Centrality and Causal Relations in Narrative Texts

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Introduction

The present paper focuses on the issue of "centrality" ("importance") of events in narrative discourse. Events in narratives vary in their relative "importance" in that some of them are conceived of as being more important than others. This observation has already been recognized as a crucial characteristic of narratives in various studies of narrative structure within the structuralist tradition (cf. e.g., Barthes 1975, Tomashevsky 1965 inter alia). Moreover, recent studies of narrative comprehension have focused on the central role played by the hierarchy of importance in the processing of narratives. As indicated in studies of memory for stories (e.g., Rumelhart 1977, van Dijk 1975, Thorndyke 1977), information is stored in memory in an hierarchical structure which corresponds to an assumed "importance scale": the higher a given proposition is stored in the cognitive representation (as reflected in e.g., summary and recall experiments), the "more important" it is judged by subjects.

Thus, importance is operationally defined on the basis of recall and summary tasks: an important event is more likely to be recalled than a less important one. Two questions arise with respect to that observation: 1. What are the factors which determine the likelihood of a given narrative unit to be recalled summarized in recall and summarization tasks? 2. How could one account for those factors?

In the first section I will address the first question. Clearly, a comprehensive answer to that question should consist of various kinds of determinants. A useful distinction among the latter is between global vs. local determinants. Among the global factors there are "structural" ones, such as the role played by the unit in question with respect to the plot as a whole (see e.g., Barthes 1975, Propp 1928 inter alia), and "pragmatic" factors (see e.g., Shen 1981).

The present paper, however, will focus on *local* determinants of importance. These determinants consist of the *causal* relations holding between narrative units. In section 1 I first propose a conceptual definition of the causal relations, and then I go on and introduce the main observations made by various studies of narrative recall and summarization regarding the way these causal relations are summarized and recalled. In general it is proposed that within a given structural unit (e.g., an Episode) that is retained in memory, *"results"* tend to be retained in the protocols, while *"causes"* tend (fully or partly) to be deleted (all other things being equal).

It should be emphasized at the outset that the isolation of that level of description (namely, the local one) should not be interpreted as suggesting that the importance of a given narrative unit is determined solely on the basis of local causal relations a unit shares with its neighboring units. Rather, it is my view that any comprehensive theory of importance in narratives should take into account both local and global determinants of importance. The isolation of the local level is done for analytic purposes only. As will become clear later on, this isolation is being made possible by focusing on relatively isolated sequences of events depicting very simple narrative sequences which are taken out of their context.

In section 2 I will address the second question, namely, the explanation for the observations which are introduced in the first section. I will propose the *inferability account*, according to which the deletability of a given proposition (within a given narrative unit) is determined by its inferability (ceteris paribus): a proposition is deletable (hence, conceived of as less "important") only if it is inferable from other proposition(s) comprising that unit.

Further, in section 3 I will propose that this "inferability account" is a powerful tool in accounting for several additional facts regarding the comprehension of narrative texts.

Section 1: The Relationship between Causal Relations and Hierarchy in Recall and Summary

1.1. Introduction

Comprehension is assumed (see e.g., Sanford and Garrod [1981], Rumelhart [1977], Schank and Abelson [1977]) to be based on the implementation of a cognitive schema with which the reader is equipped, and which corresponds to a structure underlying the text. Such a schema consists of abstract categories (e.g. Setting, or Episode) which the text's propositions are "mapped" onto. An essential part of this "mapping" is the reader's segmentation of the text's propositions into sets of propositions corresponding to the schema's categories.

Thus, for example, a given set of propositions may be grouped together to form a text segment which is assigned a structural category, e.g., is identified as a Setting, or Episode. At this stage (the next logical step if not the stage subsequent to the comprehension process), the central proposition(s) of each category is (are) stored higher in the representation, with the marginal proposition(s) under it (them).

This rough description of the comprehension process allows us now to present and characterize the data for which this paper will offer an account. These data which are derived from an analysis of results of different summary and recall experiments (Rumelhart 1975, Carmeli 1983, Shen 1985, 1988, forthcoming, inter alia) can be subsumed as conforming to one basic "summary rule" which states:

[1]
    Within a given structural unit (e.g., an Episode) that is retained in memory, "results" (i.e. the last proposition in the unit) tend to be retained in the protocols, while "causes" tend (fully or partly) to be deleted (all other things being equal) [see also note 1].

It should be noticed that the generalization in [1] holds only for those structural units (e.g., an Episode) which are represented in memory. If, for example, a given Episode is (according to some global constraints) not represented in memory because it is a less "important" Episode in comparison to other Episodes, then neither its RESULT proposition(s) nor its CAUSE propositions are retained).

The general rule in [1] holds for all types of causal relations usually referred to in the study of narrative comprehension (e.g. Rumelhart [1975]), i.e. CAUSE, MOTIVATE and ENABLE. Following various studies (e.g. Johnson-Laird and Miller [1976], Carmeli [1983] and in accordance with others (e.g. Rumelhart [1975] these three causal relations are defined in Table 1.

In what follows I will illustrate the above definitions of those causal relations and its corresponding "summary rule". The "summary rules" are summarized in Table 2.

Given: propositions X and Y, then

X Causes propositions Y if X is a sufficient or a necessary and sufficient condition for Y.

X Enables Y if X is a necessary (and not sufficient) condition for Y.
(both X and Y can describe either, events or actions – see note 2).

X Motivates Y if X is a mental state that Enables Y which is itself an (intentional) action executed by a human Agent.

Table 1: The Causal Relations

The Cause relation
Given two propositions X and Y such that Cause (X,Y), retain X's Agent (and sometimes X's Instrument) and Y.

