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Degrees of narrativity and strategies of semantic reduction ☆

Rachel Giora, Yeshayahu Shen *

Poetics and Comparative Literature, Tel-Aviv University, 69978 Tel-Aviv, Israel

Abstract

The paper examines strategies of summarization (i.e., semantic reduction) as a function of the type of text summarized. A scale defining degrees of narrativity is empirically established in terms of the type of narrative organization of events. A scalar notion of narrativity reveals that discourses low in narrativity invoke a Generalization procedure when summarized. Highly narrative texts, on the other hand, are shown to undergo Deletion when semantically reduced. Medium narrativity texts are shown to invoke both strategies. Specifically, Non-narrative and Temporally ordered texts are subsumed by a proposition which is not a subset of the original text but a higher order abstraction thereof. By contrast, Action-structured texts are represented by a subset of the original text. Causally organized texts, on the other hand, make use of both strategies and are subsumed by either a Generalization or a proposition which is a subset of the text in question.

1. Strategies of semantic reduction

Understanding a discourse is widely believed to be a reorganization of input propositions into a hierarchical output structure (e.g. Van Dijk, 1975; Van Dijk

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* E-Mail (Bitnet): yshen@taunivm

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and Kintsch, 1983; Giora, 1985; Rumelhart, 1975; Shen, 1988). Due to limited memory capacity, the reader has to organize and store the segments of discourse under some entry which 'subsumes', i.e., semantically reduces the information presented in the text into a smaller number of units (corresponding to Van Dijk's macro-propositions). An important question is what procedures the reader calls into play when performing such semantic reduction.

Van Dijk (1975, 1977) and Van Dijk and Kintsch (1983) proposed three kinds of procedures, which they termed macro-rules: Deletion, Generalization, and Integration. Deletion is a summarization procedure which takes as input a set of propositions, and produces a subset of the latter as its output. The strategy of Deletion is illustrated by the text in (1a) and (1b), and its semantic reduction in (1c):

(1a) The snake bit the farmer's son, and (as a result)
(1b) the farmer's son died.
(1c) (summary of a + b): The snake killed the farmer's son.

Results obtained in summary experiments (e.g., Rumelhart, 1975; Shen, 1988, 1989) indicate that the sequence (1a + b) is typically summarized by (1c) which consists of a subset of (1a + b), namely the agent of 1a (the snake) and a reformulation of (1b). [1] That is, part of the information which the original discourse contains is deleted in the process of summarizing the discourse. Furthermore, the non-deleted part is taken to represent the discourse as a whole.

The second macro-rule is Generalization. Here, a piece of discourse is subsumed under a certain macro-proposition which is not a subset but, rather, a higher level abstraction of the original discourse. Consider the summarization (2b) below of the text in (2a), reported in Giora (1985):

(2a) Men of all ages spend hours of their leisure time installing their own fireplaces, laying out their own gardens, building garages and making furniture. Armed with the right tools and material, newly-weds gaily embark on the task of decorating their own homes. Some really keen enthusiasts go so far as to build their own record players and radio transmitters.
(2b) So great is our passion for doing things for ourselves that we create our own surroundings.

When subjects had to choose between various kinds of summarizations, they preferred the Generalization in (2b) over others which took the form of a subpart of the given text.

The third macro-rule, Integration, is a particular kind of Generalization, where parts of the input are integrated or combined into a higher-order schema or frame.

[1] (1b) is represented in (1c) since the verb 'to kill' is semantically decomposable to: '[x] causes [y's] death'.

To take Van Dijk's example, the sequence " 'I bought wood, stones and concrete; I laid foundations; I erected walls, I made a roof ...' may be subsumed under a (macro) proposition 'I built a house' " (1975: 146).

Since Van Dijk himself explicitly presents this procedure as "a form of generalization" (1975: 146), the important distinction from the point of view of the present paper is between the two procedures of Deletion and Generalization.

