A THEORY OF DISCOURSE STRUCTURE
AND DISCOURSE COHERENCE

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1. Introduction

Interactively constructed naturally occurring talk is not well behaved. In the real world in which speakers actually produce and interpret utterances, any next utterance is possible. Everyday talk is often interrupted, repaired, resumed: hesitations, asides and elaborations on elaborations are pervasive. Yet, speakers know "where they are". Despite the disfluencies, discontinuities, apparent incoherence and complexity of everyday language use, speakers all but flawlessly recover anaphoric references, correctly interpret spatial and temporal deixis and consistently display in their utterances a clear orientation both to what had been going on in the immediately preceding discourse context and to what is currently of relevance in the real world in which the talk is taking place.[3]

Since the ultimate goal of the enterprise to be sketched in this paper is to assign a proper semantic interpretation to every clause in a discourse, we do not allow ourselves the luxury of disregarding certain utterances --those which might break up the "coherence" of a stretch of talk, for example-- in constructing a model of discourse structure. Our goal is to account for all utterances. Thus, we must provide machinery to accomplish complex segmentation tasks such as shown by Ex. (1):

(1) a. John came by.
   b. He put the groceries in the kitchen.
      c. Stop that!
      d. You kids, be quiet in there!
   e. And I put them away.
   f. Then he left.

In this case, the interrupted storytelling in one Interaction remains available to supply all the information necessary to assign personal, spatial and temporal reference after the interrupting Interaction involving the kids has been dealt with. Speakers have no difficulty in recovering the referents for them in (1e) And I put them away. and for he in (1f) Then he left. The event of putting the groceries away is also easily assigned a spatial location (in the same kitchen) and a temporal interpretation point (at an instant subsequent to the instant of putting the groceries in the kitchen).

In the following paper, we argue that the Dynamic Discourse Model (DDM), a comprehensive theory of discourse structural and semantic relations, provides much of the machinery necessary to account for the complex segmentation processes above the level of the sentence.[4] (Polanyi and Scha, 1983a, 1983b, 1984 forthcoming; Scha and Polanyi, 1985). We shall illustrate the usefulness of the DDM in explaining discourse level phenomena by giving an analysis of the notion of "discourse coherence" which uses tools provided by the DDM framework

to make "coherence" a far more theoretically solid notion than has been the case. (See Green and Morgan, 1981 for a critique of earlier proposals.)

2. The DDM: a Model of Discourse Structural and Semantic Relations

2.1 Overview of the DDM

The DDM, which may be formulated as a Discourse Parser, describes a discourse as built up by means of a sequencing and recursive embedding of discourse constituents. The unit of input to the parser is the clause encoding a single proposition.[5] The parser proceeds through the discourse left to right assigning each constituent clause to the appropriate discourse constituent and assigning to the discourse as a whole an incrementally constructed structural description in the form of a Discourse History Parse Tree. The leaves of the Tree are the clauses themselves.

2.2 The Discourse Unit Type Hierarchy

There are no uncontextualized clauses in this framework. Clauses, primitive proposition-carrying units, participate in a hierarchy of discourse constituents of various Types. Type units such as the clause, itself, and the discourse constituent unit (dcu) are formal units of linguistic structure, while the Discourse Unit --including such units as "stories", "adjacency pairs", "task oriented dialogs", and "arguments"-- is a genre unit. The Speech Event and Interaction, extra-linguistic units also part of the discourse constituent hierarchy, are conventional socially defined units with linguistic consequences.
These unit Types, with the exception of the Interaction, have sub-Types as well.
Each Type and sub-Type has its own Grammar. The Grammar specifies for each unit of that type its legal constituents and their permissible order(s).

2.3 Modelling Discourse Structure by means of a Discourse Parser

In order to process a discourse, the discourse parser makes use of the individual Type and sub-Type Grammars, calling upon parsers associated with them as needed to process constituents of the various different sorts. There is no limit to the number of times each individual parser might be made use of, nor is there any constraint placed on the order in which those parsers must be called to process any given discourse. The frequency of calls to any parser and the order of calls depends entirely on the nature of the individual discourse. The DDM framework thereby resolves an apparently insoluble problem in discourse analysis. Anything can happen in any discourse and therefore a theory of discourse structure must account for the highly individual and possibly unexpected structure of any given discourse while, simultaneously, it must account for the fact that, at any given moment, speakers are normally quite clear about the kind of discourse activity underway and have very definite expectations about what is likely to happen next.[6]

## 2.4 Discourse Coordination and Subordination

Discourse constituents are related structurally to one another by coordination and subordination. Interruptions, elaborations, asides and parentheticals are subordinations. They all disturb the orderly development of some ongoing discourse activity. Topic chains, narratives, and other list structures as well as sequences of moves in Discourse Units and Speech Events and sequences of independent Interactions are all coordinations.

