the story. In a second experiment, two different groups of subjects read the same stories and rated each idea unit as to how important it was for the overall story. The highly significant correlation between the recall scores of the same idea units across different conditions was .69 and that between importance ratings was .64, supporting the hypothesis that the idea units available and important in terms of the pre-surprise schema were also available and important in terms of the post-surprise schema.

Ease and Rapidity of Global Schema Change

The functional-cognitive theory implies that the phenomenal experience of surprise arises out of a momentary state of mental-content unorganization, and that there are two necessary and sufficient conditions for such unorganization to occur: prior establishment of a coherent global schema to make the to-be-unorganized content elements available and the sudden occurrence of incompatible information to render them unorganized. These two conditions are also necessary for the global schema change that can follow the phenomenal experience of surprise, but they are not sufficient. The functional cognitive theory implies that at least two additional conditions must hold for global schema change to occur: there must exist no significant pre-surprise content components incompatible with the to-be-created post-surprise schema, and there must be available among the pre-surprise content elements and the content elements activated by the surprising information a set of elements capable of creating and upholding an alternative post-surprise global schema. To the extent that a story can support these four conditions, it must represent a good surprise-ending story.

A further implication of the functional-cognitive theory is that whenever and wherever the above conditions hold, global schema change must occur readily and rapidly. That such is global schema change in surprise-ending stories was demonstrated in another experiment (Blanchard and Iran-Nejad, in press). Different subjects read the same physical texts as a surprising or

non-surprising story ending, while eye movement and reading time were being recorded. One of the stories used was the Marilyn story. The results showed that the time to comprehend the same critical ending statement (i.e., "I saw a man on the floor in the back of your car") was on the average 1810 milliseconds when it was not surprising and 3095 when it was surprising. This finding suggests that the global reinterpretation of the 800-word pre-surprise story stem occurred in a little more than 1 second, barely enough time to read for a second time the same 13-word surprising statement. As will be argued in the next section, it is not clear how the long-term memory schema hypothesis can explain rapid global schema changes of this type.

Implications Beyond Surprise-Ending Stories

Schema Perseverance and Change

More than half a century ago, Bacon (1920) noted (see Nisbett and Ross, 1980; Lord, Ross, and Lepper, 1979) that "the human understanding when it has once adopted an opinion draws all things else to support and agree with it" (p. 50); and today such evidence as there is on the topic supports the claim (Kuhn, 1962; Lord, Ross, and Lepper, 1979; Mahoney, 1977; Nisbett and Ross, 1980; Ross, Lepper, and Hubbard, 1975). For instance, Nisbett and Ross (1980), who reviewed the relevant literature, concluded that "Bacon is correct: People seem to persist in adhering to their theories to a point that far exceeds any normatively justifiable criterion of 'conservatism' " (p. 169) and that "few critiques of human judgmental failings ring as true as Bacon's (1920) attack on people's tendency to adhere to a preconceived belief in the face of evidence that ought, rationally, to weaken or even reverse the belief" (p. 167).

One possible reason why rapid schema change is so rare is that there are inherent constraints on human mental structures and processes. Capacity limitations, for instance, may prohibit rapid extensive change. This possibility follows readily from the long-term memory schema hypothesis of structural schema theories. Here, capacity limitations are surmounted, only for processing of schema-relevant information, through structural automaticity. This type of automaticity is based on long-term connections between concepts established only after a great deal of consistent, and initially controlled, practice. Change is impossible if it means extensive processing involving novel connections or alteration of already-automatized associations, which can only occur through the mediation of the inordinately slow and tightly capacity-limited mode of controlled processing.