The Enable relation: the "standard" case
Given two propositions X and Y, such that ENABLE (X, Y), delete all of X and retain all of Y.

The Enable relation: the "non standard" case
Given two propositions X and Y, such that ENABLE (X,Y), retain both X and Y.

The Motivate relation: the "standard" case
Given two propositions X and Y such that MOTIVATE (X,Y), delete all of X and retain all of Y.

The Motivate relation: the "non standard" case
Given two propositions X and Y, such that MOTIVATE (X,Y), in the "non standard" case, retain both X and Y.

Table 2: the Summary rules

1.2.   The Causal relations and their corresponding Summary rules

Cause relation

[2]   x. Dan kicked the ball
      y. The ball flew

In [2] Dan's kicking the ball ([2x]) is a sufficient, though not a necessary, condition for the ball's flight. Yet the flight of the ball is a direct result of Dan's kick. Thus, the relation holding between these two propositions according to the definitions of Table 1, is Cause. The rule underlying the summarization process as reflected in summary experiments conducted by various researchers (e.g., Rumelhart (1975), Carmeli (1983), Shen (1988)) states:

[5]
Given two propositions X and Y such that Cause (X,Y), retain X's Agent (and sometimes X's Instrument) and Y.

Applying [5] to the sequence in [2] will result in [2'] which is the summary proposition of [2]

[2']
Dan caused the ball to fly.

This summary proposition consists of the agent of [2x], i.e., Dan, and [2y] in full, i.e., 'the ball flew' (in addition to the semantic relation which is lexically represented by the phrase "caused to").

Enable relation

Consider

[3]
a.   Tom entered the water.
b.   Tom drowned.

[3] illustrates the Enable relation as defined in Table 1. In this case Tom's entrance into the water Enabled (but did not Cause) his drowning. Evidently, [3a] is a necessary though not a sufficient condition for [3b], since in order for Tom to be drowned he must

enter the water, but entering the water in itself is not a sufficient condition for drowning.

As for the summary rule of the Enable relation, a distinction should be made between two cases, namely, the "standard case" which conforms to the general summary rule in [1], and the "non standard" case in which the above general rule has to be slightly modified in order to cope with the data revealed in summary protocols.

Generally, the difference between these two cases can be described in terms of possible worlds. The "standard case" is a case in which the Enabling condition is a general necessary condition, i.e., where it is a necessary condition in any possible world; the "non standard" case, on the other hand, is the one in which the necessary condition is necessary only with regard to a specific situation (i.e. only in some possible worlds).

[6] and [7] below illustrate the "standard" ([6]) vs. "non standard" cases respectively. Thus, in [6], the Enabling proposition ([6a]) is a general necessary condition for [6b] in the sense that there is no possible world, given a schema such as [3], in which one drowns without entering into the water at some earlier point.

[6]
a. Tom entered the water.
b. Tom drowned.

[7]
a. In one room were sleeping two young men (X and Y in one bed) and in another one an inn-keeper and his wife.
b. The inn-keeper's wife had for some reason left her bed and went downstairs.
c. (Few minutes later) one of the young men (X) went out of the room.
d. The wife came back and (knowing that both young men had been in the same bed, and thinking that the young man (Y) was her husband) got into Y's bed.

However, let us consider propositions [7c] and [7d] which illustrate the "non standard" case of the Enable relation. In this case the young man getting out of bed [7c] is a necessary (enabling) condition for the wife's getting into that bed [7d], but only within the specific world of that story, i.e. a world in which it is assumed that the events described in the preceding propositions ([7a, b] occurred at some

earlier stage, and that the wife knew that the two men were sleeping in the same bed, and that she herself got out of her own bed, etc.). In this case, therefore, the Enabling event is not a necessary condition for the Enabled event in all possible worlds, but only in one (or some) possible world(s).

The distinction between these two cases is motivated by (at least) the different "summary rules" which are applicable for each. Let us consider each of these cases in turn.

The "standard case"

The summary rule which applies for the "standard" case as found in various studies (Rumelhart [1975], Thorndyke [1975], Black and Bower [1980], Carmeli [1983] and others) is thus formulated as follows:

[8]
Given two propositions X and Y, such that ENABLE (X,Y), delete all of X and retain all of Y.

Applying [8] to [6] above would yield the summary proposition

[6']
Tom drowned

which summarizes the sequence in [6]. Note that the summary rule as applied to the Enable relation differs from the rule applied to the Cause relation; in the Enable relation X may be wholly deleted, whereas in the Cause relation only part of X may be deleted (Carmeli 1983). (The explanation in Section 2.1 will account for this difference).

The "non standard" case

In the "non standard" case the "summary rule" to be applied is

[8']
Given two propositions X and Y, such that Enable (X,Y), retain both X and Y.

Thus, the analysis of results obtained in summary experiments of the above Decameron's story (see Shen 1985), reveal a clear tendency according to which both the Enabling event (7c) and the Enabled one (7d)) were not deleted in summary protocols. [similar findings have been found in Rumelhart (1975) and Carmeli (1983)].

It is worth emphasizing that in spite of the difference between these two cases, there is a significant characteristic shared by both, namely, the fact that in both the "result" (i.e., the Enabled proposition) is always retained. (For explanation see the account in section 2.1).

The Motivate relation

In

[4]
x. Nick intended to hurt Tom.
y. Nick murdered Tom.

Nick's intending to hurt Tom is: 1. a mental state and 2. a necessary condition (i.e. the Enabling condition) for Nick's murdering Tom.