Coordination is permitted:

1. Between a completed Discourse Unit, Speech Event or Interaction and a unit of the same Type.

2. Between two Moves of the same Discourse Unit or Speech Event if the new Move is a legal Next Move according to the grammar of the Type of Discourse Unit or Speech Event being parsed.

3. Between two dcu's or Discourse Units if the propositional content of the New unit and the propositional content of its prospective sister(s) bear a similar Instantiation relation to a common propositional element: justifying, motivating, making more specific, repairing, or otherwise expanding on the content of that element.

Subordination is unconstrained. The DDM is recursive: free embedding of discourse constituents is allowed.

Therefore, it is possible for the DDM to assign a structural description to Ex.(1) which treats the interrupting Interaction with the children as embedded relative to the interrupted "story" as shown in Figure (1A).
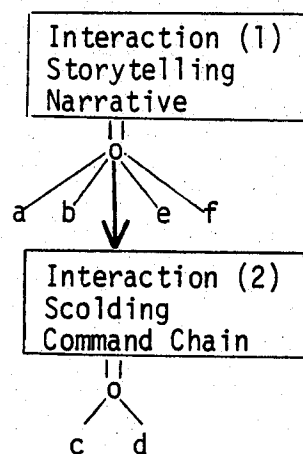
[Figure 1A]

3. The "Discourse constituent unit": "building block" of discourse

3.1 Overview of the dcu.

In the DDM framework, the discourse constituent unit (dcu) is the "building block" of discourse. Dcu's of several sub-Types have been identified including the List dcu, the Elaboration dcu, and structures involving the use of a binary operator such as IF/THEN or BECAUSE. (Polanyi and Scha, 1984) It is as dcu's that clauses join together to form complex discourse. Discourse formation is recursive: dcu's with dcu's as constituents form still larger dcu's by the processes of discourse subordination and coordination.

In this paper, we shall concentrate on the List dcu and the Expansion dcu which together allow for the construction of much --though by no means all-- complex discourse. We shall first discuss these dcu's informally and go on later to give some more details of discourse formation within the DDM framework.

3.2 The Topic-Chain

3.2.1 Simple Topic-chain dcu's

In the present framework, Ex. (2) is classified as a Topic-Chain dcu, a dcu in which each clause expresses some predication of the same extensional entity encoded in the clause as clause topic.[7]

(2) a. John is a blond
    b. He weighs about 215
    c. He's got a nice disposition
    d. He works as a guard at the bank.

All of the propositions encoded by clauses (2a-d) instantiate a higher level notion, not expressed, which might be thought of as "the properties of John now". Each proposition tells us something "about" "John". However, looking more carefully at those four propositions, we notice that not only does each concern "a property of John at the present time," but each is predicated of some "generally known and knowable property of John at the present time."

Topic-Chain dcu's are thus conceived of here as more restrictive structures than merely chains of clauses sharing a common sentential topic: Topic-Chain dcu's specify complex semantic constraints set by the constituents of the dcu. In order to be a constituent of an existing Topic-Chain dcu a next clause would need to meet the same general semantic constraints and would then be able to continue precisely the same line of discourse development.

In the case of the Ex. (2) Topic-Chain dcu, a next clause would also need to encode some generally known or knowable characteristic of that same John at the same time point. To do otherwise would take the discourse in a slightly different direction. If the next clause were:

(2) e. He has 100,000 white cells, **or**
    f. He is a spy for the Other Side, **or**
    g. He used to be a compulsive joke teller.

a somewhat different course of discourse development would be initiated --one expressing some other sort of information about John.

(2e) <u>He has 100,000 white cells</u>, is too specific and too biological a fact about John to include in the same listing with his weight and place of employment, while (2f) <u>He is a spy for the Other Side</u> is too dramatic a piece of information; information asserted moreover from the viewpoint of and Omniscient Narrator who knows things about John that people who know John in a casual sort of way probably would not know. The fact that John had been a compulsive joke teller in the past, the proposition encoded in (2g), while the kind of fact which fits the constraints on general knowability is a past rather than a present property of John. After (2g) to continue with details of John's current properties seems like a "return" to discuss issues which had appeared to have been completed earlier.

3.2.2 The Chronologically ordered Topic—chain dcu.

The constraints on Topic—Chain dcu membership in (2) involve how each individual proposition relates to a more general, abstract proposition schema concerning the extension of "John". In (3), a chronologically ordered Topic—Chain dcu, the propositions are related to one another sequentially in addition to instantiating some more abstract (unexpressed) proposition schema concerning "John". Taken together,

(3) a. Jim took all the home ec courses in high school.
     b. He was a cook in the army.
   c. He took the Cordon Bleu course in France last year.

describe Jim's culinary education. They relate to one another by each asserting a sequential step in this process. A next clause in this dcu must also give some detail of Jim's training as a cook --particularly, some development which took place within the past year.