The limitations imposed by structural theories on mental functioning are indeed very severe. As mentioned in earlier sections of this paper, the overall

structural component that these theories postulate is a long-term hierarchical network consisting of "a large and permanent collection of nodes that become complexly and increasingly interassociated and interrelated through learning" (Schneider and Shiffrin, 1977, p. 2). Then, as far as the ease and speed of occurrence are concerned, two modes of processing operate on the structural network. The first mode, called *controlled processing*, occurs under the control of, and through attention by, the subject. This mode of processing "may be set up, altered, and applied in novel situations" with relative ease, but it is also very slow and severely capacity-limited (Schneider and Shiffrin, 1977). The second mode, called *automatic processing*, has the opposite characteristics. It occurs rapidly but it is difficult to alter and is inapplicable in novel situations: "Since an automatic process operates through a relatively permanent set of associative connections in long-term store, any new automatic process requires an appreciable amount of consistent training to develop fully. Furthermore, once learned, an automatic process is difficult to suppress, to modify, or to ignore" (Schneider and Shiffrin, 1977, p. 2).

Thus, controlled processes are flexible but inordinately slow and automatic processes are fast but firmly inflexible, barring, jointly, the ease and rapidity of extensive change. It appears, then, that structural theories imply that, as far as the ease and speed of global schema change are concerned, there are severe inherent constraints on mental machinery. Structural automaticity can guarantee rapid extensive processing only to the extent that there are long-term memory connections. For instance, as observed by Clary and Tesser (1983), "the response [to expected information] most likely involves automatic (Shiffrin and Schneider, 1977) or mindless (Langer, Blank, and Chanowitz, 1979) processing where little thought or attention is required" (p. 611). Activation rapidly spreads in the associative network; but there is no mechanism to easily undo, certainly not with any degree of rapidity, what is accomplished by passive spread of activation quickly. Furthermore, since the "processing of discrepant information is believed to involve a more controlled mode of thought" (Clary and Tesser, 1983, p. 611) and since comprehension of disconfirming information often requires rapid and extensive reinterpretation and reorganization, it is not clear, given the mechanisms of structural automaticity and permanent associations, how rapid schema change can occur at all; and this seems to be supported by the evidence that this type of schema change does not ordinarily occur.

Functional Automaticity and Perseverance

Rather than postulating inherent constraints on the mechanisms of change, or, rather than postulating mechanisms with inherent constraints, one might postulate mechanisms that can readily accommodate rapid schema change

but also assume that there are pragmatic constraints on the necessary and sufficient conditions of change. For instance, according to the functional-cognitive theory, one necessary condition for global schema change is that the incoming (surprising) information must globally unorganize the pre-surprise content elements momentarily. The theory also implies that unorganization is caused by schema-independent, self-organizing, functional properties of the content elements that the surprising information activates. To the degree that the incoming information is abstract and pallid, it lacks concrete self-organizing properties and, as a result, fails to exert global unorganization.

The mechanisms that the functional theory postulates impose no inherent *structural* constraints. Functional schemata are transient and intrinsically changeable, and the elements that create and uphold them possess concrete self-organizing properties that readily admit, in principle, rapid organization and unorganization. In other words, the mental machinery postulated possesses built-in *functional automaticity*, the type of automaticity that results from concrete schema-independent properties of content elements, as opposed to structure-driven automaticity that is established after repeated consistent training. In functional automaticity, self-organizing properties enable content elements to combine readily and rapidly to create ongoing mental structures, much in the same way, by analogy, that chemical elements can combine readily and rapidly under suitable conditions. Furthermore, schema-independent functional properties of content elements also admit, and here is where the analogy perhaps breaks down, uncombination readily and rapidly under appropriate conditions.

It appears then that the structural approach can explain stability but it cannot readily explain the type of global schema change that seems to occur in the comprehension of surprise-ending stories. By contrast, the functional approach faces no difficulty in explaining the ease and rapidity of global schema change in stories, but gives the immediate impression of being too flexible to account for stability. Indeed, if structural stability were the only type of stability, the mental machinery postulated by the functional theory would be devastatingly flexible. However, one must consider the possibility that the alternative, namely, *functional stability*, can be as unyielding. As Miller (1978) illustrates, there are at least two types of stability:

> The survival of form depends on one of two principles: the intrinsic stability of the materials from which the object is made, or the energetic replenishment and reorganization of the material which is constantly flowing through it. The substances from which a marble statue is made are stably bonded together, so that the object retains not only its shape but its original material. The configuration of a fountain, on the other hand, is intrinsically unstable, and it can retain its shape only by endlessly renewing the material which constitute it; that is, by organizing and imposing structure on the unremitting flow of

its own substance. *Statues preserve their shapes; fountains perform and reperform theirs.* (p. 140, italics added)