According to Table 1, then, this case illustrates the Motivate relation. As for the "summary rule" which applies for the Motivate relation, a distinction similar to the one drawn for the Enable relation should be made, that is, between the "standard case" which conforms to the general summary rule in [1], and the "non standard" case in which the above general rule has to be modified. As in the case of the Enable relation the difference between these two cases can be described in terms of possible worlds. In the "standard case" the Enabling condition is a general necessary condition, whereas in the "non standard" case the Enabling proposition is a specific necessary condition. The passages below illustrate the "standard" ([9]) vs. the "non standard" ([10]) cases.

[9]
a. Nick intends to hurt Dan.
b. Nick hits Dan.

[10]
a. The wise men plan to hurt the Rabbi.
b. They sit and study a certain issue in the Talmud.

Thus, in [9], the Motivating proposition ([9a]) is a general necessary condition for [9b] in the sense that there is no possible world in which A hits B without A's intending to hurt B (even if the one who hurts is forced to hit the other one [e.g., when A is threatened to lose his life if he does not hit B] the conceptual analysis of this situation yields the conclusion that A intends to hurt B because of some reason [e.g., in order to save A's own life]).

Consider, on the other hand, [10] which illustrates a typical "non standard" case of the Motivate relation. [see note 3]. It should be noticed that in this case studying a Talmudic issue is part of a larger plot devised by the two wise men aimed at examining the Rabbi on that issue so as to fail him in the examination. Evidently, in order for someone to sit and study a Talmudic issue it is not a necessary condition in all (or even in most) possible worlds to intend to hurt someone else; rather, only when the specific characteristics of that world are given, namely, the larger plan of the wise men to cause the Rabbi's failure in the "exam" (and related conditions), that the wise men's plan to hurt the Rabbi is a necessary condition for their studying a Talmudic issue. Having distinguished between these two cases, the "summary rules" for each can be specified. Thus, the summary rule pertaining to the "standard" case as revealed in the above-mentioned studies states:

[11]
Given two propositions X and Y such that Motivate (X,Y), delete all of X and retain all of Y.

Applying [11] to [9] would yield the summary propositions in

[9]
Nick hits Dan.

The summary rule for the "non standard" case states:

[11']
Given two propositions X and Y, such that MOTIVATE (X,Y), in the "non standard" case, retain both X and Y.

Thus, according to this rule, both the Motivating proposition, (X) and the action it Motivates (Y), tend to be retained in summary protocols.

In sum the following three facts must be accounted for by any theory of narrative summarization. [note, that from now on the capitalized terms, CAUSES and RESULTS, are used in their broader sense which includes all three types of "results" and "causes" respectively; as for the terms of the specific causal relations, i.e. Cause, Enable. Motivate, only their first letter will be capitalized].

1. The fact presented in the general summary rule in [1], namely, that the CAUSES may be deleted (either fully or in part), while in no case may the RESULTS be deleted from the summary.

2. The difference between the Cause relation and (the "standard" cases of the Enable and Motivate relations as represented in different summary rules for these relations ([5] for the Cause relation, and [8] and [11] for the Enable and Motivate relations, respectively). Recall that in summarization (of the "standard" cases) the Motivating and Enabling propositions were generally deleted, while Causing propositions are never entirely deleted.

3. The difference between the "standard" and "non standard" cases of the Enable and Motivate relations, namely, the fact that in the "standard" cases the Motivating or Enabling propositions are totally deleted, whereas in the "non standard" cases they are not deleted.

An account for all three facts will be proposed in the next section.

Section 2: The proposed Explanation of the Relationship between Importance and Inferability

2.0. Preface: Causal and Temporal Organization.

The account to be proposed bears on an essential property of causal relations which distinguishes them from other types of semantic relations (e.g., temporal or spatial relations). Note that the definitions of causal relations (see Table 1) imply that two causally related events are logically dependent, in the sense that the very existence of the one is conditioned by the occurrence of the other; thus, e.g., the drowning of Tom in [6] above, would not have occurred unless Tom had previously entered the water. Such logical dependency, however, does not hold for the other semantic relations (e.g. temporal and spatial). This distinguishing property of the causal relation (i.e., the logical dependency), enables us to establish

inferability relations between the propositions representing these events. Thus, given two causally related events, X (the CAUSE) and Y (the RESULT), the fact that Y would not have happened without the previous occurrence of X (as in the Enable and Motivate relations), implies that X could be inferred from Y. (see note 5). The incorporation of the idea of inferability into our description of causal relations, enables us to propose our account for the data obtained in summary and recall experiments (as presented in section 1). Recall that these data revealed certain tendencies as to what may be deleted from a given summary or recall protocol (see section 1). It is my claim that the inferability account in [14] below may account for these data.

[14]
Within a given narrative unit (e.g. an Episode) which is represented in memory, the deletability of a given proposition is determined by its inferability (Ceteris Paribus): a proposition(s) may be deleted only if it/they is/are inferable from other proposition(s) in that unit.

Note that this inferability account defines the conditions under which a given proposition may be deleted from a given narrative unit, and should by no means be interpreted as suggesting an account for what is retained in memory. Thus, it does not follow from [14], that if a given proposition is retained in memory it is because there is/are another proposition(s) which is/are inferable from it. Similarly [14] does not imply that if a given proposition is retained in memory it is because it cannot be inferable from other propositions, since [14] does not state that an inferable proposition must be deleted but rather that it may be deleted. (it is assumed that there are other [presumably more global] factors, involved in determining what is retained in memory). The only constraint this account imposes on what is retained in memory is that if a given "structural" unit (e.g. an Episode) is to be represented in memory (due to some other constraints) then its RESULT proposition must be retained in memory (since it is not inferable from any other proposition) while its CAUSE proposition may (partly or fully) be deleted owing to its inferability from the RESULT proposition.