To the best of our knowledge, research has not been conducted into the question of why our cognitive discourse-understanding system has two different procedures at its disposal. But re-analysis of previous studies (Van Dijk, 1975, 1977; Rumelhart, 1975; Shen, 1985) suggests that it is the type of text summarized that determines the kind of semantic reduction procedure adopted. What emerges from the re-analysis of such studies is that the relevant distinction for different forms of semantic reductions is the one between narrative/non-narrative (Shen, 1985). Narratives are found to conform to the Deletion rule, while non-narrative texts tend to be summarized by Generalization. Thus, Van Dijk's proposed 'narrative macro-rules' were intended as specifications of the more general macro-rules of Deletion and Generalization. However, it turns out that when macro-rules are applied to narratives, Deletion rather than Generalization is used. Similarly, a close inspection of Rumelhart's (1975) summarization rules, as well as related studies (Shen, 1988, 1989), reveals that semantic reduction in narratives follows mainly Deletion type macro-rules.

By contrast, non-narrative discourse was found to be semantically reduced by a Generalization (as in example (2) above). Giora (1985) showed that the standard relation of a Discourse-Topic of a given non-narrative text, i.e, its summary, to the discourse itself is that of Generalization. She suggested that the relation between a Discourse-Topic proposition and the set of propositions which comprise the text resembles the relation between a class and its members – clearly the most prototypical example of Generalization (and see also Shen (1985) for an initial discussion of the problem).

Taken together, these observations suggest that there is some interesting relation between the type of discourse summarized (narrative versus non-narrative) and the type of summarization procedure activated (Deletion versus Generalization). The purpose of this study is to examine this relation. Since non-narrative texts have been shown to trigger the Generalization strategy (Giora, 1985), we focus on the relation between the different types of narratives and the semantic reduction associated with each. We start by establishing the notion of 'degrees of narrativity' (section 2), and then examine the way in which different types of texts invoke the various semantic reduction procedures (section 3).

2. Degrees of narrativity

A scalar notion of narrativity has been put forward by various researchers on various grounds. For example, Lichtenstein and Brewer (1982) focused on the informational structure of the text as a determinant of narrativity, or storiness.

Other studies of narratives (Prince, 1973; Rumelhart, 1975, 1977; Sternberg, 1978; Wilensky, 1983; Van Dijk, 1975; Shen, 1989; Giora and Ne'eman, forthcoming) rely largely on three main notions relevant for defining narrativity: Temporality, Causality and Action structure.

These three notions represent organizational principles which relate narrative events to one another. Thus, first, two events A and B are Temporally related if the second event occurs after the first one, as in (3): [2]

(3a) Dina came into the room.
(3b) Dan came in right after Dina.

Second, two events are conceived of as Causally related in case one (A) occurs Temporally before the other (B) and 'causes' it, as in (4):

(4a) Dina kicked the ball.
(4b) The ball flew.

(4) illustrates the causal relation holding between (4a) (the causing event) and (4b) (the caused event).

Third, A, B and C are connected via an Action structure if they are not only Temporally and Causally related but, put together, they also constitute a whole, a more global 'Action- structure'. The point to be noticed about Action structure is that, unlike the previous two types of connections which relate only two adjacent events, Action structure connects both adjacent and non-adjacent events. To say that a sequence of events A, B and C constitutes an Action structure means that not only are A and B, and B and C connected to each other linearly, but also that the non-adjacent events A and C are tied to each other too, as parts of the same (global) structure. To illustrate Action structure consider (5) below:

(5a) A snake bit a farmer's son to death.
(5b) The father, in revenge,
(5c) got his axe,
(5d) pursued the snake with that axe,
(5e) and killed it.

