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Causal Relatedness and Importance of Story Events

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The question of what makes a statement "important" in a story was studied. Causal relations were identified between all pairs of events in six folktales, using context-dependent, logical criteria of necessity, and counterfactual tests of the form: If event A had not occurred, then, in the circumstances of the story, event B would not have occurred. Causal networks were derived from these identifications for each story and two properties of them were found to predict judgments of importance: (1) the number of direct causal connections and (2) whether or not an event was in a causal chain from the opening to the closing of the story. The judged importance of a statement increased with the number of causal connections and causal chain membership. Regression analyses showed that substantial proportions of variance were accounted for jointly by both properties and uniquely by causal connections. The importance of a statement, whether identified by structural analysis or judged by naive subjects, seems to be determined by analogous assessments of the statement's causal and logical relations to other statements in the text. © 1985 Academic Press, Inc.

In this paper, we examine what makes a statement "important" in a text. We suggest that a decision about the importance of a unit in a text depends directly upon the number and quality of the relations that the unit has to other text units. In the present case, we propose that for narrative texts, causal and logical relations inferred by the comprehender are what underlie judgments of importance.

The study of important units in text has a long history. Binet and Henri (1894), in a study of recall of stories by children, found

that the units recalled were important in the sense that their omission rendered the recalled sentence or passage "unintelligible." Newman (1939) found that "essential" story elements were better recalled than "unessential" elements. Gomulicki (1956) showed that subjects selectively recall words or phrases that contribute most to the "meaning" of a passage. Johnson (1970) parsed prose materials into units between which pauses were judged by one group to occur at least 50% of the time and asked other judges to select those which were "structurally" important to the text. The number of subjects who selected a unit was correlated with the degree of recall of these units by independent groups of subjects at different retention intervals.

More recent approaches have operated within the framework of text structure analysis. Meyer and McConkie (1973) had subjects construct hierarchical outlines of expository passages. Units high in the hierarchy were recalled more often and were rated as more important than those low in the structure. This relationship between memory and level in a structure has also been found by Kintsch and Keenan (1973)

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in recall and by McKoon (1977) in recognition of propositions.

These correlational findings between importance and structure have also been found for stories. Rumelhart (1977) derived a hierarchical structure of episodic (goal-outcome) sequences based upon assumptions about superordination of the goals and found that those elements high in the hierarchy were more likely to be recalled or summarized than those lower in the hierarchy. Similar assumptions and findings on recall are reported in Black and Bower (1980).

Thus, it is a well-established empirical fact that elements judged to be important by various criteria are more likely to be recalled and summarized. However, the question as to what determines the judgment of importance remains unanswered by these investigations since, even in the structural approaches, the structure itself has been derived on the basis of judgment about what is important.

Thorndike (1917) suggested that the importance of a statement depends directly on its *relational* role to other statements in the text. If so, then the structure constructed from the text by the comprehender would also depend upon these relations. Here, we consider narrative text to be a case in point and assume that the primary relations are logical and causal in nature. This assumption that statements are linked via causal inferences is widely shared (Black & Bower, 1980; Black & Bern, 1981; Graesser, 1981; Lehnert, 1978, 1981; Mandler & Johnson, 1977; Nicholas & Trabasso, 1980; Omanson, 1982a, 1982b; Schank, 1975; Rumelhart, 1975, 1977; Stein & Glenn, 1979; Trabasso, Secco, & van den Broek, 1984; Warren, Nicholas, & Trabasso, 1979).

When a person judges the importance of a statement, he or she apprehends the *conceptual dependencies* that the statement has to other parts of the text. Judging importance thus would take into account the antecedents, consequences, and implica-

tions of a statement. Importance, therefore, depends upon the number of operative and direct connections a statement has to other statements.

The relations that a statement has to other statements are identified in two ways, either of which may serve as a basis for judging its importance. The first relational property is a qualitative assessment of how statements in a text are linked to each other. Statements which are linked by successive causes and consequences through the story from its opening to its closing have been assumed and variously identified as important by being in a "causal chain" (Schank, 1975; Trabasso et al. 1984; Warren et al. 1979), by being "central" (Omanson, 1982a, 1982b), or by lying on a "critical path" (Black & Bower, 1980). Such events are found to be better recalled (Black & Bower, 1980; Omanson, 1982b; Trabasso et al., 1984), more frequently summarized and given higher ratings of importance (Omanson, 1982b) than events which are not on the causal chain.

The second relational property is a measure of how many direct, operative links a statement has to other statements. The number of connections has been referred to as either "structural centrality" or "relational density" by Graesser and his associates (Graesser, 1981; Graesser, Robertson, & Anderson, 1981) and as simply the "number of causal connections" by Trabasso et al. (1984). Both sets of investigators have shown that this variable predicts recall. In the present study, we examine whether both of the above structural properties predict judgments of importance of story events.

One problem with a relational approach is that the identification of the causal and logical relations between statements must be made reliably. In a recent chapter, Trabasso et al. (1984) analyzed four stories studied by Stein and Glenn (1979). Using logical criteria of "necessity in the circumstances" and counterfactual reasoning (see Mackie, 1980, and below for a fuller de-

description), Trabasso et al. identified the direct causes and consequences of statements and depicted the story as a causal network of events and event relations. The advantages of this procedure are that it provides a logical, analytic, and a priori basis for identifying causes and consequences in narrative text, while, at the same time, allowing for the derivation of both the causal chain and number of connections. Trabasso and his colleagues showed that the causal variables predicted the amount of immediate and delayed recall, the particular events children thought were most important, and the kinds of answers they gave to why questions.

