

Related Disciplines – discourse analysis and use I

Rapporteur: Ines Busch-Lauer

Jerry Hobbs:

Summaries from Structure

Illustrating the notion of adjacency of pairs of words, compound nominals, syntax and compositional semantics, Jerry R. Hobbs demonstrated that interpreting texts includes explaining the adjacency of clauses, sentences and larger segments of discourse.

Based on the fact that the source of discourse structure is precisely the same as the source of intrasentential syntactic structure (a predicate-argument relation); and rather of a compound nominal in case of longer stretches of text, an abductive framework was developed for syntax, compositional semantics and local pragmatics, wherein to parse and interpret a sentence W is to prove the expression $(-e) S (W, e)$ meaning that there is a situation or eventuality e such that the string of words W is a grammatical sentence describing or conveying e (the assertion of the sentence). Both hypotactic and paratactic coherence relations are captured in this framework.

According to the proposed model the text "Bank Robbers" was analysed, resulting in a tree-like structure of the text with five types of coherence relations:

Explanation, Ground-Figure, Parallelism, Contrast, Occasion.

The report provoked a lively discussion focussing on:

1. Procedures of getting a summary out of this proposed tree-like model from a bottom-up or top-down approach; Procedures of getting summaries of linear and dynamic texts.
2. The coherence relations in the sample text (sentences 1 and 2 in relation to 3 to 9; 4a to 4b-9); the role of propositions for summarizing.
3. Computational realisation of the model, e.g. for large-scale, complex text structures.
4. The relevance of the knowledge base for summarizing. What role does the world knowledge of the summarizer play in the process of summarizing? Is the knowledge of the user of summaries to be considered in this process? There is the need to adapt summaries to users' knowledge and purpose.

Summaries from Structure

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Structure from Adjacency

To understand our environment we seek the best explanation for the observable facts we find there. Similarly, to interpret texts we seek the best explanation for the "observable" facts that are presented in the text. This view can be cashed out computationally by taking the interpretation of a text to be the most economic abductive proof of the logical form of the sentences in the text, where "abductive" means that assumptions are allowed at various costs (Hobbs et al., 1993).

Among the observable features of our environment that we seek to explain is the adjacency or proximity of objects; this generally escapes our notice except when it is out of the ordinary, as when we enter a room and see a chair on top of a table. A similar situation obtains in language. A text is a string of words and one of the features of the text that requires explanation is the adjacency of pairs of words or larger segments of text.

The simplest example of this is provided by compound nominals. When we see the phrase "turpentine jar" in a text, the interpretation problem we face is finding the most reasonable relationship in the context between turpentine and jars, using what we know about turpentine and jars. In many cases, the relationship is one arising out of one of the nouns itself, as in "oil sample", where the relation between oil and the sample is precisely the "sample of" relation.

Syntax and compositional semantics can be seen as arising out of the same need to explain adjacency. When we see the pair of words "men work", we need to find some relation between them. The hypothesis that sentences have syntactic structure amounts to the acceptance of a set of constraints concerning the relation that can obtain between two words or larger stretches of text. In this case, the constraint is that the second word itself provides the relationship. The men have to be the agent of the working. Whereas in the case of "oil sample", "sample" provides a possible relationship, in the case of "men work" "work" provides the obligatory relationship. (This is not quite true; metonymy is possible, so that the second word need only provide a relationship between the event and something functionally related to the first word.)

The tree structure of sentences arises from the fact that the adjacency relation can be between larger segments of text than simply single words, where the segments have their own internal tree

structure resulting from adjacencies. For example, in

John believes men work.

we don't seek to explain the adjacency between "believes" and "men". Rather we first explain the adjacency between "men" and "work", and only then the adjacency between "believes" and "men work" (or the adjacency among "John", "believes", and "men work", depending on your view of the structure of the clause.) This grouping occurs even in the absence of syntactic constraints. Consider the two compound nominals, "Stanford Research Institute" and "Cancer Research Institute". In the latter, we must first find the relationship between cancer and research, and then find the relationship between cancer research and the institute, whereas in the former, we group "research" with "institute" and then "Stanford" with "research institute".

In order to explain adjacencies between segments of text larger than one word, we need to have an idea of the principal information conveyed by the segments. For example, in "research institute" the reference to the institute is, in a sense, more primary than the reference to research. A research institute is a kind of institute, rather than a kind of research. Similarly, in "men work" the information about some entities working is more primary than the information about the entities being men. Therefore, as we compose larger and larger segments of text, we must have some sense of the primary information conveyed by the composite segments.

The rules of syntax and compositional semantics are a set of constraints on how segments of text can be grouped together and on what the primary information conveyed by the composite segment is. At the level of the main clause, the primary information is often what is conveyed by the main verb and/or by adverbials, although this can be overridden by such factors as intonation, newness, topicalization, and so on. We may call this primary information, however it is determined, the *assertion* of the clause. It is, in a sense, a summary of what the sentence conveys.