An Action structure is a high-order organization which hierarchically connects not only adjacent events (as is the case of both Temporal and Causal structures), but also events which are remote from one another on the temporal axis of a given discourse. Thus, a story according to various studies (e.g., Rumelhart, 1975, 1977; Van Dijk, 1976) is more than pairwise relationships among events, but rather, a string of events combined into a psychological whole. This psychological whole

[2] The reader is advised that the texts used here consist of 'narrative clauses' as defined by Labov (1972), that is, clauses which are presented in iconic order in the text.

termed here Action structure is typically characterized as consisting of goal-oriented/Problem-solving structure. Such a structure usually takes the following form: One or more events (e.g., (5a), a snake kills a farmer's son) create some Problem for the protagonist(s) of the story (e.g., (5b) the farmer's retaliation feelings). The protagonist Attempts to solve the Problem (e.g., (5c,d) the farmer's attempt to kill the snake) and there is a (positive or a negative) Outcome to that attempt (e.g., (5e) the snake's death). The Problem, Attempt and Outcome make up a global structure. [3] We can see that in such a structure the first component (the Problem) is causally related to the second component (the Attempt), and that the Attempt is causally related to the third one (the Outcome). However, the point about Action structure is that the first and the third components, though non-adjacent, are related too via a non-linear causal connection.

We hypothesized that the most prototypical narrative is organized via an Action structure, whereas the least prototypical narrative consists merely of Temporal relation. Narratives based on Causality would thus constitute the intermediate case. The following experiment was conducted to test this hypothesis.

2.1. *Experiment 1*

The aim of this experiment is to show that narrativity is a scalar notion where Action Structure > Causal Structure > Temporal Structure. Particularly, we wanted to show that readers judge narratives which exhibit Causal connectivity as better examples of narrative than the ones which exhibit Temporal connectivity, and that they prefer texts which exhibit Action structure over both Temporal and Causal structures.

2.1.1. *Method*

Subjects: 103 subjects of both sexes, aged 16–18 (grades 11–12) of a senior high school in Tel-Aviv.

Materials: 12 narrative texts, 4 exhibiting Temporal connectivity (T), 4 exhibiting Causal connectivity (C) and 4 exhibiting Action structure (A) (see Appendix). They were composed for this experiment by research students as a special assignment. Even though we intended the texts to be pure versions of each type, informal observation revealed that some of the texts produced were not exclusively of one type of connectivity or another. For example, in some of the Temporally and Causally connected texts, a very small amount of another kind of connectivity

[3] The farmer-snake story falls within the domain of a specific type of Action structure, namely, *point structure* (Wilensky, 1983). A point structure is a specific type of Action structure which consists of conflicting Goals (or Problems). The conflict can either be between two opponents whose goals contradict each other, as in the farmer-snake case, or between two rival goals held by a single protagonist.

In this paper we focus on this type of Action structure, because the distinction between Action structure and the other two structures (i.e., the Temporal and Causal ones) is more noticeable with regard to that type of Action structure (see also Wilensky, 1983).

Table 1
Degrees of narrativity as a function of connectivity type: temporal(T), causal (C) and action-structure (A) – Classification of responses

Texts	T	C	Total	C	A	Total	T	A	Total
N	19	50	69	16	51	67	8	61	69
χ^2		13.92			18.28			40.7	
$p <$		0.001			0.001			0.0001	

infiltrated (e.g., a Temporally connected event sequence in an otherwise Causally connected text). To guarantee that such slightly mixed versions are nevertheless classifiable as one type or another, four independent judges checked the naturalness of the texts and the type of connectivity (Temporal, Causal and Action structure) they exhibit. The judges' agreement was high (about 90%); all disagreements were resolved through discussion.

The texts were presented without their titles and contained no Discourse-Topic statement. Three different questionnaires were prepared, each containing two pairs of narratives of equal length and style. One contained a Causal/Temporal pair and a Causal/Action structure pair, another contained a Causal/Action structure pair and an Action structure/Temporal pair and the third contained an Action structure/Temporal pair and a Temporal/Causal pair.