The present study builds on the Trabasso et al. (1984) study. In particular, we make more explicit the assumptions and procedures of the original causal analysis employed by Trabasso and his colleagues since they relied primarily upon counterfactual reasoning and did not explain other properties of the causality concept necessary to the analysis. Using counterfactual criteria to judge relations between events provides a reliable basis for capturing the conceptual dependencies which obtain. However, counterfactual tests do not effectively distinguish between conditions that enable events and factors that cause them. We also extend the analysis to judgments of importance by adults on a different set of stories.

We were fortunate to discover a study that used stories from an oral tradition, thereby assuring their naturally occurring complexity, and that investigated the judgment of importance of statements (Brown & Smiley, 1977). These investigators studied the ability of adults and children to rank and recall important statements in six stories from the folk literature of Japan and China (Sakade, 1957, 1958). Our objective was to predict the average importance ratings given by their adult subjects using a priori knowledge of the causal role of each statement in the stories.

In the present analysis, we define the concept of causality employed, consider

the logical criteria for identifying relations, and discuss the kinds of causal relations that can occur. Then we illustrate the analysis through a derivation of the causal structure for one of the six Brown and Smiley (1977) stories. Finally, we examine whether the properties of the causal network are predictive of judgments of importance of the events portrayed in each of the six stories.

Concept of Causality

In order for the comprehender to apply world knowledge and make *causal* inferences, a context in which events, states, and actions occur must be inferred (cf. Collins, Brown, & Larkin, 1981). The inferred context provides what we refer to as a set of "circumstances" and is crucial to the definition of causation (Mackie, 1980). The circumstances contain the background conditions and presuppositions necessary to infer multiple necessary and sufficient causes in a story. Without the circumstances, the particular events lack "meaning."

The concept of causation with respect to the events in a narrative assumes that certain properties are linguistically encoded in the description of the events, resulting in causal coherence at the sentence level. These linguistic features, modified from those suggested by Lakoff and Johnson (1980), occur within or across a set of statements portraying a causal event. In the set of statements, there is a patient (either a person or an object) who undergoes state changes as a result of actions or processes enacted by an agent. Agents may be either persons or physical mechanisms. Agents that are persons are assumed to cause actions and may be motivated either by some goal or caused to act by unidentifiable psychological mechanisms. Agents that are physical mechanisms are assumed to cause processes. Temporal and spatial contiguity is assumed to exist between the agent and patient in order for a given action or process to effect a particular state change.

Consider, now, as an example the first three statements of *The Father, His Son and Their Donkey* story in Table 1. In statements (1) through (3), we read that a patient, the donkey, is undergoing a change in location from home to the town. This state change is a result of an action, taking the donkey, on the part of two agents, the father and his son, and their action is motivated by a goal, to sell the donkey. Note that a large number of supporting inferences is required for these statements to be understood this way: One may presuppose that the father and his son own the donkey, that they are leaving home and are on their way to the town, that they are riding the donkey or walking beside it on a road, that they are selling the donkey to raise money for other needs, and so on. Although these inferences create part of the circumstances and aid in connecting events, they are assumed but not identified in the present analysis. Graesser (1981) has identified such inferences for narrative texts in a network representational system by using why and how questions on the events in the surface representation of the story. The present analysis identifies relations between the surface events but assumes that what is being related are the conceptualizations underlying the surface events. The relations themselves entail unspecified inferences.

Consider as a second example statements (53) through (56) in Table 1. Here, the donkey is the agent. Its state is described in statement (53), namely, that it does not like being tethered to a pole carried by the father and his son. This state psychologically causes it to act by kicking which results in a state change of an object, the breaking of the rope. This state change physically causes the donkey, now a patient, to undergo another state change of falling into the water.

Logical Criteria

To judge whether a causal relationship exists between two events, the criterion of

necessity in the circumstances is used (Mackie, 1980). Necessity is tested by the use of a counterfactual argument of the form: If not A then not B. That is, an event A is said to be necessary to event B if it is the case that had A not occurred then, in the circumstances, B would not have occurred. In the above example, event (53) is said to have caused event (54) since if the donkey had not disliked being tied then it would not have kicked ferociously. Likewise, event (54) caused event (55) since if the donkey had not kicked ferociously then it would not have broken the rope. Note that each of these judgments assumes a context in which the events, states, and actions occur.

In analyzing pairs of events, it is normative for us to answer affirmative to the counterfactual assertion with high confidence in order to accept an initial judgment of a causal relation. In some cases, the judgment may be less than certain and a relationship may be accepted as the best available option in spite of a lower degree of confidence. It should be noted that the criterion of necessity in the circumstances implies that the consequence is *dependent* in some manner on the cause or that the cause *determines* the consequence. Finally, it should be stressed that we followed Trabasso et al. (1984) in positing a relation to exist only if the cause was believed to be operative at the time of the effect. As a result, only direct causes are identified. However, direct causes may operate over a distance in the text. A frequent example of a cause which operates at a distance and yet is a direct cause occurs when a goal motivates an action that is enabled by an immediately prior action. The goal may have been established several statements prior to the enabling action. Specifically, statement (2), the goal of going to town, motivates the father and son to resume their journey in (47) and (48). However, the act of tying the donkey's legs in (45) enables them to carry the donkey (47) over the bridge (48).