3.3 The Expansion dcu.

So far the discourses we have seen have been "flat" --consisting of clauses listing propositions with similar semantic relationships to one another. Discourse does not consist solely of such sequences of clauses, of course. In the present framework, an <u>Expansion dcu</u> is formed when the proposition encoded in one dcu is expanded upon semantically by the propositional content of clauses making up an immediately following dcu. An Expansion dcu consists of the expanding dcu and a dcu which immediately precedes it. Ex. (4) is a paradigmatic Expansion dcu:

(4) a. Jim is a great cook.
     b. He took all the home ec courses in high school.
     c. He was a cook in the Army.
     d. He took the Cordon Bleu Course in France last year.

The propositions corresponding to clauses (4b–d) explain how Jim came to be a good cook. They expand our understanding of important aspects of the proposition which asserts that he is a good cook. The DDM treats a dcu which expands on a proposition encoded in the discourse in an immediately preceding clause as subordinated to the clause on which it expands as shown in Figure (4A).
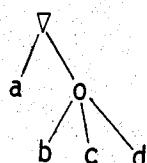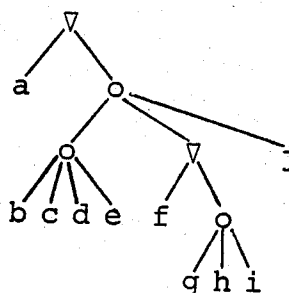
[Figure 4A]

(The ▽ at the node joining (4a) to the chronologically ordered Topic–Chain dcu consisting of coordinated clauses (4b–d)indicates that (4b–d) is sub–ordinated with respect to (4a).)[8]

Discourses are more complex, too, than merely list structures following semantically higher level proposition encoding clauses. We shall not have the opportunity here to tease out all of the complex cases and we shall limit ourselves to dealing with only a few of the simplest complexities. In Ex. (5), for example, a dcu describing "John" is conjoined to dcu's describing "Jim" and "Harry" into a three constituent List dcu suppleting the semantically more general requesting dcu.

(5) a. Tell me about the young men in town.
 b. John is a blond.
 c. He weighs about 215.
 d. He's got a very nice disposition
 e. He's a very good athlete, too.
 f. Jim is a great cook.
  g. He took all the home ec courses in high school.
  h. He was a cook in the Army
  i. He took the Cordon Bleu Course in France last year.
 j. and Harry is the scholar in the group. etc.

The List dcu consisting of a "John"–dcu, a "Jim"–dcu, and a "Harry"–dcu is an appropriate reply to (6a) <u>Tell me about the young men in town.</u> because all three are members of the set referred to in (5a) as "the young men in town". A set/element Relation exists between the extension of the NP in the request dcu and the topics of the three constituents of the List dcu which suppletes the requested information. The structural description of (5) is given in Figure (5A). In the Discourse History Parse Tree, the three List dcu's are co–ordinated to one another in a List dcu and embedded relative to (5a). Each constituent dcu of the three element List has its own internal structure represented as well.
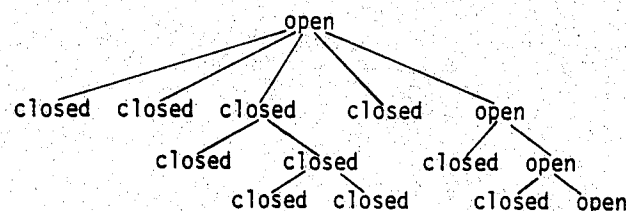

[Figure 5A]

Thus far we have constructed structural descriptions of discourses by inspection. We have taken the perspective of one with an overview of the entire discourse. However, in processing discourse we cannot assume that we have the full text in front of us. Discourse is parsed incrementally as it occurs. Therefore, if we are to model the processes of discourse formation and segmentation, we must have a theory of discourse structure which will allow us to assign a structural description to discourse as it unfolds, building up the Discourse History Parse Tree from left to right, one clause at a time. The Dynamic Discourse Model provides us with tools for constructing such a left to right Parse Tree.

4. Discourse Parsing

4.1 "Structural Accessibility" in the Discourse History Parse Tree

The DDM Parser processes a discourse from left to right, one clause at a time building up incrementally a Discourse History Parse Tree. The Tree specifies the order in which constituents of various Types occurred in the discourse parsed and specifies which constituent units have been completed, which were interrupted and abandoned and which remained incomplete at any given time. Building up the Discourse History Parse Tree is essentially a process of attaching newly processed constituents at structurally accessible positions in the developing Tree.