If the functional assumption is correct, schemata, like fountains, are intrinsically unstable and their actual stability is completely determined by the system that continues to create and re-create them. It must be noted that it is not the case that functional stability is proposed as an a posteriori explanation of schema stability. Rather, functional stability predicts schema perseverance a priori. Consider, for instance, the hypothesis, discussed earlier in connection with the pre-surprise and post-surprise global schemata, that basically the same content elements can create and uphold two internally coherent but mutually incompatible schemata. Another way of stating this hypothesis is that different groups of subjects holding incompatible initial schemata may find support in the same data for their opposite views, which is one of the major findings of perseverance studies (see Lord, Ross, and Lepper, 1979; Nisbett and Ross, 1980).

Perseverance in Stories

The evidence suggests that global schema change occurs readily and rapidly in surprise-ending stories, but perhaps not elsewhere. The functional approach implies that the conditions most directly responsible for schema change are domain-independent. This hypothesis implies that schema change fails to occur, when it does in stories or elsewhere, not because there are inherent constraints on long-term memory structures and/or available modes of information processing, but because the particular prerequisite functional conditions are not met. For instance, the functional-cognitive theory implies that if in a particular surprise-ending story only the first two conditions hold—availability of a coherent pre-surprise schema and the sudden unorganization of the pre-surprise content elements—but the creation of the post-surprise schema is impossible, the net result of the unorganized pre-surprise content elements organizing themselves again into the same pre-surprise schema might be an even *more* coherent schema. This somewhat counterintuitive prediction follows in a straightforward fashion because, where the same content elements are involved, global organization after global unorganization is likely to result in the survival, among all the self-organizing pre-surprise content elements, of those that are most fitting, so to speak, or most relevant, to the pre-surprise schema.

We tested this hypothesis in a preliminary experiment. Different groups of subjects read different versions of the Marilyn story. One group of subjects read the no-surprise version in which the ending was consistent with the Gabriel-Bad global schema. A second group of subjects read the same story stem—that created and upheld a Gabriel-Bad schema—with a different

ending: Gabriel called the police, they came, put handcuffs on Marilyn, thanked Gabriel, and left. Immediately after reading the story (the stem + ending) in 12 paragraph-long segments on the computer screen, subjects were directed to an interference math test. After 10 minutes and before anyone finished the math test, they were suddenly directed to a set of instructions asking them to write a *coherent* summary of the story they had read in less than 100 words.

Despite the strong implication in the ending that Gabriel had committed a good deed—he deserved to be thanked by the police—and that Marilyn had committed a crime, the protocols revealed absolutely no sign that subjects had shifted to a Gabriel-Good-Marilyn-Bad schema. Rather, consistent with the enhanced coherence hypothesis, subjects in the surprise-unresolved condition included in their protocols intrusions consistent with a more coherent (or extreme) Gabriel-Bad schema. The following summary is representative in content of the protocols of the seven subjects in this condition:

> Marilyn, a nurse, was driving home from the late shift. She had a funny feeling the whole way. She noticed she was about out of gas, so she stopped at Gabriel's station. He was an ex-convict, but she believed him to be friendly. Once there, he wants her to come inside the station, Gabriel ceases to be friendly and pulls a gun on her. As he attacks, Marilyn faints. ([ending information] When she is coming to, she hears Gabriel on the phone and sirens. Then the police come in and put handcuffs on her.)

The above summary was also representative in content of the protocols by the seven subjects in the no-surprise Gabriel-Bad condition. However, the protocols of the Gabriel-Good-Marilyn-Bad condition differed with regard to the incidence of extreme intrusions. For instance, five of the subjects in this condition, but only one from the Gabriel-Bad condition, explicitly mentioned that Gabriel raped or attacked her, and three, but none from the other condition, included the intrusion that Gabriel was an ex-convict. It is beyond the scope of this paper to discuss why subjects in the surprise-ending condition did not shift to a Gabriel-Good-Marilyn-Bad schema. However, even a conservative interpretation of the protocols would be that they are highly reminiscent of the perseverance findings.