From the set of direct, proximal causes,

TABLE I
THE FATHER, HIS SON AND THEIR DONKEY

Pause unit	Average importance
1. A father and his son	3.35
2. were taking their donkey to town	3.41
3. to sell him	2.71
4. at the marketplace.	1.29
5. They had not gone a great distance,	1.24
6. when they met a group of pretty maidens	2.65
7. who were returning from the town.	1.24
8. The young girls were talking and laughing.	1.41
9. when one of them cried out, "Look there.	1.94
10. Did you ever see such fools,	3.00
11. to be walking alongside the donkey when they might be riding on it?"	3.47
12. The father, when he heard this,	1.82
13. told his son to get up on the donkey,	3.41
14. and he continued to stroll along merrily.	1.94
15. They traveled a little further down the road,	1.29
16. and soon came upon a group of old men talking.	2.76
17. "There," said one of them,	1.59
18. "that proves what I was saying.	2.00
19. What respect is shown to old age in these days?	3.53
20. Do you see that idle boy riding the donkey,	3.18
21. while his father has to walk?	3.18
22. You should get down	2.41
23. and let your father ride!"	3.06
24. Upon this, the son got down from the donkey	2.94
25. and the father took his place.	3.35
26. They had not gone far	1.12
27. when they happened upon a group of women and children.	2.41
28. "Why, you lazy old fellow,	2.76
29. you should be ashamed."	2.76
30. cried several women at once.	1.35
31. "How can you ride upon the beast,	2.82
32. when that poor little boy can hardly keep up with you?"	3.59
33. So the good-natured father hoisted his son up behind him.	3.47
34. By now they had almost reached the town.	1.59
35. "Tell me friend," said a townsman,	1.65
36. "is that donkey your own?"	2.12
37. "Why yes," said the father.	1.94
38. "I would not have thought so," said the other.	2.41
39. "by the way you overwork him.	3.18
40. Why, you two are strong	2.29
41. and are better able to carry the poor beast than he is to carry you."	3.47
42. "Anything to please you sir," said the father.	2.71
43. "we can only try."	2.41
44. So he and his son got down from the donkey.	3.00
45. They tied the animal's legs together,	2.88
46. and, taking a pole,	1.65
47. tried to carry him on their shoulders	3.47
48. over a bridge	1.59
49. that led to the marketplace.	1.41
50. This was such an odd sight	2.00
51. that crowds of people gathered around to see it,	2.65
52. and to laugh at it.	2.18
53. The donkey, not liking to be tied,	3.06

TABLE 1—Continued

Pause unit	Average importance
54. kicked so ferociously	2.71
55. that he broke the rope.	2.94
56. tumbled off the pole into the water.	2.88
57. and scrambled away into the thicket.	3.00
58. With this.	1.12
59. the father and his son hung down their heads	2.65
60. and made their way home again.	1.94
61. having learned that by trying to please everybody.	3.65
62. they had pleased nobody.	3.82
63. and lost the donkey too.	3.76

indirect or distal causes may be inferred by transitivity. This is achieved by joining together successive causes and effects, that is, A and B would be joined to B and C, forming the chain A-B-C. Thus, if A is necessary in the circumstances for B and B is necessary in the circumstances for C, then A is necessary in the circumstances for C, assuming that the set of circumstances has not changed (Lewis, 1973).

For direct, operative causes, one may employ various criteria of sufficiency in the circumstances (Mackie, 1980). Trabasso et al. (1984) used a "weak" definition of sufficiency: Event A is sufficient in the circumstances for event B in the sense that if A is put into the inferred context and the events are allowed to go on from there, event B will occur. Since the identification of causes is context dependent, a strong definition, such as if event B did not occur then one would infer that event A had not occurred either, is not used. The latter definition would be used if one wished to identify general, sufficient causal relations that hold independent of the context. In narrative analysis, the identification of relations is between particular causes and consequences since these are embedded in the context of a story.

Kinds of Causal Relations

To facilitate the identification of causal relations among events, the taxonomy of

relations described in Warren et al. (1979) was employed. The advantage of naming the relations is that the name constrains which events can be causes or consequences. That is, if a relation is labeled as "motivational," the relation must be between a goal and an action. In the taxonomy, there are six types of inferred relations that can exist between statements: motivation, psychological causation, physical causation, enablement, temporal succession, and temporal coexistence. The distinction between motivation and psychological causation is mainly on the basis of goal versus nongoal-directed actions. To illustrate, statement (53) motivates statement (54). The state of not liking to be tied (53) is assumed to be a goal state which motivates the donkey to kick ferociously (54). In contrast, statement (45) psychologically causes an involuntary action in statement (53). The original act of tying the donkey's legs (45) has the psychological effect of the donkey not liking his present state (53).

A physical cause involves naive interpretations of the physical world or of mechanical causality between objects and/or people. Thus, statement (54) physically causes statement (55). The donkey's kicking (54), given one's knowledge of the physical world, causes the rope to break (55).

Enablements involve actions, occur-

rences, or states which are necessary but not sufficient to cause other actions or states. For example, statement (48) enables statement (56). Enablements are conditions and not causes in the sense of the causation criteria described above. Yet, enablements satisfy the necessity in the circumstances criterion and pass the counterfactual test. Enabling conditions as well as other background conditions are thus given status equivalent to causes in determining relations between events, even though that of enablements may not contain causative verbs (actions or processes), agents, or state changes.

In temporal succession, two events happen in sequence but are not causally related. It is also not the case that the first event enables the second event. Statements (59) and (60) are temporally successive but (59) is neither a cause nor an enablement of (60). The fact that the father and his son hung down their heads (59) was not necessary for them to make their way home (60).

In temporal coexistence, two events happen at the same time but are not causally related. Statements (6) and (8) are related by temporal coexistence. The girls' laughing and talking (6) occur with one of them crying out, "Look there", and so on (8). The fact that they were laughing and talking was not necessary for one of them to call out.

METHOD

Derivation of a Causal Network Representation

The six stories obtained from Ann Brown (via personal communication) were entitled: (1) *How to Fool a Cat*, (2) *The Dragon's Tears*, (3) *The Father, His Son and Their Donkey*, (4) *The Kettle That Would Not Walk*, (5) *A Test of Skill*, and (6) *The Squire's Bride*. Causal networks were derived for all six stories and are available

upon request, from the first author. For purposes of illustration and saving space, only one derivation, that for *The Father, His Son and Their Donkey*, is reported in detail.