The source of discourse structure is precisely the same as the source of intrasentential syntactic structure. Two phrases, or clauses, or sentences, or larger stretches of discourse are adjacent in the discourse, and this fact requires explanation. A relation between them must be found to explain that adjacency. Whereas in the syntactic structure of sentences the relation among adjacent elements is most commonly a predicate-argument relation, the case of larger stretches of unrestricted text is more like the case of compound nominals, in that the relation that explains the adjacency can in principle be any plausible relation between the situations described by the segments of text.

As with the case of syntax, while we compose larger and larger segments of text, we must have some sense of the primary information conveyed by the composite segment. We must be able to

specify the "assertion", or equivalently, a summary, of a supraclausal segment of text. This is both harder and easier than in the case of compound nominals. It is harder in that whereas it is always the second noun of a noun-noun pair that is primary, with two supraclausal segments it may be the first or the second, or the primary information may arise equally out of both.

It is easier in that a smaller number of relations can obtain between two situations or eventualities described in supraclausal segments than can obtain between two nouns. For compound nominals, Downing (1977) and others have convincingly argued that the relation between the two nouns can be virtually anything, given the right context. On the other hand, Levi (1978) argues convincingly that the vast majority of the relations can be viewed as instances of no more than a dozen or so different abstract relations, such as predicate-argument, function, containment, and so on.

Similarly, it is possible that the relation between two adjacent supraclausal segments of text can be anything at all in the right context. The hearer must simply figure out the most plausible relation between the situations described and the most plausible assertion or summary of the composite segment. Unfortunately, such a view of discourse coherence gives no guidance as to what the assertion or summary of the composite segment is.

But overwhelmingly, the relation between supraclausal segments can be viewed as an instance of one of three broadly construed abstract relations—causality, the figure-ground relation, and similarity. I will refer to these as *coherence relations*. A theory of discourse coherence and discourse structure that recognizes this fact about discourse must develop characterizations of each of these relations, explicate the various classes of instances of each relation, and for each of these classes, define the assertion or summary of the composite segment. This is what I have tried to do in previous work (e.g., (Hobbs, 1985) and what I will try to recast into an abductive framework in this paper.

While I will focus on the way these three relations relate supraclausal segments of text, they can also relate material within single clauses. For example, elements of a list exhibit the similarity required of parallelism (cf. Polanyi, 1988). In the sentence,

A car hit a jogger in Palo Alto last night.

there is an implicit causal relation between the jogging and the hitting. These relations go beyond what is given to us by compositional semantics.

While I have focused, and will continue to, on the *interpretation* problem, it is important to keep in mind that interpretation and generation are intricately interrelated. A speaker seeks to generate utterances that will be understood. When two segments of coherent discourse are uttered in

sequence, it is because the speaker expects the hearer to recover the relation that is intended to be conveyed by the adjacency. Conversely, the hearer must often reason about what the speaker is trying to achieve and the other ways in which the speaker might have chosen to achieve it, in order to determine the best interpretation for a stretch of discourse.

From Coherence Relations to Structure and Summaries

In Hobbs et al. (1993) a unified abductive framework for syntax, compositional semantics, and local pragmatics is presented. In this framework, to parse and interpret a sentence $\bar{W}$ is to prove the expression

$$(\exists e)S(\bar{W}, e)$$

meaning that there is a situation or eventuality e such that the string of words $\bar{W}$ is a grammatical sentence describing or conveying e . e is the assertion of the sentence. We will take this as our starting point for a treatment of discourse structure.

The tree-like structure of discourse can be captured with two axioms:

$$\begin{aligned} (\forall w, e)S(w, e) &\supset Segment(w, e) \\ (\forall w_1, e_1, w_2, e_2, e)Segment(w_1, e_1) \wedge Segment(w_2, e_2) \wedge \\ CoherenceRel(e_1, e_2, e) &\supset Segment(w_1 w_2, e) \end{aligned}$$

The first axiom says that a sentence w describing an eventuality e is a coherent discourse segment describing e . The second says that if two segments w_1 and w_2 describe the eventualities e_1 and e_2 , respectively, and e_1 and e_2 are related by some coherence relation, then the concatenation $w_1 w_2$ is a coherent discourse segment.

The variable e in the second axiom is the assertion or summary of the composite segment $w_1 w_2$. It is determined by the assertions of the constituent segments, e_1 and e_2 , together with the relation that holds between them by virtue of which $w_1 w_2$ is itself a coherent discourse segment.