Let us now specify the way this inferability account handles the data for each of the three types of causal relations, Cause, Motivate and Enable.

2.1. Importance and Inferability

2.1.1 The Enable Relation

[1'] and [6] below repeat the definition of the Enable Relation as previously presented in Table 1, and the sequence illustrating (the "standard" case of) this relation, respectively.

[1']
X Enables Y if X is a necessary (and not sufficient) condition for Y.

[6]
a. Tom entered the water.
b. Tom drowned.

Recall that it was argued in section 1.1 that within the above sequence, [6a] is a necessary but not a sufficient condition for [6b], since in order for Tom to be drowned he must enter the water, but entering the water is not a sufficient condition for drowning. In this case it can easily be noticed that from the fact that Tom drowned ([6b]) it can be inferred that he had (at some earlier point) entered the water ([6a]).

Thus, the tendency in the summary protocols to delete the Enabling propositions is explained by the "Inferability account": the Enabling proposition is inferable from the retained one. As for the "non standard" case of the Enable relation (the illustration of which is repeated in [7]), it might also be handled by the "Inferability account".

[7]
a. In one room were sleeping two young men (X and Y) in one bed and in another one an inn-keeper and his wife.
b. The inn-keeper's wife had for some reason left her bed and went downstairs.
c. (Few minutes later) one of the young men (X) went out of the room.
d. The wife came back and (knowing that both young men had been in the same bed, and thinking that the young man [Y] is her husband) got into Y's bed.

Recall that in this sequence, unlike the "standard" case, only when [7a,b] are given, then [7c] (i.e., X's getting out of his bed and leaving his friend alone) is a necessary condition for [7d] (i.e. for the woman

getting into Y's bed). In terms of inferability this difference directly implies a significant difference between these two cases: unlike [6], where the Enabling proposition could be inferred from the Enabled proposition without any additional condition, in the present case the Enabling unit [7c] cannot be inferred from the Enabled one ([7d]), unless [7a] and [7b] are also given.

This difference between the two cases of the Enabled relation corresponds to the difference between these two cases in the summarization of the two sequences. Recall that the Enabling proposition ([7c]) (as well as the Enabled event) was not deleted in the summary protocols. (see Shen [1985]; similar findings can be found in Carmeli [1983]). Thus, according to the "Inferability account", since [7c] is not inferable from [7d] it cannot be deleted from the summary of this sequence.

2.1.2 The Motivate Relation

Basically, the previous argument holds also for both the "standard" and "non standard" cases of the Motivate relation (whose definition is repeated in [1"]). This is implied by the very definition of the Motivate relation in terms of the Enabled relation. In addition to the above account, however, it is worth mentioning the following linguistic argument which explains this point from another perspective.

[1"]
A proposition X Motivates Y if X is a mental state that Enables Y which is itself an (intentional) action executed by a human Agent.

According to this argument the Motivating proposition is already included (at least on a high level of specificity) in the verb indicating the Motivated action. Consider

[15]
a. Nick intended to hurt Tom.
b. Nick murdered Tom.

Here [15a] Motivates [15b]. We can infer from the verb "to murder" in [15b], which is an intentional verb, that the Agent intends to hurt the Patient in some way, (for reasons of hostility, etc). However, we

cannot unequivocally infer from Nick's desire to hurt Tom whether or not he actually did so. In such a case it will be somewhat strange if (all other conditions being equal), [15a] will be retained and [15b] deleted in summarizing this sequence, while the reverse is possible. This line of argument holds also in the "non standard" case. Thus, so goes the argument, the fact that the Enabling proposition is not deletable is accounted for by the "Inferability account" according to which when the Motivating proposition is not inferable from the (main) verb of the Motivated one, it is retained in memory. Consider [10] below (which was previously used in section 1.1):

[10]
a. The wise men plan to hurt the Rabbi.
b. They sit and study a certain issue in the Talmud.

Evidently, in this case, there is no simple way of inferring [10a] from [10b]'s verb ("study", or even "study a Talmudic issue") without applying to further information of that specific world (namely, the fact that studying a Talmudic here is part of a larger plan devised by the two wise men in order to examine the Rabbi on that issue and to fail him in the examination). Thus, as our "Inferability account" would predict, we find out, indeed, that in this case both the Motivating proposition, ([10a]) and the action it Motivates ([10b]), tend to be retained in summary protocols.

2.1.3 The Cause Relation

[1'''] and [2] below repeat the definition of the Cause relation as previously presented in Table 1, and the sequence illustrating this relation.

[1''']
Proposition X Causes proposition Y when X is a sufficient or a necessary and sufficient condition for Y

[2]
x. Dan kicked the ball.
y. This caused the ball to fly.

Considering [2], it should be noted that the fact that Dan kicked the ball ([2x]) is a sufficient, though not necessary, condition for the ball's flight. The flight of the ball, in this particular world, came as a

direct Result of Dan's kick. It appears that one cannot infer the sufficient condition (Dan's kick) from the flight of the ball, as the ball could have flown for a number of reasons. On the other hand one cannot infer, from Dan's kicking the ball, that the Result would be that the ball flew, as e.g. something could have stopped it. This may account for the fact that according to the "summary rule" of the Cause relation neither the Cause nor the Result are totally deleted (see [5] above).