Table 1 shows the units for *The Father, His Son and Their Donkey*. The units were obtained by Brown and Smiley (1977) using Johnson's (1970) procedure. These units served as "statements" in the analysis since we found that they contained sufficient state or action information to identify the conditions or causes required for meeting the necessity in the circumstances criterion. In the Brown and Smiley (1977) study, importance was operationally defined: Adult judges sorted statements of each story into quartiles according to the "importance of each statement to the story as a whole." Statements in the lowest quartile were assigned the value 1 and those in successive quartiles of increasing importance were assigned the values of 2, 3, and 4. The mean importance value is listed for each statement in Table 1.

The first step in the analysis involves the finding of direct, operative causal relations between pairs of statements. A pair of statements is judged to be related causally (or not) by intuition, followed immediately by a counterfactual test. After an initial pass through the entire story, the causal pairs are retested by counterfactual reasoning. Then, the pairs are assembled via common statements into a causal network. Once in the network, relations are tested for a third time using counterfactual reasoning. During the process of counterfactual testing, pairs of statements may be eliminated or added to the set of causal relations.

The two authors analyzed three of the stories together and then, as a check of reliability, three of the stories independently. They agreed on an average of 96% of the relations (average $\kappa = .59$, all $p < .01$, Cohen, 1960). Differences were resolved through discussion. A third judge, Paul van

den Broek, experienced in such analyses on other stories, independently derived causal networks for all six stories. His judgments were compared against the aggregate of the authors' judgments. The proportion of agreement averaged 97% (average $\kappa = .68$, all $p < .01$).

Figure 1 depicts the causal network derived for *The Father, His Son and Their Donkey*. Statements (1) and (2) share temporal coexistence since the father and his son in (1) are agents of the action in (2). Note that together, these statements provide the "setting" information of the story (Stein & Glenn, 1979) and a beginning set of circumstances since they introduce the protagonists in a time and place. Statement (3) provides further circumstances and motivates (2) since it contains a goal for the action. If the father and his son were not going to sell the donkey, they would not be taking the donkey to the town. While there

may exist other reasons for their action, we assume that the storyteller included statement (3) as the main reason for their going to town with the donkey. Note that statement (3) is taken as necessary in the circumstances for statement (2) in particular, but not for statement (2) in general. That is, we are not willing to claim that, in general, fathers and sons go to town with their donkeys in order to sell them. Thus it can be seen that the present use of the counterfactual analysis applies to particular cause-effect pairs and not to general ones (Lewis, 1973).

Continuing our analysis, statement (4) enables statement (3) to be realized since the father and his son would have to be at the marketplace in order to sell the donkey. If they were not at the marketplace, they would not be able to sell the donkey. Note that statement (4) alone is not sufficient to sell the donkey. For example, both the fa-

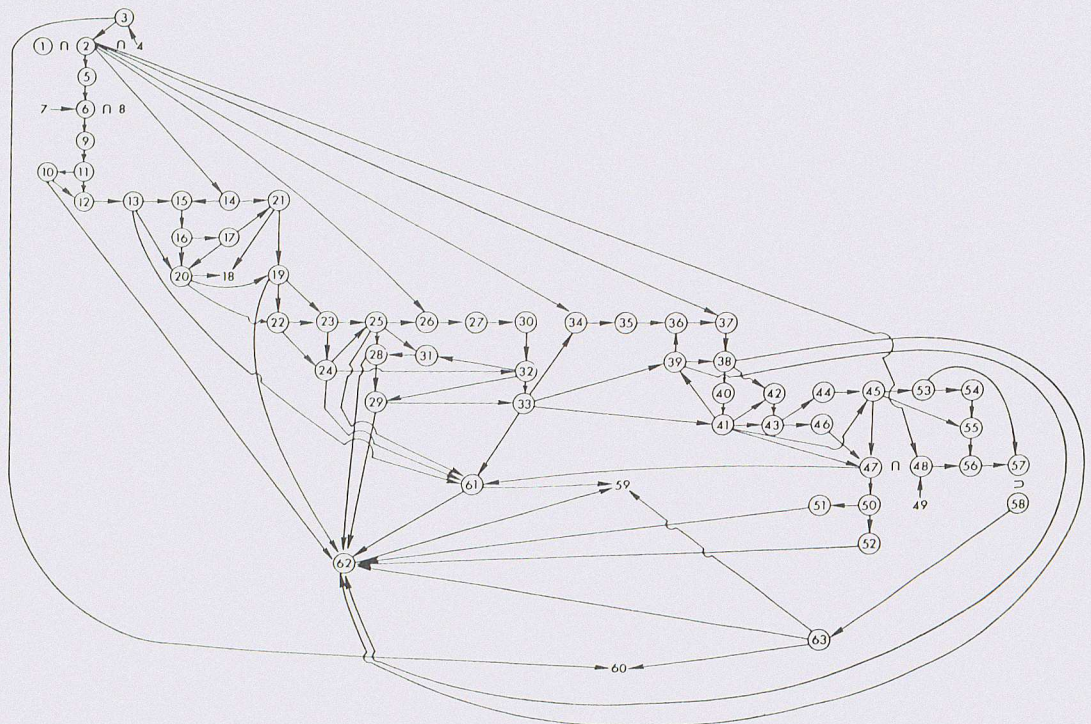


FIG. 1. Causal network representation for *The Father, His Son and Their Donkey* story.

ther and his donkey would have to be present as would potential buyers, a marketplace, a medium of exchange, and so on. Statement (2) physically causes statement (5) since the act of taking the donkey to town results in their going some distance toward the town. If they had not been taking the donkey to town, they would not have gone some distance. Statement (5) enables (6) as does (7). The respective actions of going some distance and of the maidens returning from town together enable the father, son and donkey to meet the maidens. If the father, his son and the donkey had not gone some distance or if the maidens had not been returning from town, they would not have met. We have already pointed out that (8) is in temporal coexistence with (6) and does not meet the necessity criterion. Statement (6) psychologically causes statement (9). That is, the sight of the father, son, and donkey causes one of the maidens to cry out. If she had not seen them, she would not have cried out.