Summary and Conclusions

The structural story grammar approach maintains that surprise-ending stories, like their no-surprise counterparts, are comprehended in terms of a single underlying event structure. The surprise-ending story differs in that the particular outcome-relevant initiating event is omitted from where it is expected early in the story. As a result, when the outcome occurs in the ending, it is unforeshadowed and it surprises the reader. The functional-cognitive

approach taken in this paper began with the assumption that what is unique about the surprise-ending story is that it creates and upholds two incompatible global schemata, one immediately after the other. Therefore, in attempting to account for the comprehension of the surprise-ending story, one must deal with the problem of how global schema change occurs. Furthermore, the contribution of the pre-surprise portion of the story is determined by the information that is present in the story prior to the surprise and not by the information that is absent from it.

At a more general level, it was shown that the mechanisms postulated by the structural approach impose inherent constraints on rapid global schema change. The structural component itself is a long-term hierarchical network; and the process component consists of top-down or bottom-up script-guided operations. With regards to the ease and speed of occurrence, two types of mental processes have been postulated: automatic and controlled. Automatic processes are fast, but difficult to alter and inapplicable to novel situations. Controlled processes are applicable to novel situations, but are very slow and capacity-limited. On the other hand, rapid global schema change means extensive automatic processing that involves alteration of already-active relations as well as establishment of novel ones, areas where structural automaticity is not only inapplicable but also counterproductive. It was concluded, therefore, that structural schema theories are not equipped to deal with the type of rapid global schema change that seems to occur in comprehension of surprise-ending stories.

Very different from structural automaticity is functional automaticity, which is readily applicable to novel situations and which can occur with appropriate rapidity. Functional automaticity is determined by concrete properties of self-organizing content elements that can, given suitable conditions, readily and rapidly combine and uncombine. It was argued that what makes rapid global schema change possible, where it happens, is predominantly functional automaticity.

Structural theories assume that comprehension processes are exclusively script-guided or script-driven. An "overwhelming limitation of all [such] top-down processes . . . [is that they] cannot characterize input that does not conform to . . . [their] expectations" (Lehnert, 1981, p. 329). By contrast, the functional approach assumes that comprehension is under the exclusive control of schema-independent sources, even where schema-guided or schema-driven operations seem to play a predominant role. It seems that this proposal is similar in type, though perhaps different in detail, to that made by Lehnert (1981) when she claimed:

> There is infinite variation in the number of plots that are possible, and people can understand a story with a new plot line whether they've seen a similar plot before or not. This suggests that plot recognition must be based on bottom-up processing, rather than a top-

> down analysis. We can attain the flexible recognition capabilities of a bottom-up analysis scheme by constructing configurations of primitive and complex plot units. (p. 329)

To the extent that the term *bottom-up* in the above quotation can be interpreted as schema-independent or element-determined, Lehnert's alternative to the structural story grammar overlaps with the present functional approach.

Finally, schema-independent sources postulated by the functional approach are assumed to be concrete functional properties of content elements. In this respect, that is, with regards to the emphasis on the role of concrete content, as opposed to that of the abstract structure, the present approach is similar in spirit to Wilensky's (1983) content-based alternative to structural story grammar. Therefore, not only does the functional model provide alternative ways of viewing global schema change, schema incompatibility, and automaticity, but it is also compatible with recent alternatives to structural schema theory.

References

Bacon, F. (1920). *The new organon and related writings.* New York: Liberal Arts Press.

Bartlett, F.C. (1932). *Remembering: A study in experimental and social psychology.* Cambridge: Cambridge University Press.

Black, J.B., and Wilensky, R. (1979). An evaluation of story grammars. *Cognitive Science, 3,* 213–230.