One might, however, reach the conclusion that there is a complete symmetry between Cause and Result in terms of inferability; one can neither infer the Result from the Cause, nor the Cause from the Result. My central argument, in contrast, will be that in the causal relations as represented in a given text (to be distinguished from causality in "reality") one may infer more information about the Causing proposition from its Result, than vice versa. To substantiate this claim, I will present two complementary arguments.

Argument 1

A common sense analysis of the conceptual structure of a Causing proposition would assume this structure to consist, generally, of a minimum of three components: Agent (or theme, in the case where no intention is involved in the Causing event), event (or action) and Patient (see note 6). Result propositions consist, generally, of two components: theme and a resultant state. Thus, in

[16]
x. The snake bit the farmer, and as a result
y. the farmer died

the Causing proposition, [16x], consists of the three components mentioned above: an Agent (the snake), an Action (the biting), and a Patient (the farmer). In the Result proposition, [16y], we find the two components, namely, the Theme (the farmer) and the Resultant state (the farmer's dying). Given the Result proposition, we can infer the patient of the Causing proposition. This stems from a plausible assumption about the relationships between Causing and Result propositions, according to which these two propositions share the same referent; i.e., the Causing proposition's patient is identical to the

Result proposition's patient and the Result proposition's theme. From the fact that the farmer is the theme of [16y], it is also the patient of [16y].

Note, however, that according to the above analysis, one might reasonably assume that one might as well infer the Result proposition's theme from the Causing proposition's patient, in contrast to the "inferability account". In what follows, however, I will argue that this apparent possibility does not hold. To clarify the claim, let us consider

[17]
'Dan kicked the ball with his foot'

Note, that the proposition represented in [17] consists of an instrument ("Dan's foot"), in addition to an Agent (Dan), an Action (kicking the ball), and a patient (the ball). Assuming, further, that [17] is a Causing proposition, note that both [18Y'] and [18Y"] may be its Resulting proposition.

[18]
Y'.   The ball flew.
Y".   Dan's foot got hurt (as a result of the kick).

Note, that in [18Y"] the former instrument, i.e., Dan's foot, is now interpreted as the Causing proposition's patient. Assume, now, that the story chooses to continue only one of the possible positions, e.g., that of the ball's flying ([18Y']). A possible "continuation path" of [18Y], then, could consist of the sequence:

[18']
a.   The ball flew and hurt Nick.
b.   He burst out crying so loudly that he woke his mother, etc.'

If this is the actual path chosen to be represented in the story, then only one of the potential patients (i.e. the ball) is actually selected as the necessary link in the causal chain which these propositions constitute. It therefore seems that the asymmetry between Cause and Result stems from a special property of causality as represented in the text. The Causing proposition opens up a range of potential patients which can, in principle, appear simultaneously. Thus we cannot infer from it the actual identity of the patient. On the other hand the Result proposition indicates the choice of an actual

patient in a given text and so reduces to one the range of possible identities of patients. This reduction is the reason for arguing that the Causing proposition is, in principle, "more inferable" from its Causing one, than vice versa: whereas one can infer the identity of the patient from the Result proposition, the Result proposition's theme is not inferable from the Cause proposition.

Argument 2

To complete the picture, I will argue that a Causing proposition is more inferable than the Resulting one. Note, that "more inferable" simply means that the range of possible predicates of the Causing proposition is smaller than the range of possible predicates of the Result proposition. Consider

[19]
x.   The snake bit the farmer.
y.   The farmer died.

If we are given the Causing proposition ([19x]), together with the identity of the farmer as the theme of the Result proposition ([19y,] [supplementary information not included in the Cause, as previously shown], and are then asked to infer the predicate of the Result proposition, we encounter a number of possibilities, as in

[20]
a.   The farmer died.
b.   The farmer got a fright.
c.   The farmer fled.
d.   The farmer lay writhing in pain.

A common feature of all these predicates is that they all indicate different resultant states of affairs: an action, a mental state, a physical state and a process, respectively. The implication is that when one is asked to infer a Result of a particular action or event, he would encounter several possibilities from which to choose. On the other hand let us consider the second case where both the Result proposition (the farmer died) and the Agent of the Cause proposition (the snake) are given, as in 'the snake caused the farmer to die.' Assume that here, too, we are required to complete the missing predicate, i.e., the fact that the Cause of death was the snake biting

the farmer. Here too there are several possible ways in which the snake could have Caused the farmer's death: (I refer here to direct causation only. Clearly the number of options of indirectly killing the farmer are enormous); the snake could bite him, strangle him, (by coiling itself around his neck), etc. However, the range of potential predicates is all of one type: neither a mental nor a physical state are candidates for a predicate in which a snake causes a man's death. The semantic constraint the missing predicate must meet, requires both that it be an action that changes the situation, and that the action be included in the range of actions a snake can perform in relation to a man. Evidently, this semantic constraint precludes the possibility of the missing predicate being either a mental or a physical state.

We can generalize from this example to standard examples of the Cause relation that given a Result proposition whose theme acts intentionally (i.e. in case that it is an animate being or an animal) we can assume the predicate of the Result to have more potential "fillers" than the Causing proposition's predicate. Neither physical nor mental states (as opposed to events) can Cause changes in states of affairs affecting the volitional subject of the Result proposition. Consequently we can infer more information about the predicate of a Cause proposition from combining the Result proposition together with the Agent of the Cause proposition than from the combination of Cause proposition and subject of the Result proposition.

Note that this claim does not cover the case where the Result proposition's theme is not a volitional subject, but rather, e.g. an object. Nevertheless, I regard this problem as marginal when dealing with narrative texts as the majority of the propositions in causal chains are volitional. Furthermore, this attests to the very widespread applicability of the argument presented here, to narrative texts.