The next two statements involve conversation and cognitions which present special difficulties. We adopted a set of conventions for analyzing sequences of utterances in accordance with the causal and logical criteria used in identifying nonconversational statements. First, the act of "saying" something was assumed to be caused by prior events. However, "saying" does not cause what is said; rather, we assumed that "saying" enables one to utter words. What is uttered is caused by events both internal and external to the speaker. In most of the conversations in the Brown and Smiley stories, utterances frequently serve as reasons for other utterances either by the same speaker or by the addressee. In this sense, then, an utterance may cause another utterance if the first is necessary in the circumstances for the second, even though we are not aware of all of the reasons why someone utters something. Thus, in the first encounter, statement (9) enables (11)

which, in turn, psychologically causes (10). If the maiden had not said something, she would not have said (11) and (10). Her observation of their walking beside instead of riding on the donkey implies that she values the latter and thus regards them as "fools" for doing the former. Hence, if she had not observed that they were walking instead of riding, she would not have said that they were fools.

The maiden's remarks in (10) and (11) have a psychological effect, namely, (12) wherein the father hears what she said. Obviously, if the remarks had not been uttered, the father would not have heard them. The consequence of the father hearing the content of the utterance psychologically causes him to carry out an action in (13), namely, telling his son to climb on the donkey. If the father had not heard the maiden's remarks, he would not have asked his son to climb on the donkey.

In statement (14), they resume their journey. Note that statement (2) contains goal information: The father and son had a subordinate goal of going to the town. Thus, (2) motivates (14) in that if they had not wanted to go to town, they would not have continued their journey. Statements (13) and (14) jointly enable (15). The son's riding on the donkey and the father's strolling alongside together enable them to travel farther down the road. These conditions enable (16), their coming upon a group of old men.

Their meeting (16) psychologically causes one of the men to perceive them and to speak to them (17). The old man's speaking (17) enables him to utter statements (18) through (23). These utterances involve a logical sequence. Statements (20) and (21) serve as reasons for the events in (18) and (19) and are, in turn, dependent upon prior events. The son's being on the donkey (13) and the group of old men talking (16) psychologically result in the evaluation of the boy in (20) while the father's walking alongside (14) psychologi-

cally causes the inference that he had to walk (21). Statements (20) and (21) are the bases for (18) since the conclusion drawn in (18) depends upon the evidence given in (20) and (21). Two further consequences follow from (20) and (21): An imperative that the boy should get down (22) which would enable his father to ride (23), and the goal of showing respect (19) which motivates (23). This episode ends with (22) and (23) motivating the son to get down (24). This enables the father to get on the donkey (25) which is also psychologically caused by (23).

Once again, the subordinate goal of going to town in (2) motivates the action contained in (26). Note that (26) is also enabled by (25) since, in the circumstances, the father had to be on the donkey before they could resume their journey to the town. This resumption physically results in their going some distance (26) before the journey is interrupted by yet another encounter that initiates a new episode. The fact that the father, son, and their donkey are traveling on the road (26) psychologically causes the women to perceive them (27). Observing the boy walking behind the father (24) psychologically causes the women to cry out (30), proclaiming that the boy can hardly keep up with his father (32). Statement (32), in turn, serves as the reason for an evaluative question: How could the father ride under such circumstances (31)? If the women had not disapproved of the son's walking, they would have raised the question. The father's riding (25) also psychologically causes (31) in conjunction with (32). Statements (31) and (32) were taken to be the bases for (28) and (29), respectively. The women accuse the father of being lazy (28) because they observe him riding while his son walks (25). They also tell him that he should be ashamed (29) because they boy can hardly keep up with him (32). Apparently, the father understands the implications of the question in (32) since it along with the chastisement in (29) psychologically cause him to bring the boy up behind him on the donkey (33).

Once again, their journey is resumed (34), motivated by their subordinate goal of going to town (2), and enabled by the father and the son both riding on the donkey (33). Their approach to the town (34) psychologically causes a townsman to address the father (35). His speaking (35) enables him to raise an evaluative question of the ownership of the donkey (36) which is psychologically caused by an assessment of the manner in which the pair were treating the donkey (39). The father is psychologically caused to respond affirmatively (37) to the question in (36). This response is also based upon the fact that the father and the son are taking the donkey to town (2). The answer in (37) psychologically causes the townsman to deny the assertion in (38) for the same reason that he raised the question in the first place (36), namely, that he believes that the father and son overwork the donkey (39). The basis for this psychological effect is the fact that the father and son are both riding on the donkey (33). The townsman's speaking in (38) enables him to carry the argument further (40). Since the townsman assumes, for unspecified reasons, that they are strong (40), this leads psychologically to his belief that they are better able to carry the donkey than it is to carry them (41). The latter phrase in (41) is another reason why the townsman asserts that they overwork the donkey (39). The gullible and accommodating father answers, "Anything to please you" (42), in response to the whole address initiated by (38) but most directly caused by the implicature to carry the donkey in (41). The father's reply (42) enables him to indicate in (43) that they will comply, which is psychologically caused by the implicit imperative in (41). As a result, the father is psychologically caused by his agreement to cooperate in (43) to get down with his son (44) and to begin a series of actions to carry the donkey, the first of which is to obtain a pole (46). They tie the donkey's legs (45) which is enabled by their getting down (44) and caused psychologically by the suggestion to carry the donkey in (41). Having tied the

donkey's legs (45) and having obtained the pole (46) enable them to carry the donkey (47). This act is also psychologically caused by the townsman's suggestion in (41). The act of carrying (47) physically causes them to go over a bridge (48) which is also motivated by (2), their original subordinate goal of traveling to the town. The fact that the marketplace is near the bridge (49) constrains them to cross the bridge since the bridge leads to the town.