Blanchard, H.E., and Iran-Nejad, A. (in press). Comprehension processes and eye movement patterns in the reading of surprise-ending stories. *Discourse Processes.*

Brent, S.G. (1969). Linguistic unity, list length, and rate of presentation in serial anticipation learning. *The Journal of Verbal Learning and Verbal Behavior, 8,* 70–79.

Brewer, W.F., and Lichtenstein, E.H. (1981). Event schemas, story schemas, and story grammars. In J.D. Long and A.D. Baddeley (Eds.), *Attention and performance IX* (pp. 363–379). Hillsdale, New Jersey: Erlbaum.

Brewer, W.F., and Lichtenstein, E.H. (1982a). Stories are to entertain: A structural-affect theory of stories. *Journal of Pragmatics, 6,* 473–486.

Brewer, W.F., and Lichtenstein, E.H. (1982b). *An affective and structural theory of the reader's story schema.* Unpublished manuscript.

Brewer, W.F., and Nakamura, G.V. (1984). The nature and function of schemas. In R.S. Wyer and T.K. Srull (Eds.), *Handbook of social cognitions: Vol. 1* (pp. 119–160). Hillsdale, New Jersey: Erlbaum.

Chomsky, N. (1965). *Aspects of the theory of syntax.* Cambridge, Massachusetts: MIT Press.

Clary, E.G., and Tesser, A. (1983). Reactions to unexpected events: The naive scientist and interpretive activity. *Personality and Social Psychology Bulletin, 9,* 609–620.

Frisch, A.M., and Perlis, D. (1981). A re-evaluation of story grammars. *Cognitive Science, 5,* 79–86.

Hering, E. (1897). Theory of the functions in living matter [F. Welby, Trans.]. *Brain, 20,* 232–258.

Hurvich, L.M., and Jameson, D. (1957). A component-process theory of color vision. *Psychological Review, 64,* 384–404.

Iran-Nejad, A. (1983). Qualitative and quantitative causes of the experience of affect. *Dissertation Abstracts International, 43,* 3847A.

Iran-Nejad, A. (1984 May). *Qualitative and quantitative aspects of the comprehension of surprising information.* Paper presented at the annual meeting of Midwestern Psychological Association, Chicago, Illinois.

Iran-Nejad, A., Clore, G.L., and Vondruska, R.J. (1984). Affect: A functional perspective. *The Journal of Mind and Behavior, 5,* 279–310.

Iran-Nejad, A., and Ortony, A. (1984). A biofunctional model of distributed mental content,