As shown in Figure [6A], only the rightmost positions of the node dominating the most recently parsed clause are structurally accessible. All other nodes and positions are structurally inaccessible.

```
                        open
         _____/|_____
        /       /       /   \          \
    closed  closed  closed  closed      open
                      /\        /\        /\
                 closed closed closed  open
                         /\          /\
                    closed closed  closed  open
```

[Figure 6A]

Only constituents at accessible nodes enjoy the formal status of "currently being constructed" --all other constituents are considered for the purpose of discourse construction to have been completed, or , if left incomplete, to have been abandoned. They are not resumable. Should a speaker wish to say more "about" the content of a closed constituent, a new constituent must be created and the link with the old unit made explicit. The development of the "content" can then be continued in this new unit.(See Section 7 below)

A new constituent is attached to the Discourse History parse Tree either as the rightmost constituent at a structurally accessible existing level in the Parse Tree --coordinating it to the constituents already attached at that node-- or alternatively, the new constituent may be attached as the right constituent of a new node inserted directly above a node dominating the preceding clause. In this latter case, the new constituent is embedded relative to the left constituent of the new node. Examples of these possibilities are shown in Figure [7A].

$+\ C_5\ \Longrightarrow$

$+\ C_6\ \Longrightarrow$
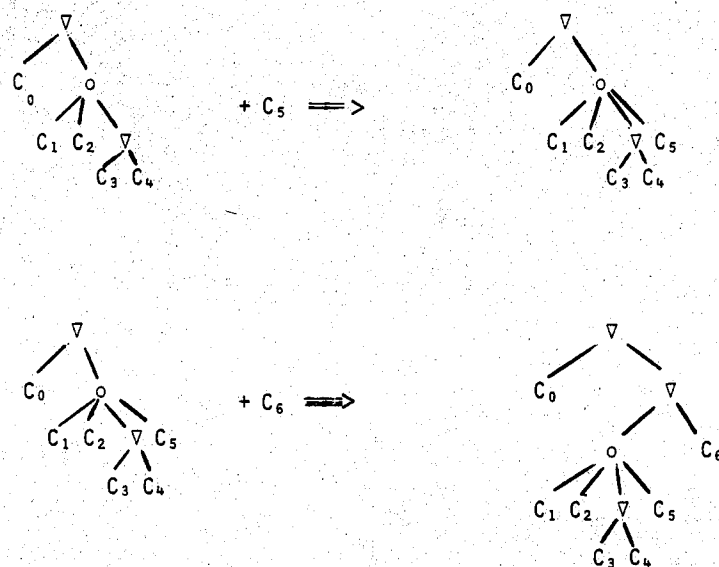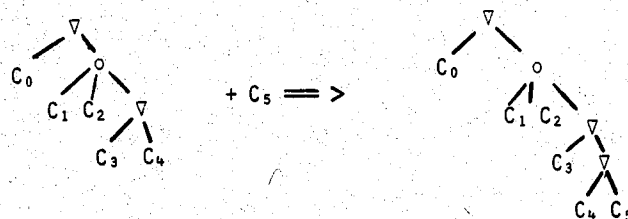
[Figure 7A]

4.2 "Discourse Adjoin"

Discourse coordination even to a constituent at a structurally accessible node is highly constrained. As described above, coordination is permitted between constituents of the same Type and then only in restricted cases.

However, there is one additional case which was not discussed earlier in which discourse coordination is possible. If a clause can be subordinated relative to a dcu at a structurally accessible position, but can not be coordinated to a unit dominated by that node because of a failure of semantic congruence, the new unit may be adjoined to the existing unit at a new coordination node immediately dominating the accessible constituent. This attachment process, called Discourse Adjoin, is illustrated in Figure 8A.

$+\ C_5\ \Longrightarrow$
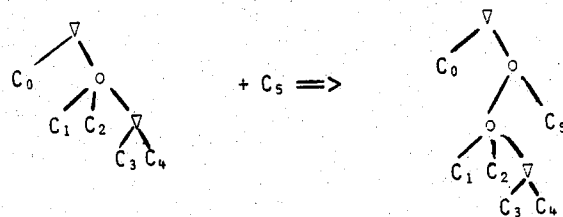
[Figure 8A]

All other discourse constituents, whether or not semantically related to the last clause parsed will be subordinated with respect to that clause. (See figure [9A])

$$C_0 \quad C_1\ C_2 \quad C_3\ C_4 \quad + C_5 \implies C_0 \quad C_1\ C_2 \quad C_3 \quad C_4\ C_5$$

[Figure 9A]

4.3 Discourse Pops.

If while parsing a constituent of a given Type, the Parser encounters a clause which is not a legal next Move according to the Grammar of that Type of constituent, the Parser must try to find out if this new constituent is 1: the next Move of a constituent whose completion was interrupted but which is still accessible for completion; or, 2: if this new clause is the first constituent of some other unit all together.