The final encounter occurs as they are crossing the bridge with the donkey on the pole, prompting an evaluative comment by the storyteller (50). Two sets of consequences ensue. The first pair of events are of little further interest. The townspeople are psychologically caused to gather (51) and laugh (52) at the odd sight (50). The second set of consequences is more serious. The original act of tying the donkey's legs (45) has the psychological effect of the donkey not liking its present state (53) which motivates it to kick ferociously (54) which, in turn, physically causes the rope to break (55). The original act of tying (45) enabled the ropes to be around the donkey's legs so that they could be broken by its kicking. As a result of the rope breaking (55), the donkey involuntarily falls into the water (56) which is enabled by its presence on the bridge (48). The donkey scrambles away (57), an action caused by two sources: his being in the water (56) and his dislike of being tied (57). The statement in (58), "With this," is taken to be mean "after tying the donkey," and is thus regarded as temporally coexistent with (57). Thus, the donkey's escape has produced an involuntary state in which the father and the son have lost the donkey (63). The final consequences are that the father and son hang down their heads in (59), an effect produced by the loss of their donkey, and they return home in (60), motivated by the fact that they will not be able to achieve their original goal (3) because of the donkey's loss (63).

This story contains a moral. Our approach to morals and other interventions into the story by the storyteller has been to

look for the reasons behind the storyteller's comments. In this case, we identify a causal dependency between statements in the story and the concluding remarks by the storyteller. This analysis shifts the point of view from the main protagonists to that of the storyteller. However, the analytic process remains the same. We assume that the storyteller is motivated to conclude in (61) and (62) that the father and son learned that by trying to please everybody (the actions of compliance in statements 13, 24, 25, 33, and 47), they ended up pleasing no one (the reactions in 10, 19, 28, 29, 38, 39, 51, and 52). Statement (61), a generalization, and the loss of the donkey (63) are, respectively, a motivation and a psychological cause for (62), their failure to please anybody, including themselves.

Causal Chain Identification

In order to identify whether or not the event depicted by a statement is in a causal chain (Black & Bower, 1980; Omanson, 1982a, 1982b; Trabasso et al., 1984), criteria are needed for opening, closing, and continuing the chain of events. Trabasso et al. (1984) defined the opening of the causal chain as consisting of those events which introduce the protagonist(s), set the time and locale, and initiate the story's action. In *The Father, His Son and Their Donkey*, these statements (1), (2), and (3). The closing of a story is defined in terms of what happens to the protagonist's goal(s). If the goal is attained, the causal chain ends with statements that indicate goal attainment; if the attempts fail, the causal chain ends with the direct consequences of the failure. In *The Father, His Son and Their Donkey*, statements (61) and (62) are summary consequences of the protagonists' failure to sell the donkey. Once the opening and closing statements are identified, one traces events via causal connections from the opening to the closing events. Those events which have causes and consequences leading from the opening to the closing are in the causal chain. Those events which lack causes or which do not eventually lead to

the closing events are "dead-end" events (following Schank, 1975). The causal chain, generally, is the longest chain of events through the story.

In Figure 1, causal chain events are circled numbers while the dead-end events are left uncircled. Statements (1), (2), and (3) open the causal chain with setting information, which introduces the protagonists in a time and place, and with goal information relevant to the action that follows. In this story, the closing occurs with the moral in statements (61) and (62), which summarizes the father and his son's multiple attempts and failures, and with statement (63), the failure of the stated goal to sell the donkey. The remaining causal chain events are found by tracing connections from statements (1), (2), and (3) through to statements (61) and (62). If a connection can be found through an event from the opening to the closing statements, it is judged to be in the causal chain. If it cannot, it is judged to be a dead-end event. Some examples of dead-end events are (4), (8), and (59). Event (4) is a condition which would enable a goal in event (3). Event (8) is a temporal coexistence without consequences. Event (59) is an emotional reaction without further consequences pertaining to goal attainment or failure.

Our definition of a causal chain is an attempt to operationalize Schank's (1975) original idea. Other operationalizations are those of Omanson (1982a) and Black and Bower (1980). Omanson based his identification on criteria that events be both causal and purposeful; Black and Bower required that the events lead to a successful outcome in the problem-solving sequence. In addition to using explicit, logical criteria for judging causal relations, Trabasso et al. (1984) made explicit the criteria for opening the causal chain and changed assumptions about the ending. Since stories do not invariably lead to successful outcomes, such as *The Father, His Son and Their Donkey*, goal-failure as well as goal-attainment criteria should be used to define the end of the story.

RESULTS AND DISCUSSION

Two properties of the networks were found for each story: The number of direct connections (forward and backward) for each event in the network and whether or not an event was in the causal chain. For example, statement (24) has a total of five connections of which two are causes for (24) and three are effects. Statement (24) is also in the causal chain since its causes can be traced to the opening statements and its effects can be traced to the closing consequences. Statement (49) has only one connection, an effect, and is a dead-end event since it is not caused. Temporal connections, as designated by the intersection signs in Figure 1, refer to two events linked temporally but not causally and in the measure of number of connections count as single connections. Thus, statement (1), although assigned to the causal chain, has only one connection, namely, to statement (2). Statement (1) does not share statement (2)'s connections even though they are temporally coexistent since statement (1) does not have the causal effect that the content in statement (2) implies.

