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# JUDGING THE COHERENCY OF DISCOURSE

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## ABSTRACT

The component propositions of a coherent discourse exhibit anaphoric, spatio-temporal, causal and thematic structures. Not all of this structure is explicit, but must be inferred using a model of cognitive knowledge. The organization of knowledge in the model allows a bottom-up analysis of discourse. Further, knowledge is formed into small complexes rather than into the large monolithic structures found in Scripts/Frames.

## 1. The Structure of Coherent Discourse.

A discourse is judged coherent if its constituent propositions are connected. Various types of cohesive links are observed in discourse: anaphoric, spatial, temporal, causal and thematic. We will formally describe the structure of a well-formed discourse in terms of these connectives.

### 1.1 Anaphora.

Two kinds of anaphora can be distinguished. The first is marked by the presence of a proform (or by the repetition of a form):

(1) Henry travels too much. He is getting a foreign accent.

Antecedents may be nominal, verbal or clausal.

The second kind of anaphora has a dependent that is an abstract

term for the antecedent. For example,

(2) John put the car into 'reverse' instead of 'drive' and hit a wall. The mistake cost him $200 in repairs.

'Mistake' in (2) is an abstract characterization of the gear selection expressed in the first sentence.

A conventional way to label the recurring actors in discourse is as 'dramatis personae'. However cohesion can result not only from multiple appearances of people, but of any concept, as in (2).

1.2 Spatio-temporal and Causal Connectives.

Space, time and cause give coherency to a set of propositions.

(3) The King was in the counting house, counting out his money. The Queen was in the parlour, eating bread and honey.

The actions in (3) are set in different rooms, but of the same 'palace'.

(4) After Richard talked to the reporter, he went to lunch.

The temporal sequence of events in (4) is expressed by 'after'.

(5) John eats garlic. Martha avoids him.

To non-aficionados garlic is known only for its aroma, detection of which causes evasive action.

Cause, illustrated in (5) is an important discourse connective. Note however, that this is an ethnocentric view; in other cultures a different position may have to be taken, for example, a teleological world view (White: 1975).

This dimension of discourse structure is termed its 'plot' structure.

1.3 Thematicity.

Discourse is expected to have a theme, to have a topic. For example,

(6) Dino Frances drowned today in Middle Branch Resevoir after rescuing his son Dino Jr. who had fallen into the water while on a fishing trip.

is a new story from the New York Times, with a theme of, say, 'tragedy'.

Discourse may have more than one theme, but these should not conflict.

(7) Eating the fish made Gerry sick. He had measles in May.

In (7) we have an incoherent structure. The proposition 'Gerry sick' belongs both to a topic 'food-poisoning' and to a biography of illnesses. The analysis of fairy-tales by Lakoff (1972) suggests that discourse has a strictly tree-like thematic organization.

It is concluded that the propositions of a coherent discourse are connected either by coreference or (preferably) causally, and that it has a single theme (which may be the root of a tree of themes).

## 2. The Role of Inference.

Not all of discourse structure is overtly stated; discourse is highly elliptic. In (4) the discourse connective 'after' is present to mark a temporal sequence, but in (5) there is no realization of the causal relation between the two propositions. Normally one assumes that a discourse is coherent; hence (3) is most acceptable if the rooms are taken as being within the same habitation. Evidently a reader must infer omitted structure. The inferences are made from his cognitive store of world knowledge.

There is much discussion at present about inference as part of understanding. To make inferences is easy; the problem is to make the right ones. It helps to have a goal. It is suggested that discourse can be said to be understood when it has been judged coherent, as defined above.

## 3. Mechanisms of Inference.

A model of cognitive knowledge -- an encyclopedia -- should be capable of making the inferences necessary to form an opinion about the coherency of a discourse. The present encyclopedia originated with Hays (1973); a fuller description can be found in Phillips (1975). It is implemented as a directed graph. Labeled nodes characterize concepts and labeled arcs relations between concepts.

Propositions have a structure of case-related concepts, based on Fillmore (1969). This is our 'syntagmatic' organization of knowledge. As propositions are essentially the building blocks of discourse, we will not dwell on their structure here.