In the first case of returning to complete parsing a previously interrupted unit, the system POPS up to the level of the previous unit rendering all intervening partially completed units structurally inaccessible.[9]

In the second case , when a parse is interrupted by intervening material and no POP to a higher level is possible, the DDM parser embeds the interrupting material relative to the last clause parsed. In this case, both the embedding node and the nodes dominating it in the Parse Tree remain structurally accessible.

4.4 "Semantic Value Frame"

In order to permit a determination to be made if a given constituent is to be coordinated or subordinated in the Discourse History Parse Tree, the DDM associates a Semantic Frame with each constituent of every Type. These Semantic Frames, taken as a whole, represent the semantic interpretation of the constituent. Each Frame consists of slots which are filled by semantic parameters abstracted from the content, encoding form, and syntagmatic placement of each constituent parsed. These parameters specify Place, Time, Activity, Participant Set, Goals and Attributes which define the given constituent. In addition, the Frame may specify purely structural information such as, for a list matching Attributes with Individuals, for example, that there is an alternation between good and bad attributes, or for a Narrative dcu, that there is a sequential Relation between the last Event clause parsed and the next Event.

Coordination between structurally appropriate constituents requires participation by the constituents in a higher level (more abstract) unit whose Semantic slots are filled by parameters which correspond to the Union of the Values of the parameters of the coordination candidates. Semantic subordination --such as elaboration or other types of expansion-- likewise requires <u>both</u> legal structural relationship in the Parse Tree <u>and</u> semantic congruence between the higher level and embedded constituents.[10]

If a next clause is "congruent" with a constituent at an accessible node in the Parse Tree, a coordination node directly dominating this accessible node and the new clause will be created. This coordination node will inherit the Union of the Values of the parameters of the constituents it was created to contextualize.

5. Discourse Coherence

Having sketched very roughly the outlines of some of the important aspects of the DDM approach to discourse structure, we shall focus our attention on the issue of discourse "coherence". Making use of the notions we have been developing, we shall explain why some sequences of clauses create a "coherent" discourse while others may be perceived as constituting a somewhat less well put together whole.

Let us begin by considering example (2) again. (2B)

```
(2B) a. John is a blond
     b. He weighs about 215
     c. He's got a nice disposition.
     d. He works as a guard at the bank.
?    e. He has 100,000 white cells.
??   f. He loves ice cream.
```

seems much less coherent than (2C)

```
(2C) a. John is blond.
     b. He weighs about 215
     c. He's got a nice disposition.
     d. He works as a guard at the bank.
     e. He loves ice cream
?    f. He has 100,000 white cells.
```

In 2C, (2Cf) <u>He has 100,000 white cells.</u> while clearly beginning a different sort of discourse development than was going on in (2Ca-e) does not feel "out of place". (2Ce) <u>He loves ice cream.</u> similarly is perceived as in its proper place. In (2B), however, clause (2Bf), identical in form to (2Ce), <u>is</u> out of place. After beginning a new aspect of discourse development with the assertion of John's white corpuscle inventory, John's love of ice cream (2Bf) seems "stranded", displaced. How do we account for this?

In the DDM framework, we explain the difference in acceptability of (2B) and (2C) in terms of a match between semantic development and clause placement in (2C) and a mismatch between them in (2B). We shall use the concepts of discourse structure and a discussion in terms of clause by clause discourse parsing to motivate this assessment of structural/semantic matching and mis-matching. Let us follow along clause by clause as the DDM Parser analyzes the discourses in (2B) and (2C) and builds up the Discourse History Parse Trees which correspond to them.

(2B/C)a. <u>John is a blond.</u>

concerns the blondness of some "John", "NOW". For discourse construction purposes, this is a primitive dcu with Semantic

Values <John, NOW, blond>. It is the first constituent. The dcu corresponding to (2B/C a) is the first node on the Parse Tree. [Figure A]

        a   <John, NOW, blond>
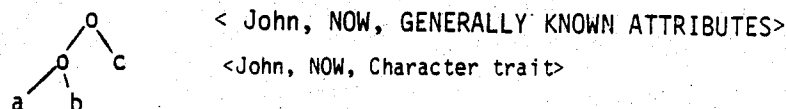

[Figure A]

(2B/C)b. <u>He weighs about 215</u>.

concerns the weight of some "he", "NOW". Since (2B/C b) follows (2B/C a) and there is no other candidate for the referent of the pronoun, we assume that "he" is coreferential with "John", giving us the Semantic Values <John, NOW, weighs 215>. Comparing the Values of (2B/C b) with (2B/C a) we notice that "John" and "NOW" are held in common and that furthermore "blond" and "weigh 215" are both PHYSICAL ATTRIBUTES. We create a new coordination dcu with the Values <John, NOW, PHYSICAL ATTRIBUTES>. (2B/C b) is the right daughter of this node. (Figure B)

      o   <John, NOW, PHYSICAL ATTRIBUTES>
     /\
    a b   <John, NOW, weight>
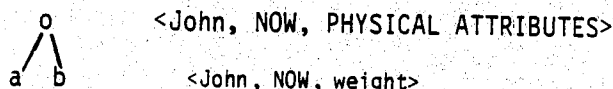
[Figure B]