Multiple regression analyses were carried out on the importance ratings for each statement in each story with the number of direct connections and causal chain role as independent factors. Table 2 summarizes the regression findings for the full model of

TABLE 2
SUMMARY OF REGRESSION ANALYSIS: PROPORTION OF VARIANCE (R^2) ACCOUNTED FOR BY CAUSAL CHAIN AND CONNECTIONS FOR EACH STORY

Story	Full model	Connections		Causal chain	
		Alone	Unique	Alone	Unique
Cat	.44**	.41**	.22**	.22**	.03
Father	.41**	.38**	.28**	.11**	.02
Test	.36**	.35**	.18**	.18**	.01
Kettle	.25**	.22**	.12**	.11**	.01
Dragon	.19**	.13**	.06*	.08*	.01
Average	.30	.27	.15	.14	.02

* $p < .05$.

** $p < .01$.

the two factors and their interaction, for each factor alone, and for the unique variance of each factor.

In Table 2, it can be seen that for all six stories, the full model accounted for significant, high proportions of the variance. Connections alone and causal chain alone each accounted for substantial, significant proportions of variance. In all six cases, the interaction between the two factors was not statistically significant. When one factor was entered into the regression before the other, connections uniquely accounted for significant proportions in five out of six stories. However, causal chain failed to account for any significant unique variance.

The full model accounted for an average of 30.2% (range was from 16.7 to 44.4%) of the variance in the importance ratings. The number of connections accounted uniquely for 14.6% on average, while the causal chain accounted uniquely for an average of only 2.1%. The high, average common variance of 12.2% indicates that events in the causal chain are also more highly connected than events that are dead-end.

The main effects of causal chain membership and the number of causal connections on judgments of importance are respectively shown in Figure 2. In Figure 2, the average importance judgment increased in value as the number of direct causal con-

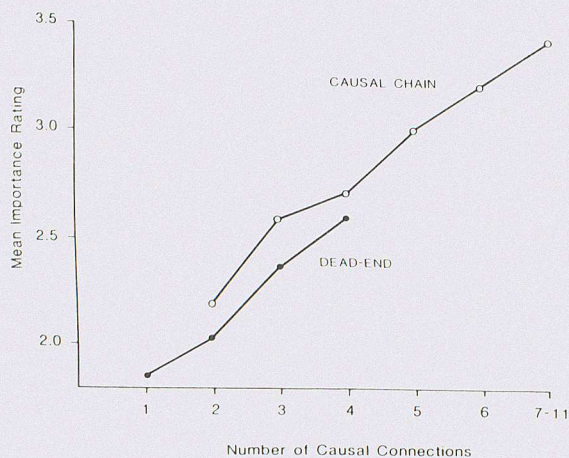


FIG. 2. Average importance judgment values for dead-end and causal chain statements that vary in the number of direct causal connections.

nections increased. In Figure 2, it can also be seen that the average importance rating was higher for events in the causal chain than for those which were dead-end.

One reason why the proportion of unique variance accounted for by the causal chain was nonsignificant was that the events in the causal chain had more connections than those which were dead-end. However, when causal chain and dead-end events share the same number of connections (2 through 4 in Figure 2), the two curves were essentially parallel, reflecting their statistical independence and their nonsignificant interaction.

Content differences occurred between causal chain and dead-end events which also contributed to the low proportion of unique variance attributable to the causal chain factor. The dead-end events contained information not found in the causal chain events, namely, locative or temporal information and conversational asides which do not allow causal connections. Examples of locative units are "at the marketplace," "for the fireplace," and "far away, in a strange country." Temporal examples include "one day," "suddenly," and "after a few moments." Conversational asides frequently mark points of speaker emphasis such as "me, a dragon" or "anyone, let alone a cat," exclamations such as "well, what do you know!" or "by some magic!" and social conventions such as "as you please" or "good day." While the locative information may provide enabling conditions and therefore be necessary for other events, the temporal and conversational statements cannot play such a role. Consequently, these statements have at most only one relation: that of temporal coexistence or succession. These three content categories respectively accounted for 10, 12, and 12% of the dead-end statements and received very low average importance ratings of 1.23, 1.24, and 1.74. These kinds of statements arose from the parsing of the story into pause units. Normally, these kinds of units would be a part of a sentence. In addition to these clauses,

more complete statements, all of which were emotional responses, were dead-end in nature. These accounted for an additional 15% of the dead-end units and were rated 2.05 in importance. Thus, content differences can be used to explain the low ratings of dead-end events whose number of connections is either 1 (or possibly 2) in Figure 2. When the connections factor was entered first into the multiple regression, this source of variation was removed from the causal chain factor's effect.

The remaining content categories, states, goals, and actions, were common to both causal chain and dead-end events. While these three categories respectively accounted for 20, 3, and 27% of the dead-end events, they did not differ from one another in importance, each having an average rating of 2.26, a value below the average importance rating of causal chain events (2.72). Normalizing the distribution for these dead-end events, the respective percentages were 32, 6, and 62; the respective percentages for these events in the causal chain were 32, 9, and 59. Thus, the relative distributions of states, goals, and actions were quite similar. When these common types of events were equated for number of connections in Figure 2, the judgments of importance were higher for causal chain events.

The fact that connectivity is colinear with the causal chain and uniquely accounts for substantial variance in importance judgments of narrative statements depends upon the story used. Trabasso and van den Broek (1985) carried out multiple regression analyses on two other existing corpora, that of Stein and Glenn (1979) on story recall and that of Omanson (1982b) on four measures of story understanding: immediate and delayed recall, importance judgments, and summaries. In both of these cases, the causal chain factor accounted for substantial unique variance. A comparison of the present Brown and Smiley stories with those used by Omanson and by Stein and Glenn showed that events in the

present stories were significantly less likely to be on the causal chain and to be more connected ($p < .05$). Thus, differences in variation among the independent variables may have accounted for the differences in the amount of variance accounted for by the two factors across the studies (see Trabasso & van den Broek, 1985, for a more detailed treatment).