Procedure: Subjects were presented with two randomly different questionnaires each containing two pairs of different narrative types of equal length. The order of narrative presentation was controlled. 69 questionnaires presented the Temporal/Causal pair, 67 the Action/Causal pair, and 69 the Action/Temporal pair. Subjects were asked to select from each pair the text they considered a better example of narrative.

2.1.2. Results and discussion

As shown in Table 1, Action-structured texts were selected as the best examples of narratives, the Causally connected narratives came second, and the Temporally organized texts came last. The differences were significant ($\chi^2 > 3.84$).

These findings confirm our claim for degrees of narrativity. They show that the variable of the type of connectivity contributes to the scalability of narrativity. Readers' ability to distinguish between better and worse examples of narratives is sensitive to the connectivity type. Texts which exhibit Temporal organization are considered least narrative on the scale of narrativity: Only 27.5% of the subjects preferred them to Causally organized texts, and only 11.5% preferred them to the Action-structured narratives. Texts which are organized Causally occupy a medium position on the scale of narrativity. 72.5% of the subjects preferred them to the Temporally ordered texts and 23.9% preferred them to the Action-structured texts. At the top of the scale are Action-structured narratives. 75% preferred them to Causally structured texts, and 88.5% preferred them to Temporally organized texts.

A plausible account for the above findings pertains to the relations obtaining between the three types of narrative organization. These three structure types can be viewed as forming a subsumption hierarchy, so that Causality subsumes Temporality, and Action structure subsumes both Temporality and Causality. This suggests that these relations differ not only in type but also in amount of connectivity: They manifest that the difference between Temporal, Causal and Action structure relations correlates with an increase in the number of connections between the events discussed: for A and B to be Temporally connected is to exhibit one connection (Temporality); for A and B to be Causally connected is to exhibit two connections (Temporality + Causality); for A, B and C to be connected via Action structure is to exhibit three connections (Temporality + Causality + non-linear Causality). [4]

Given that connectivity affects the coherence of the text (see, e.g., Wilensky, 1983), it is plausible to assume that, as a result, connectivity affects the prototypicality of narratives: the more coherent the narrative, the more likely it is to be judged as higher in narrativity.

Although we believe that the connectivity type is just one (major) factor among others affecting scalability of narrativity, in our study this possibility constitutes the most plausible hypothesis. A closer look at the text materials does not provide for any better alternative accounting for our findings, such as the length of the text, the style, the number of protagonists, the specific content, etc. None of these factors distinguishes one type of narrativity from the other. Our hypothesis gains even further support from the strength of readers' preference which is markedly higher (as we would predict) for the comparison involving the supposed extremes of our scale (T–A) than for either pair of supposedly adjacent text types.

3. Degrees of narrativity and summarization strategies

Since the narrative/non-narrative distinction is scalar rather than dichotomous, we next consider the relation between the various discourses along this scale and the type of semantic reduction strategy they invoke. We predict that as has been shown for non-narrative texts (Giora, 1985), low-narrative discourse containing just one connection (Temporal structure) will invoke the Generalization procedure when summarized, while highly narrative discourse (Action structure) which abounds in number of connections will invoke the Deletion procedure; and

[4] The reader is advised that the notion of connectivity developed in this study differs radically from that used in other current research. Some research into narrative comprehension (e.g., Trabasso and Sperry, 1985; Trabasso and Van den Broek, 1985) makes use of this notion to refer to the number of causal relations holding between two events in a story: A proposition is rated high in connectivity if it has many causal connections with other propositions in the text. This theory allows for only one connection (Causal) to obtain between any two events. By contrast, our notion of connectivity consists of three types of connections between events (i.e., Temporal, Causal, or Action Structure). Therefore, within the present framework, two events can be connected via several types of connections.

intermediate narrative discourse (Causal structure) will lend itself to both procedures of semantic reduction.