(2B/C)c. <u>He's got a nice disposition</u>.

concerns the "disposition" of "John" "NOW". "a nice disposition" is <u>not</u> a PHYSICAL ATTRIBUTE. It is, however, an ATTRIBUTE, a generally known character trait. We create a new coordination dcu with Values <John, NOW, GENERALLY KNOWN ATTRIBUTES> by taking the lowest common denominator of the Values of (2B/C c) and the <Values John, NOW, PHYSICAL ATTRIBUTES> which contextualized the preceding clause. We embed (2B/C c) to this coordination node as the rightmost daughter. (Figure C)

      o   < John, NOW, GENERALLY KNOWN ATTRIBUTES>
   / \
  o   c   <John, NOW, Character trait>
 /\
a b
      [Figure C]

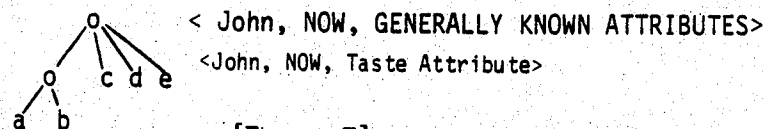(2B/C)d. <u>He works as a guard at the bank</u>.

concerns "employment" of "John" "NOW". <John, NOW, works as a guard at the bank> can be seen as an expansion of <John, NOW, GENERALLY KNOWN ATTRIBUTES>. Therefore, we coordinate (2B/C d) as the rightmost sister at the existing highest node.(Figure D)

```
        o          < John, NOW, GENERALLY KNOWN ATTRIBUTES>
       /|\
      o c d        <John, NOW, Employment Attribute>
     /\
    a  b
```
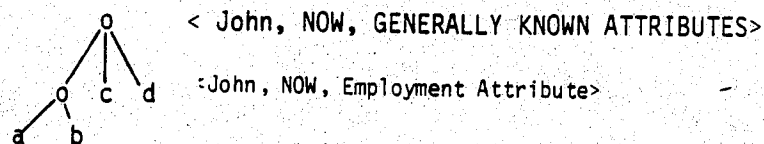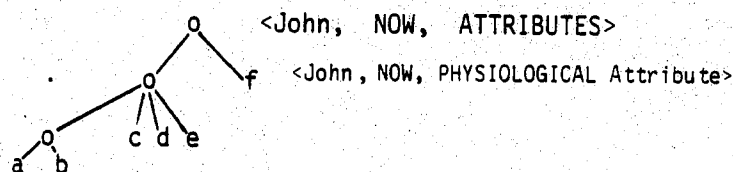
[Figure D]

In (2C), (2Ce) encodes a proposition "John loves ice cream" allowing it to be coordinated within the<John, NOW, GENERALLY KNOWN ATTRIBUTES> dcu because "loving ice cream" is a known and knowable ATTRIBUTE of an individual. For 2C this results in the Tree shown in (Figure E).

```
         o         < John, NOW, GENERALLY KNOWN ATTRIBUTES>
        /|\\
       o c d e     <John, NOW, Taste Attribute>
      /\
     a  b
```

[Figure E]

For (2C f) He has 100,000 white cells. we must create a new highest level coordination node to accommodate its propositional content concerning a specialized PHYSIOLOGICAL ATTRIBUTE of John's. Taking the lowest common denominator between a PHYSIOLOGICAL ATTRIBUTE and a GENERALLY KNOWN ATTRIBUTE results in the dcu with Values <John, NOW, ATTRIBUTES> which can accommodate both dcu's. (2Ce) is embedded relative to this new highest level node as the rightmost constituent of the dcu. (Figure F)

```
          o        <John, NOW, ATTRIBUTES>
         / \
        o   f      <John, NOW, PHYSIOLOGICAL Attribute>
       /|\
      o c d e
     /\
    a  b
```
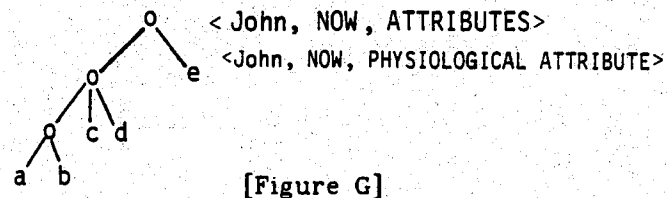
[Figure F]

With (2C f) the discourse has changed direction. We expect now to input more clauses which tell us about John's attributes or, to learn more about John's blood count or other physiological details. What we do not expect, however, is that after hearing about John's white blood count, we shall learn more about John's generally known and knowable attributes. After all, by shifting from a dcu which would accommodate such a detail the discourse moved to a different state. Now, to try to go back is not possible according to the DDM Parser. The attachment of (2C f) as the rightmost constituent at the highest level in the Parse Tree means that the dcu which would accommodate such material is closed off, inaccessible as shown in Figure F. Yet in (2B), the discourse feels as though semantically it would like to "return".