Summary

To sum up, we will review, briefly, how the "inferability account" accounts for various cognitive facts presented in section 1.

1. The general tendency for RESULTS to be retained with greater frequency than their CAUSES, within a given structural unit, was explained by the fact that CAUSING propositions (or parts of them) may in some cases, be

inferred from their RESULTS, but not vice versa. (all other conditions being equal).

2. Cause relations were shown to differ from Motivate and Enable relations in that Causing propositions are not entirely deleted while the Enabling and Motivating propositions are (at least in the standard cases) deleted. This was accounted for by the proposal that the latter are fully inferable from Motivated and Enabled propositions (respectively) and are thus deletable, while causing propositions cannot be inferred from Caused propositions and thus only their inferable parts are deleted.

3. The difference (which pertains to both the Enable and Motivate relations) between those cases where the Enabling and Motivating propositions are totally deleted and those in which these propositions are retained in summary tasks was also explained on the basis of inferability. Thus, it was argued that propositions which could not be inferred from Enabled and Motivated propositions, were retained in full in summary protocols.

(For a detailed discussion, and rejection, of an alternative account based on the Figure - Ground distinction the reader is referred to Appendix 1).

In order to substantiate and augment the explanatory power of the proposed account, the next section will present additional facts to which the explanation may be extended.

Section 3: Extending the Range of Phenomena explained by the Relationship between Importance and Inferability

3.1 Directionality

A key feature of the account suggested here is that there exists an asymmetry in direction of inference; that is, from the RESULT towards its CAUSE rather than in reverse order. In the present section I will suggest several independent findings supporting this account. Let us start by considering the following study carried out by Trabasso et al. (1981). Relevant to our discussion is the following experiment. A group of children of different ages were presented with sentences describing different events (i.e. "focal sentences") as if these were part of a larger sequence of events constituting a story which is not fully presented before them. The subjects, then, were asked to "continue" this sequence by providing sentences which

complete this unfinished story. The subjects could choose to complete the "focal sentence" by producing sentences which relate to the "CAUSES" of these "focal sentences" (i.e. "Backward" responses) or sentences representing their "RESULTS" (i.e. "Forward responses"; ["Forwards" or "backwards" relates to the question of whether the continuation describes an event occurring temporally before, or after, the focal event]). For example, if the "focal sentence" was 'Anne pushed the table' the subjects could continue it "forwards" (e.g. ……. and then ran out of the house) or "backwards" (e.g. because she was angry). The subjects could respond using either one of four options: 'before' may be an event prior to the focal event, or the cause of the focal event, while 'after' may be an event subsequent to the focal event, or the result of the focal event.

The first experimental finding was that focal sentences were continued by 'forwards' responses. In 75% of the responses, the continuations to the focal sentences were events occurring after the focal event. More significant for our purpose, however, were the following two findings:

a) What characterizes the 'forward' responses is that the events which have described tended to be events which temporally followed the focal event, rather than direct results of the focal event.

b) In those cases where the direction of continuation was 'backwards' (in 25% of the responses) the events described were either direct causes of, or reasons for, the focal event. In accordance with this tendency was the subjects' use of causal and temporal connectives. Thus, when the event in the response sentence occurred before the focal event the subjects tended to use causal connectives, e.g. 'in order that', rather than temporal ones. On the other hand, when the response event occurred after the focal event, there was an overwhelming tendency to favor non-causal connectives (e.g. and, and then, after, etc.). [No significant differences were found between the different age groups.]

To conclude, these results indicate that the "natural" direction of subjects' moving from one event to another, is "backwards", i.e. from results to their direct causes, from actions to intentions to achieve a given aim which causes the above-mentioned actions, etc. To put it in the authors' words:

"… Backward reasoning in narratives usually represents an attempt to find the reason for or the direct cause of a focal event whereas supplying the event that follows a focal event does not necessarily constrain the subject to a direct causal link" (pp. 252).

Evidently, these findings can be accounted for by the "Inferability account"; according to this account, the fact that causes are more "available" if their results are given in comparison to the reverse situation can be explained in that the causes are more easily inferred from their results, than vice versa. (see also note 7).

3.2. Narrative Coherence

Further support to the "Inferability account" is found in another type of facts, to which the explanation may be extended, facts related to the concept of "narrative coherence". A plausible implication of the "Inferability account" is that a given sequence of propositions in which the inferable propositions (i.e., the "less important" ones) are preserved whereas those which the former ones can be inferred from (i.e., the "more important" ones) are deleted, would be conceived of as less "coherent", than a story in which the former propositions are deleted and the latter preserved (ceteris paribus). This is implied by the above "Inferability account", according to which, in the latter case, the "gap" in line of events created by the "missing" (i.e. deleted) propositions, can be easily inferred from propositions which do occur in the text; the possibility of spanning the "gap" amounts to the (relatively) higher degree of text coherence. On the other hand in the other case, (in which the inferable propositions are preserved while their counterparts are deleted) the same line of argument would lead us to conclude that the text is "less coherent" than the former. (For a similar, although less explicit, account developed within Literary theory, cf. Tomashevsky (1965), Barthes (1973) inter alia). Evidently, if this reasoning holds, then a high correlation would be expected to be found between the more "important" propositions, and those "less important" propositions perceived as necessary for preserving narrative coherence. Studies conducted by Kemper (1982) partially substantiate the correlation between 'important' propositions and propositions considered necessary for preserving narrative coherence. ('partially' as they do not relate to all three types of Causality), thus strengthening the explanatory power of the "Inferability account". Let us briefly examine Kemper's experiments.