3.1. Experiment 2

The aim of this experiment is to show that low narrativity (Temporally connected) discourse elicits Generalization as a summarization strategy, while highly narrative (Action-structured) discourse elicits Deletion, and medium-narrativity (Causally connected) discourse elicits both strategies almost equally when semantically reduced.

3.1.1. Method

Subjects: 103 subjects as in Experiment 1

Materials: 9 (out of the 12) narrative texts of Experiment 1, 3 exhibiting Temporal connectivity (T), 3 exhibiting Causal connectivity (C) and 3 exhibiting Action structure (A), were presented in three different questionnaires. The questionnaires contained each three different narratives (Temporal, Causal and Action structure) in different orders of presentation.

Procedures: Subjects were presented with 2 different questionnaires. They were asked to write one sentence telling what each text was about. Generalization versus Deletion procedures were then scored.

3.1.2. Results and discussion

As shown in Table 2, procedures of semantic reduction varied as a function of the type of discourse summarized. Temporal narratives were mainly summarized by a Generalization strategy (95%), while Action-structured texts invoked mostly Deletion (75.5%). Differences were highly significant ($\chi^2 > 3.84$) (see Appendix for examples). Causally connected discourse, though mainly reduced by Generalization (65%), allows for a certain amount of Deletion procedure (35%) as well, which makes it an intermediate case.

Our findings established a correlation between the type of text summarized and a summarization strategy invoked. It shows that texts low in narrativity (Temporally organized) are reduced via a Generalization strategy and Action-structured narratives are shown to invoke Deletion as a summarization strategy. Causally

Table 2
Degrees of narrativity vis-à-vis semantic reduction strategies (Generalization (G) vs. Deletion (D)) – Classification of responses

	Temporal	Causal	Action
N	101	100	102
G	96 (95%)	65 (65%)	25 (24.5%)
D	5 (5%)	35 (35%)	77 (75.5%)
χ^2	75.51	9.00	26.5
$p <$	0.0001	0.005	0.0001

connected texts form an intermediate case, lending themselves frequently to both Generalization and Deletion.

We speculate that these summarization strategies are a function of the amount of connectivity of a narrative structure. A narrative which is multiply connected can be represented by one of its parts. High connectivity allows for a retrievel of deleted elements. Where such connectivity is deficient, an alternative procedure is sought for in terms of common features or similarity (see also general discussion).

4. Discussion and conclusions

This paper has two goals: First, it attempts to establish that the type of narrative organization affects degrees of narrativity in texts. Second, it attempts to show that it is the type of narrative organization that accounts for the selective use of semantic reduction strategies (i.e., Generalization and Deletion) readers employ in summarization.

With respect to the first goal, we have shown that the set of narratives examined ranges from the best to the worst example of Narrative. The Action-structured discourse ranks highest on the narrativity scale; the Causally connected text is second best, while the poorest example of Narrative is the Temporally organized text. We speculated that these three organization types differ from each other in terms of the amount of connectivity: The Action-structured discourse has the highest number of connections (Action, Causal and Temporal); the Causally connected text exhibits two types of connections (Causal and Temporal); the Temporally organized text contains only one type of connection (Temporal).

Further support for our theory comes from a recent developmental study (Shen and Berman, in press), which examines the development of 'narrative knowledge'. The findings suggest that the developmental phases in the use of linguistic forms (such as tense, clausal connectives, and null subject) correspond to our proposed scale. The development of the use of linguistic forms corresponds to a conceptual shift from Temporal to Causal to Action structure in the way children relate events in narratives. These findings, then, attest to the psychological reality of our scale of narrativity.

With respect to our second goal, we noted that while previous work established the use of various modes of semantic reduction (e.g., Van Dijk's (1975, 1977), distinguishing between Generalization and Deletion), no attempt was made to account for these different cognitive strategies. Our research suggests that it is the type of text that determines which strategy is exercised. Specifically, we have shown that the narrative/non-narrative scale accounts for the choice of different summarization procedures. Thus, Temporally organized discourse is summarized by the Generalization rule. As a result of its intermediate degree of narrativity, Causally connected discourse is reduced by both Generalization and Deletion procedures. Only the highly connected type of narrative discourse, the Action-structured text, is summarized by the Deletion rule.