The amount of variance accounted for by the two factors may have depended upon variation between the stories reported in Table 2. The proportion of events in the causal chain has a rank order correlation of .72 with the proportion of variance accounted for by this factor; for connections, the correlation is a perfect 1.00. However, the correlation between the two factors themselves is negative in value ($p = -.33$), reflecting the same inverse correlation seen in comparisons of the properties of the Brown and Smiley with the Stein and Glenn and Omanson stories.

Visual inspection of the causal networks for the story in Figure 1 and for those of Stein and Glenn (see Trabasso et al., 1984) and of Omanson (see Trabasso & van den Broek, 1985) indicates that the networks become more linear and less connected as one progresses from stories originating in the oral tradition (Brown & Smiley) to ones modified from that tradition for children (Stein & Glenn) or written expressly for experimental purposes (Omanson). In effect storytellers in the oral tradition achieve coherence by omitting irrelevant detail and including only events which are highly related to what has been previously stated. However, it is possible to achieve coherence with linear, largely causal chain stories since Trabasso et al. (1984) found a perfect linear correlation across the four Stein and Glenn stories between amount recalled and proportion of events in the causal chain.

Previous reports that the causal chain alone determines recall (Black & Bower, 1980; Omanson, 1982b), summarization, or importance judgments (Omanson, 1982b)

should be reexamined in light of the present study. Given the substantial common variance between causal chain and number of connections in the present study, it is possible that events identified as "central" or on a "critical path" covaried with connectivity. Trabasso and van den Broek (1985) in a reanalysis of Omanson's (1982b) data found that connectivity shared substantial variance with the causal chain factor and that both accounted for significant, unique proportions of variance on recall, summarization, and importance judgments.

Brown and Smiley (1977) found developmental differences in children's abilities to determine levels of importance of story events, both in judgments and recall (but see Pichert, 1978). Distinguishing among different levels of importance may be assumed to depend upon the making of causal inferences during encoding. The more relational inferences made for a given event, the more likely the comprehender would later be able both to recall and judge the importance of that event. Young children may initially make few relational inferences and thereby construct a less coherent network of events. In support of this conjecture, Stein and Glenn (1979) found that fifth grade children recalled more information and gave more causes as answers to why questions than did third and first graders. Trabasso et al. (1984), in their reanalysis of the Stein and Glenn data, found that the slope for the linear recall across stories as a function of the proportion of causal connections declined systematically for the younger children. Capacity limits as to the number of causal inferences made for a given event during the course of reading or listening to a narrative may account for the developmental differences found in these studies. Such limits may, in turn, depend upon knowledge as well as other memorial limits (Chi, 1978).

The fact that causal relations account for substantial proportions of the variance in judgments of importance supports the assumption that causal inferences underlie

the construction of a story representation in memory as first proposed by Rumelhart (1975) and Schank (1975). Rumelhart (1977) later revised his model to reflect a hierarchical structures of events. Such a hierarchy served as the basis for Black and Bower's (1980) model. It is possible that hierarchical representation in terms of goal superordination may be a *consequence* of the application of naive theories of psychological and physical causation to narrative events on the part of those who do story analysis and representation. In general, superordinate goals may have more causal consequences that subordinate goals, but it is possible for subordinate goals to dominate a story. A case in point is *The Father, His Son and Their Donkey* story where the superordinate goal of selling the donkey is never realized and a subordinate goal of taking the donkey to town dominates the action. The subordinate goal (2) was given an average importance rating of 3.35 and had six causal connections; the superordinate goal (3), however, was rated as less important (mean = 2.71) and had only three causal connections. Van den Broek and Trabasso (in press) found that the degree to which goals were summarized depended upon their causal role rather than upon their hierarchical status. A superordinate goal was summarized more often than a subordinate goal only when these goals were in the causal chain and had more connections than the subordinate goal. Thus, one cannot assume, a priori, that a superordinate goal is the most important goal even though it may be placed at the top of a hierarchical scheme.

Connectivity of statements plays a role in the hierarchical structures for nonnarrative as well as narrative texts (Kintsch & van Dijk, 1978; Meyer & McConkie, 1973). In these systems, connectivity is a combination of overlap between arguments, as well as logical and causal connections. Keenan, Baillet, and Brown's (1984) recent contrast between causal and argument overlap as predictors of speed of processing

and degree of recall suggests that causal and/or logical dependencies among propositions may play a larger role in the representation of nonnarrative text than had been previously assumed. In support, van den Broek and Trabasso (1984) had judges rate the strength of causal relatedness for pairs of events taken from the Stein and Glenn stories. They found that the judgments of causality varied with the number of intervening causes, independent of argument overlap as well as temporal or surface distance factors. Trabasso and van den Broek (1985) assessed the degree of argument overlap between pairs of statements in the Stein–Glenn and Omanson stories and converted this measure to one of distance in a network. They found that the proportion of variance accounted for by argument overlap was negligible on judgments of importance as well as recall and summarization measures.

Finally, all discourse analysis involves judgment. Structural analyses entail numerous judgments, many of which remain nonexplicit. Our results indicate that judgments of importance are determined, in part, by local linking of one event to another by causal and/or logical inferences. The result of these individual links is a network of events and event relations. Our analysis, it should be pointed out, has been restricted to identifying relations between explicit statements in the text. Graesser (1981) identified and provided evidence for causal inferences which may be entered into the network structure. Together, these sets of relations appear to be used in judgments of importance. If this is generally the case, then structural analysis involves processes similar to that used by subjects. The long history of correlational findings between importance and other measures such as recall may be a result of similar knowledge of the world and of processes of naive causal reasoning by both the analysts and the subjects.

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