Enabling and Enabled Actions

Kemper composed a number of stories all of which were made up of a sequence of propositions representing actions as well as mental and physical states. (The distinction between actions and mental and physical states has no relevance here, but will be relevant in the forthcoming section). Actions were divided into two types, namely, superordinate and subordinate. This dichotomy parallels the distinction made in this paper between Enabling (subordinate) actions and Enabled superordinate actions. Subordinate actions, in fact, Enable the execution of the central actions which are thus Enabled by them. In every story the number of subordinate and superordinate actions was equal. In all the stories, and throughout the texts, an equal number of subordinate and superordinate actions were deleted, creating stories with gaps (missing links).

These stories were then presented to a group of subjects, who were told that each of these stories misses certain propositions and were asked to complete them. The main finding for the present discussion, was that subjects tended to complete a greater number of superordinate than of subordinate actions (for statistical details see p. 105 of Kemper's article). This conclusion supports the claim presented at the beginning of this section. Using the notion of "causal coherence" (Kemper's terms are neutral with respect to causality) to interpret the above finding it seems that subjects completed those parts in the causal chain which appeared to them as causally incoherent. The fact that these parts coincided with pro-positions describing superordinate (Enabled) actions reflects that these propositions are essential for preserving causal coherence and so must be retained in summaries (as summary propositions).

In contrast, subordinate (Enabling) actions may be deleted without affecting causal coherence, and so their inclusion in the summaries is optional.

Physical states that Enable actions and mental states that motivate actions

Kemper carried out another experiment similar in procedure but different in that it examined the relation not between subordinate

and superordinate actions, but between the three types of causally related propositions: actions, mental states and physical states. The actions and the mental states belong to the story characters, while the physical states pertain to the "story world".

The following sentences illustrate the different types of pro-positions:

1. Physical state: The sun shone and a light wind blew.
2. Mental state: Tom wanted to fly his new kite.
3. Action state: Tom ran into the road.

The importing finding (from the point of view of the present paper) was that actions were completed far more frequently than mental or physical states. We can rephrase this result in terms of causal coherence; when actions connecting mental and physical states are missing from a story, the story is perceived as (causally) less coherent than another in which physical states (which generally Enable actions) and/or mental states (which generally Motivate actions) are deleted (ceteris paribus).

Evidently, these data can be accounted for by the "Inferability account". According to this account Enabled and Motivated pro-positions preserve narrative coherence as from them the missing links can be inferred, while Enabling and Motivating propositions do not preserve narrative coherence as the missing links cannot be inferred from them.

Conclusion

The proposal made in this paper is merely a starting point for discussing the problem of defining "important information". The analysis proposed for the concept of "Importance" was a priori limited in two ways: 1. to the analysis of local units, and not the text as a whole. Clearly, a more comprehensive investigation of the notion will be required to cope with a wider area of discussion than that defined in this paper. This area of discussion should combine a discussion of both the causal relations (which are local semantic relations) and other more

global factors participating in the organization of events in a hierarchy of importance. By 'global' I refer primarily to two types of factors:

1. Textual (i.e. non-semantic) factors belonging to the "surface structure" of the text, e.g. evaluation devices (see Shen (1985) who presents the concept developed by Labov) or factors like 'viewpoint' and the amount of textual space devoted to a description given events (see Sternberg (1975)).

2. Global factors, involving, e.g., the narrative structure underlying a given story, or the cultural conventions which undoubtedly, fulfil a central role determining hierarchical relations of importance (see, e.g. Shen (1981)). Over and above these questions, the area of discussion may be broadened by studying the relationship between the concept of importance as seen in the comprehension of narrative texts and in the comprehension of other texts. So, for example, Perry's discussion (1986) points out the relevance for discussing "centers of information" in discourse comprehension. This concept is related to our discussion in that "a center of information" is generally assumed to be that information from which other information can be inferred but not vice versa.

A combination of these factors with those dealt with in this paper is an essential condition for constructing an inclusive theory of the concept of importance and a more precise definition of its status in the process of text comprehension.

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FOOTNOTES

1 The only exception to this generalization is the case of the Dead End which I will not address here (see Shen [1985]). The DEAD END proposition constitutes the result of a preceding proposition but not a cause for propositions describing states of affairs which obtained later in time. The subject was discussed in depth in a previous paper on the structure of the action

in a short story text (Shen (1985)) and, as it is not directly relevant to the current topic will not be dealt with here.

2 I owe this definition to the work of Carmeli (1983) who developed the discussion in Miller and Johnson-Laird (1976) and showed how the definition of the Enable relation stems from their discussion. The examples appearing in her work together with examples given me in personal communication, convinced me that this was the optimal definition of the Enable relation. It should be stressed, as Carmeli has pointed out, that other studies have defined this relation in a totally different way (e.g. Colby and de Beaugrande (1979)).

3 This sample is taken from an analysis of a story by Agnon, "The Power of Torah" and analyzed thoroughly in Shen [1985].

4 Talmy and Hopper's claim does not differentiate between the types of causal relations dealt with here. CAUSES and RESULTS are discussed only very generally. When their evidence is reanalyzed in terms of the distinctions drawn in this paper one sees clearly its relevance to Cause and Motivate relations while its validity for the Enable relation is doubtful.

5 The CAUSE-RESULT relations are defined here in terms of probability logic (This definition is based on the analysis in Johnson-Laird and Miller (1976)).