Our findings indicate that text organization derives from more general principles of conceptual organization – for instance, the distinction between class versus scenario. Thus, texts low in narrativity are processed like classes: they are labeled by a Generalization which is not a member of the set but represents the class set of common features (e.g. 'bird' versus the set of birds) (cf. Giora, 1985). Highly connected narratives, on the other hand, by appealing to scripts and scenarios (Mandler, 1984), resemble part–whole relations which allow for metonymy: unlike 'bird', 'drive' is a part of the 'driving to the party' scenario. The 'driving' scenario includes various parts of which only one is selected: I had access to a car, I got into a car, I drove to the party, I parked the car and got out, etc. (Schank and Abelson, 1977; Rhodes, 1977; Lakoff, 1987). It is the high cohesiveness of concepts which center on part–whole relations then, that allows for a highly narrative discourse to be represented by one of its constituents (Mandler, 1984; Markman, 1987). Texts deficient in narrativity thus elicit an alternative semantic reduction strategy (cf. Giora and Ne'eman, forthcoming).

Appendix

1. A Temporally organized narrative

It was the end of September, a strong wind was blowing. We went out to fly kites as high as we could. After a short while we stopped looking up the sky and discovered that the earth was covered with a carpet of colorful leaves. We left the kites behind and looked for fallen leaves of various colors. Meanwhile we noticed that the flowers were blooming. On our way home I felt a drop of rain on my nose.

Examples of semantic reduction through Generalization procedure:
It's the fall.
It's the end of the summer and the beginning of winter.
A walk in the open.
The fall and its effects on children.
The things that happen to us in the fall.

Examples of semantic reduction through Deletion procedure:
While flying the kites we found an interesting blooming.
Kids are flying kites but they get excited because of the fallen leaves and leave the kites behind.

2. A Causally organized narrative

Tom disliked the neighbor's cat and picked at his whiskers as a result. The cat got angry and scratched him in his ear. Tom's ear bled. He ran to his mother, tears in his eyes, and showed her the scratches. His mother treated his ear and then

approached the neighbor demanding that the cat be removed from the yard. The neighbor did not like the idea and yelled at Tom to stop molesting the cat. Tom, his feelings hurt, looked the cat in the eye and said: "I hate you". The cat looked at him indifferently, miaowed and went away.

Examples of semantic reduction through Generalization procedure:

The fight of Tom and the cat.
The fight of Tom and the cat and their mutual hatred.
What happens when you hate the neighbor's cat.

Examples of semantic reduction through Deletion procedure:

Tom was scratched by the neighbor's cat.
The cat whose whiskers were picked at.

3. An Action-structured narrative

In a far away country there lived a good-hearted man with his big family. The happiness of the family was clouded by a great trouble – they had nothing to live on. The man had to wander far away from his family in search of a job. He worked in a construction site, but his employers did not pay him properly. They also treated him badly. All they cared about was their house. They wanted it built fast and cheap. They did not care about the people who worked for them. Time went by, the building was rising up and so was the hate of the man for his employers. One day, a few days before the building was finished, the man decided he had had enough and secretly demolished the building. He went back to his place with no food for his children but with pride in his heart.

Examples of semantic reduction through Generalization procedure:

Humans' attitude.
Unnecessary degradation causes revenge.
Pride versus money.

Examples of semantic reduction through Deletion procedure:

Because he had to provide for his family, the man had to work in a construction site.
The poor worker who did not overcome his pride.
A poor man who worked in a construction site away from his family, was badly treated by his employers. To take revenge, he demolished the building he had built and went back to his family, poor but proud.

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