mental structures, awareness, and attention. *The Journal of Mind and Behavior, 5,* 171–210.
Iran-Nejad, A., and Ortony, A. (1985). Qualitative and quantitative sources of affect: How valence and unexpectedness relate to pleasantness and preference. *Basic and Applied Social Psychology, 6,* 257–278.
Katchalsky, A.K., Rowland, V., and Blumenthal, R. (1974). *Dynamic patterns of brain cell assemblies.* Cambridge: MIT Press.
Kintsch, W. (1980). Learning from text, levels of comprehension, or: Why anyone would read a story anyway. *Poetics, 9,* 87–98.
Kuhn, T.S. (1962). *The structure of scientific revolutions.* Chicago: University of Chicago Press.
Lachman, R., and Dooling, D.J. (1968). Connected discourse and random strings: Effects of number of inputs on recognition and recall. *Journal of Experimental Psychology, 77,* 517–522.
Langer, E., Blank, A., and Chanowitz, B. (1979). The mindlessness of ostensibly thoughtful action: The role of placebic information in interpersonal interaction. *Journal of Personality and Social Psychology, 36,* 635–642.
Lehnert, W.G. (1981). Plot units and narrative summarization. *Cognitive Science, 4,* 293–331.
Lord, C.G., Ross, L., and Lepper, M.R. (1979). Biased assimilation and attitude polarization: The effects of prior theories on subsequently considered evidence. *Journal of Personality and Social Psychology, 37,* 2098–2109.
Mahoney, M.J. (1977). Publication prejudices: An experimental study of confirmation bias in the peer review system. *Cognitive Theory and Research, 1,* 161–175.
Mandler, J.M., and Johnson, N.S. (1976). Some of the thousand words a picture is worth. *Journal of Experimental Psychology: Human Learning and Memory, 2,* 529–540.
Mandler, J.M., and Johnson, N.S. (1977). Rememberance of things parsed: Story structure and recall. *Cognitive Psychology, 9,* 111–151.
Mandler, J.M., and Johnson, N.S. (1980). On throwing out the baby with the bathwater: A reply to Black and Wilensky's evaluation of story grammars. *Cognitive Science, 4,* 305–312.
McClelland, J.L., and Rumelhart, D.E. (1981). An interactive activation model of context effects in letter perception: Part 1. An account of basic findings. *Psychological Review, 88,* 375–407.
Mill, J.S. (1965). *On the logic of moral sciences.* New York: Bobbs-Merrill. (Originally published 1843).
Miller, J. (1978). *The body in question.* New York: Random House.
Minsky, M. (1975). A framework for representing knowledge. In P.H. Winston (Ed.), *The psychology of computer vision* (pp. 211–277). New York: McGraw-Hill.
Neisser, U. (1967). *Cognitive psychology.* New York: Appleton-Century-Crofts.
Neisser, U. (1976). *Cognition and reality.* San Francisco: Freeman.
Nisbett, R., and Ross, L. (1980). *Human inference: Strategies and shortcomings of social judgment.* Englewood Cliffs, New Jersey: Prentice-Hall.
Ross, L., Lepper, M.R., and Hubbard, M. (1975). Perseverance in self-perception and social perception: Biased attributional processes in the debriefing paradigm. *Journal of Personality and Social Psychology, 32,* 880–892.
Rumelhart, D.E. (1975). Notes on a schema for stories. In D.G. Bobrow and A. Collins (Eds.), *Representation and understanding: Studies in cognitive science* (pp. 211–236). New York: Academic Press.
Rumelhart, D.E. (1977). Toward an interactive model of reading. In S. Dornic (Ed.), *Attention and performance* (Vol. 4) (pp. 573–603). London: Academic Press.
Rumelhart, D.E. (1980). Schemata: The building blocks of cognition. In R.J. Spiro, B.C. Bruce, and W.F. Brewer (Eds.), *Theoretical issues in reading comprehension: Perspectives from cognitive psychology, linguistics, artificial intelligence, and education* (pp. 33–58). Hillsdale, New Jersey: Erlbaum.
Rumelhart, D.E., and McClelland, J.L. (1982). An interactive activation model of context effects in letter perception: Part 2. The contextual enhancement effect and some tests and extensions of the model. *Psychological Review, 89,* 60–94.
Schank, R.C., and Abelson, R.P. (1977). *Scripts, plans, goals, understanding.* Hillsdale, New Jersey: Erlbaum.
Schneider, W., and Shiffrin, R.M. (1977). Controlled and automatic human information processing: I. Detection, search, and attention. *Psychological Review, 84,* 1–66.
Shiffrin, R.M., and Schneider, W. (1977). Controlled and automatic human information pro-

cessing: II. Perceptual learning, automatic attending, and a general theory. *Psychological Review, 84,* 127–190.

Solomon, R.I., and Corbit, J.D. (1974). An opponent-process theory of motivation: I. Temporal dynamics of affect. *Psychological Review, 81,* 119–145.

Stein, N.L., and Glenn, C.G. (1979). An analysis of story comprehension in elementary school children. In R. Freedle (Ed.), *New directions in discourse processing* (pp. 53–120). Norwood, New Jersey: Ablex.

Thorndyke, P.W. (1977). Cognitive structures in comprehension and memory of narrative discourse. *Cognitive Psychology, 9,* 77–110.

Thurmond, P.J. (1978). If cornered, scream. *Ellery Queen's Mystery Magazine, 71,* 66–68.

Wilensky, R. (1983). Story grammars versus story points. *The Behavioral and Brain Sciences, 6,* 579–623.

Woll, S.B., and Graesser, A.C. (1982). Memory discrimination for information typical or atypical of person schemata. *Social Cognition, 1,* 287–310.