How does this come about? When parsing (2B), after dealing with (2B/Cd) He works as a guard at the bank.(Figure D above), the parser must create a new coordination node with Values <John, NOW,

ATTRIBUTES> in order to accommodate (2Ce) <u>He has 100,000 white cells</u>.
(2Ce) is the rightmost constituent of this coordination node. (Figure G)

< John, NOW, ATTRIBUTES>
<John, NOW, PHYSIOLOGICAL ATTRIBUTE>

[Figure G]

When parsing (2Bf) <u>He loves ice cream</u>. the parser can not coordinate
(2Bf) with (2Be) since <John, NOW, loves ice cream> is not a
PHYSIOLOGICAL ATTRIBUTE but a personal preference, a GENERALLY KNOWN
or knowable ATTRIBUTE of John NOW. This is precisely the kind of
ATTRIBUTE which would have been accommodated under the now closed
left sister coordination dcu. Therefore, in order to accommodate (2Bf)
the parser attaches it as the rightmost sister at the top level, as shown
in Figure H:

< John, NOW, ATTRIBUTES>
<John, NOW, Taste Attribute>
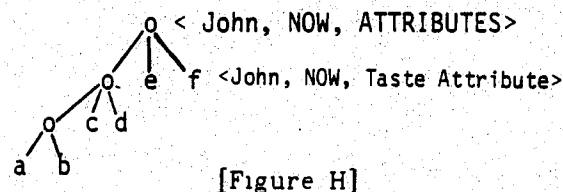
[Figure H]

Since (2Bf) has Values which could have been perfectly
accommodated under the "old" coordination dcu, and is more remotely
related to the new highest level dcu which has become its mother, the
discourse understander has an impression of structural incoherence.
Before the newest highest level coordination necessary to integrate (2Be)
into the discourse, semantic development and structural placement of the
clauses encoding the propositions making up the discourse semantic
structure went hand in hand. After the need to accommodate the
semantically less related element and the subsequent closing off of the
dcu appropriate to contextualize (2Bf), that semantic/structural lockstep
was broken. Thus, as understanders we have a feeling of some sort of
"return" somewhere in (2Bf) and the awareness of some sort of discourse
disorganization. The characterization of the resulting discourse as "not
very coherent" or "poorly organized" originates in the incongruence
between surface structural clausal placement and their underlying
semantic Values.

6. <u>Constraints on Discourse Coherence</u>
Discourse "coherence" is an artifact of the discourse construction
process.
Expressed in terms of the DDM-framework, a general rule for
producing maximally coherent discourse would be:

> Group sequentially all units at the same level of structure in the Discourse History Parse Tree whose Values permit contextualization under the same higher level unit.

More specifically speakers will perceive a discourse as "coherent" in so far as the following constraints on discourse coherence are observed:

1. Each constituent of the discourse encodes the kind of information expected and occurs in the order predicted for it by the Grammar of the Type unit being constructed.

2. All interrupting material is semantically related and recoverably relevant.

3. Any unit whose construction was interrupted for the insertion of semantically related relevant material is clearly resumed and eventually completed.

4. The number of levels of embedding is kept to a minimum.

5. The semantic Values of coordinated constituents vary monotonically.[11]

When these constraints are met, structural coordination and subordination will match semantic congruence between the semantic values of the units involved. Discourse surface ("syntactic") relations among units will match up with the "underlying" discourse semantic relations among those units.

7. Relations with Other Discourse Models

In the Dynamic Discourse Model a very strong claim about the nature of discourse structure is being made. We claim that discourse has the form of a Tree, and that human discourse processing involves an awareness of which constituents are resumable and which ones are no longer structurally resumable despite speakers' ability to talk about whatever they might want to whenever they might want to do so.

Unlike the treatment for discourse suggested by Reichman (1978), in the DDM discourse syntactic relationships arising from the specific placement of one clause versus others in the flow of discourse are kept separate from the semantic relationships which might obtain among propositions which occurred in even very different discourses altogether. In our view, the conflating of the structural with the semantic in Reichman's Context-Space formalism results in the failure of her system to provide an adequate account of discourse structural properties. For Reichman, discourse coherence reduces formally to "talking about the same thing". Her context spaces, once opened, can never be closed again since a speaker may, at any moment, decide to say something more about an issue long since abandoned in the flow of talk. Our dcu's and other discourse Type units remain open as long as they are structurally accessible in the Discourse History Parse Tree. Then they are permanently closed.