To prove $CoherenceRel(e_1, e_2, e)$ is to explain the adjacency of w_1 and w_2

To interpret a text $\bar{W}$ is then to prove the expression

$$(\exists e)Segment(\bar{W}, e)$$

meaning that $\bar{W}$ is a coherent segment of discourse conveying or describing the situation or eventuality e . e is the assertion or summary of $\bar{W}$. Thus, one of the products of an interpretation of this sort is a summary of the text derived from its structure.

To explicate a theory of discourse coherence and discourse structure along these lines is to specify the various ways in which

$$CoherenceRel(e_1, e_2, e)$$

can be established, including what e is.

The common distinction between hypotactic coherence relations, with dominant and subordinate component segments, and paratactic coherence relations is easily captured in this framework. If the relation is hypotactic, then e is either e_1 or e_2 , corresponding to whether w_1 or w_2 is dominant. If the coherence relation is paratactic, then e must be computed from e_1 and e_2 .

In the talk, I will examine five examples of coherence relations and their corresponding summaries.

1. **Explanation:** This is defined in terms of causality. The relation is hypotactic. The explanandum is dominant and thus contributes the assertion or summary; the explanans is subordinate.
2. **Ground-Figure:** The definition of this relation requires us to have axiomatized the notion of a *system*, that is, a set of entities and relations among them, and the notion of an entity external to the system being, in some perhaps metaphorical sense, *at* an element in the system. The relation is hypotactic. The figure is dominant and contributes the assertion or summary; the ground is subordinate.
3. **Parallelism:** The definition of this relation involves recognizing the similarity of entities. The text segments must assert the same properties of similar entities. The relation is paratactic. The summary of the composite segment is the generalization of which the assertion of each segment is an instance. Elaboration is a limiting case of this coherence relation, where the entities are not merely similar but identical.
4. **Contrast:** This relation is defined much like parallelism. The text segments must assert contrary properties of similar entities. The relation is generally hypotactic. Usually, the second segment is the dominant one, but this can be overridden.
5. **Occasion:** This is a weak form of causality or a strong form of temporal succession. It

involves the first text segment describing an event or situation that sets up the occasion for the event or situation described by the second segment. The relation is paratactic. The summary or assertion of the composite segment is a coarser-grained description of the sequence of state changes described by the component segments.

A summary of the entire text can be derived in this fashion. However, it should be kept in mind that it may not be the "summary" that is required for any particular application.

Footnote

- 1] This view of syntax emerged from a conversation with Mark Johnson.

References

- Downing, Pamela, 1977. "On the Creation and Use of English Compound Nouns", *Language*, vol. 53, no. 4, pp. 810-842.
- Hobbs, Jerry R., 1985. "On the Coherence and Structure of Discourse", Report No. CSLI-85-37, Center for the Study of Language and Information, Stanford University.
- Hobbs, Jerry R., Mark Stickel, Douglas Appelt, and Paul Martin, 1993. "Interpretation as Abduction", *Artificial Intelligence*, No. 63, pp. 69-142.
- Levi, Judith, 1978. *The Syntax and Semantics of Complex Nominals*, Academic Press, New York.
- Polanyi, Livia, 1988. "A Formal Model of Discourse Structure", *Journal of Pragmatics*, Vol. 12, pp. 601-638.

Related Disciplines – discourse analysis and use II

Rapporteur: Woojin Paik

Anneli Rothkegel:

Abstracting in the perspective of producing a text

Anneli Rothkegel (University of the Saarland) reported on theoretical principles of a text production model. The presenter noted that abstracting or summarizing is a specific sub-type of text production. The presenter also said that strategies of producing the mini-text controls the processing of the maxi-text. Representing processes of abstracting is described as representing text production processes.

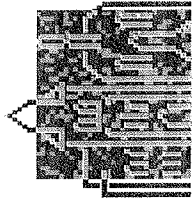
The presenter showed that there are three levels of text space. They are:

- a) text content (information);
- b) text function (presentation of information); and
- c) text form (sequencing of (b(a))).

She also explained that three characteristics of text actions (TAs): change of states (CHANGE); propositional content (PROP); and explicit markers (LANG) relate to form a predicate-argument structure.

In conclusion, the presenter remarked that summarizing is a sub-type of general writer's activities which can be described in terms of TAs. TAs are an instrument for representing human strategies of the text composition. In addition, the explicit formulation of the relationship between function, content, and linearization allows the construction of a computer model which may be applied for investigating and/or supporting human text production.

In discussion, there was an inquiry about the relative position of the presenter's theory in terms of Searle's notion of perlocution. In response to a question about the difference between German and English, the presenter responded that German chains of connectors are more explicit but the conceptual level is the same. There was a question regarding the constraint of the source text structure on the summary text structure, and the options of transforming the source text structure to the summary text structure. Regarding the comment about the general schema for texts, the presenter responded that the schema is very flexible in her model. One audience member commented that the presenter's model is about text reception not text production since the result



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