6 I am referring to the proposition which describes explicitly and in detail, the event (or action) of the cause. Sometimes the Patient may not appear explicitly in the surface structure of the sentence. In such cases it is clear that in the deep structure of the sentence it will be necessary to represent the Patient.

7 I would like to add two qualifications to this point. 1. It should be noted that Trabasso and Johnson's results are even more impressive than they appear at first, when their experimental procedure is considered. Subjects were asked to make up a focal sentence and to add a sentence, which, in terms of sentence order, (and not semantic relations) would appear after the focal sentence. To my mind this order itself invites a completion of the following sentence by the introduction of the event which occurs after the focal event. It may be assumed that if the sentence order was altered, e.g. by leaving the empty place before the focal sentence, as in "... Anne pushed the table", so that the sentence had to be completed 'backwards', the tendency to complete backwards also in terms of event chronology would be much stronger. It therefore seems that the general direction of response was not forwards (temporally) but balanced between forwards and backwards. 2. Note that the fact that the conclusions were drawn from children does not, in this case, cast doubt on the validity of the results for adults. On the contrary this paper stresses the fact that, in contrast to the Piagetian view, children of different ages are as proficient as adults in the area of causal organization. This study includes different aspects of causal organization while I will address myself only to one of them.

Appendix 1: the Figure-Ground account

An alternative proposal to the one favoured by the present account is the Figure - Ground account as introduced in Talmy (1975), Hopper (1979), Reinhart (1984), inter alia. According to this view the

basic asymmetry between CAUSE and RESULTS is not specific to causal organization, but is rather common to other types of conceptual organizations (see also note 4). Thus, various related entities of the world (e.g., objects, events etc.) fulfill different conceptual roles corresponding to the Figure-Ground distinction. For example, two temporally ordered events A and B are tended to be perceived so that A (the former) is the Ground and B is the Figure. This correspondence of the Figure clause and the Ground clause to the perfect vs. non perfect distinction, or the main vs. subordinate clause, respectively. Apparently, the asymmetry between CAUSE and RESULT as revealed in the summary and recall experiments can be accounted for by arguing that the priority of the RESULT over its CAUSE is due to the fact that CAUSES are perceived as the Ground in relation to which RESULTS are perceived as the Figure. Evidently, such an account bears on the assumption that there is a basic principle of organization underlying the causal as well as other types of organization.

Although such an account can handle a wide range of linguistic data, it cannot fully account for the "psychological" data (obtained in summary and recall experiments) due to the following two considerations.

1. In principle, any attempt to postulate a general principle of organization applicable to both causal and other types of organization fails to account for the psychological evidence presented in section 1.1. The main reason for this failure is that this evidence requires more refined distinctions among causal relations than the dual distinction between CAUSE and RESULT (i.e., between the Cause relation and the Enable and Motivate relations, between the "standard" and "non standard" cases of Enable and Motivate relations).

2. By contrast to what is implied by the Figure-Ground distinction, the linguistic representation of causal relations differs from that of other types of semantic relations, hence there cannot be one basic principle that will account for both the causal and non-causal relations. Let us consider first the linguistic representation of causal relations. Consider, for example, the case of subordination construction as illustrated in [12], [13] and [13'].

[12]
a. The farmer died (because) the snake bit him.
*b. The snake bit the farmer until/to the point that the farmer died.

[13]
a. Nick met Ruth after he arrived at school.
b. Nick arrived at school before he met Ruth.

[13']
a. The red ball is above the yellow ball.
b. The yellow ball is below the red ball.

Note that each of these pairs of sentences represents two optional constructions (marked as a and b) of representing three semantic relations in a subordination construction, namely, causal ([12]), temporal ([13]) and spatial ([13']) relations. Thus, in the "a" sentences the subordinated clause consists of the "Ground" entities (namely the causing event, the former event and the lower object, respectively), while the "Figure" entities (namely the resultant event, the preceding event and the upper object, respectively) are represented in the matrix. On the other hand the "b" sentences consist of the reversed order, i.e., where the "Ground" and "Figure" entities are located in the matrix and the subordinated clauses, respectively.

According to the Figure-Ground account the preferred constructions are those of the "a" sentences in which the "Ground" and "Figure" entities are posited in the subordinate and the matrix clauses, respectively. And indeed, language users do prefer these constructions over those of the "b" sentences. Thus, Clark (Clark [1973]) found that when subjects are asked to describe verbally a picture depicting two objects, one of which is located above the other (as in [13']) their preferred linguistic description is that in [13'a] (ceteris paribus). A similar result was obtained for temporal relations between earlier and later events (as in [13]), that is, subjects tended to place the 'earlier' event in the subordinate sentence and the later event in the main sentence (as in [13a]). Similarly, Talmy observed (Talmy [1973]) that construction of [12a] is preferred over [12b] which is an ungrammatical construction. Note, however, that there is a significant difference between the preference of [12a] in comparison to that in [13a] and [13'a]. This difference lies in the obligatoriness of a linguistic construction in each of the two cases.

In the case of causal relation the linguistic system precludes the "b" construction as grammatically ill-formed, whereas in the case of temporal and spatial relation both the "a" and "b" sentences are grammatically well-formed (for most languages in the case of temporal relations) and the preference of the "a" constructions depends on speaker "psychological" (to be distinguished from "grammatical") considerations.

Returning to our starting point, then, it is my claim that this difference between the causal and the other two types of semantic relation substantially reduces the possibility of assuming the existence of one basic principle of organization underlying the causal as well as other types of organization.

Taken together, these two considerations suggest that any account for the data of the causal organization must consider the unique characteristics of this organization, as revealed in both the summary and recall data and in the linguistic representation of causal relation.

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