The highly seminal work done by Grosz on Task Oriented Dialogs suggests that we may well be on the right track with this approach (Grosz, 1977). Her work indicates that anaphoric elements may refer back to structurally accessible referents in the Discourse History Parse Tree but are blocked from referring to elements in structurally closed parts of the tree. Grosz' parse tree was basically a semantic tree: the structure of the discourse mirrored the structure of the instantiated Speech Event. In developing the DDM, we have generalized aspects of Grosz' discourse model first developed for highly constrained discourse to discourse in general. We expect that this structural approach to discourse will yield fruitful results, shedding light on linguistic phenomena which pose problems for sentential treatments including:

1. determining the units initiated in English by There-sentences, wh- and it-cleft sentences, sentences with full nominals in subject position, sentences containing preposed temporal and locative adverbials and other marked sentential encoding forms. (See Ehrlich and Koster, 1983; Prince, 1980; Scha, 1982, 1984.)

2. explaining the functioning of discourse anaphora involving both pronomial and zero forms; and,

3. elucidating the scope and functioning of conjunctions, and the use of particles and lexical items such as well, so, anyway, etc. in English which clearly have discourse segmentation functions. (see Gulich 1970; Polanyi and Scha 1983, forthcoming; Schiffrin, forthcoming.)

NOTES

[3] The work of the Ethnomethodologists in analyzing conversation makes clear how competent, indeed, speakers are in displaying their orientation to topical, and social constraints on discourse.(See papers in Schenkein, 1978).

[4] The present paper cannot begin to present the formal, technical details of the theory. Many of these are to be found in Polanyi and Scha, 1984, forthcoming; and Scha and Polanyi, 1985.

[5] This is a theory of discourse structure. We assume in constructing this theory an adequate theory of sentential syntax and semantics. We are not prepared to deal with sentence internal issues at this time. We shall use the term clause to refer to any minimal syntactically well formed proposition carrying linguistic structure. A "sentence", "word" or "incomplete phrase" may also function as a clause in this framework.

[6]We thus clearly reject Morgan's arguments against discourse grammars —although we agree that "text linguistics" has provided few solid insights to date into how language is structured above the sentence. (Morgan, 1981).

[7]We shall not engage the issue of what a sentence topic is; how such an object might be defined, etc. We should like to point out, however, that linguists investigating topic-chaining, switch reference, the trace of identity in discourse etc. will find that the model of discourse structure sketched here provides a grasp on such hitherto slippery notions as "already in the discourse", "new to the discourse", etc.

[8]In the case of Ex. (4) one can easily paraphrase the discourse with the compound complex sentence ("binary structure dcu") in Ex. 4B:

(4B) a. Jim is a great cook BECAUSE
 b. He took all the home ec courses in high school.
 c. He was a cook in the army.
 d. (and) he took the Cordon Bleu Course in France last
  year.

[9]In Ex. (1), (1d) was rendered structurally inaccessible by (1e). More importantly, the entire embedded Interaction was rendered unresumable from the viewpoint of the embedding Interaction by the POP at (1e). A "continuation" of the Interaction with the children would be seen thus as a "new" interruption from the point of view of the storytelling.

In trying to model discourses which human understanders are able to segment without difficulty, the DDM is a model of discourse "competence" though it is by no means a model of only "coherent" discourse. The DDM models discourse from the point of view of one Interaction. In some very complex circumstances discourses may be interleaved and the competence model as proposed would break down. Human discourse understanders have difficulty themselves in understanding what exactly is going on in interleaved interactions when cognitive performance problems in "keeping track" may interfere with smooth discourse production and understanding.

[10]The process of Value matching is largely extra-linguistic involving real world knowledge, common sense reasoning and inference procedures. (See Hobbs 1979, forthcoming)

[11]Rather than try, in a footnote, to give an entire theory of Monotonic Semantic Variance in Discourse, we suggest that:

If:	then:	will be better than:
a) good<better<best	a) John is good swimmer.	Sam is a better swimmer.
b) good<great<fantastic	Sam is a better swimmer.	John is a good swimmer.
c) over there<there<here	Harry is the best swimmer.	Harry is the best swimmer.
d) remote past<past<present<future		
	b) John is a good basketball player.	John is a great tennis player.
	He is a great tennis player.	He is a good basketball player.
	He is a fantastic swimmer.	He is a fantastic swimmer.
	(Ego in Boston)	
	c) John lives in Boston.	Stan lives in California.
	Harry lives in Vermont.	John lives in Boston.
	Stan lives in California.	Harry lives in Vermont.
	d) My grandfather was a teacher.	My grandfather was a teacher.
	My father was a teacher.	I am a teacher.
	I am a teacher.	My father was a teacher.
	My children shall be teachers.	My children shall be teachers.

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