### 3.1 Anaphora.

If the dependent is a proform then part of understanding is to determine the correct antecedent. There are syntactic constraints (Langacker: 1969) which serve to narrow down choices for antecedents and to give an order of preference. The chosen antecedent will be the first that, when substituted for the proform, produces a meaningful proposition that is coherent in context.

A meaningful proposition is one that has a counterpart in the encyclopedia. The counterpart may be the self-same proposition, or more likely, a generalized proposition (hereafter a GP). For example, rather than 'Joan drink milk', we would expect to find 'animal imbibe liquid'.

How are GPs found? All concepts belong to partially ordered taxonomic structures in the encyclopedia (our 'paradigmatic' organization of concepts). From any concept it is possible to follow paradigmatic relations to a more general concept, which may be a constit-

uent of a proposition. An intersection of paradigmatic paths originating from each concept in a discourse proposition (hereafter a DP), taking account of syntagmatic structure, gives a GP. If there is no such intersection, then the DP is not consistent with encyclopedic knowledge.

Abstract terms can be defined by complexes of GPs, each having sufficient conceptual content to define situations in which they apply. For example, a definition of 'mistake' must be such that it applies to part of the first sentence in (2).

3.2 Space, Time and Cause.

To infer omitted spatio-temporal and causal relations (termed 'discursive' relations in the encyclopedia), it is also necessary to locate GPs. The encyclopedia, of course, includes these relations, but between GPs. Schematically, from a discourse proposition $P_1$ we can locate $P_2$, a GP, in the manner outlined above. $P_2$ may have a discursive relation R to another GP, $P_3$. A proposition $P_4$, a particularized version of $P_3$, and the relation R, between $P_1$ and $P_4$, can be added to the discourse, figure 1.

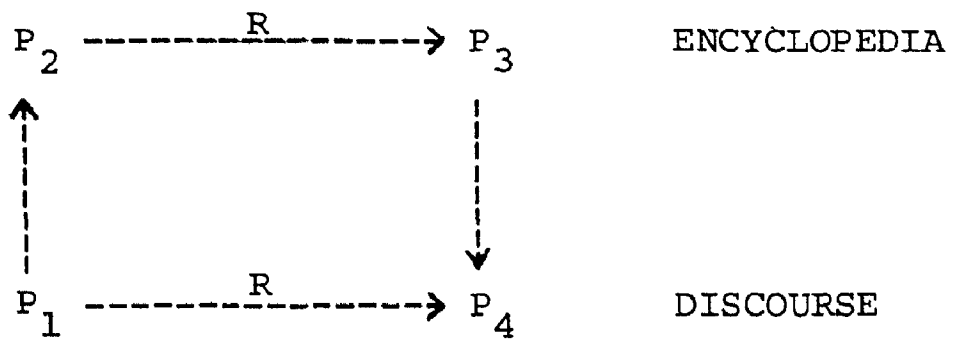



Figure 1.

Often $P_4$ will be a proposition already stated in the discourse; merely the relation need be inferred to augment the plot structure. It may, however, be necessary to infer a chain of propositions to link the original DPs. The question arises whether there is a limit on the number of propositions in a 'sensible' inferred path. Intuitively there is, but at present we have no formal insight.

3.3 Thematicity.

A theme is a complex of GPs, structurally indistinguishable from that used in characterizing abstract terms like 'mistake'. The potential presence of a theme is detected in the process of seeking GPs for DPs. All GPs, whether or not they are part of a thematic definition, can be located by paradigmatic searches; some GPs have additional structure indicating that they are components of themes. It is not sufficient to establish a theme for discourse by separately finding DPs that correspond to all the GPs of a theme. The thematic definition and the relevant part of the discourse must be tested holistically to ensure that the correct coreferentialities exist among the propositions.

3.4 Overview of Inference.

There are two basic processes underlying inference. First there is the process of locating a GP given a DP. This is implemented essentially by a breadth-first search through the paradigmatic structure of the encyclopedia. Secondly there is the process of matching a complex of propositions in discourse against an encyclopedic complex. The latter process is qualitatively different as it involves tests for coreference that the former does not.

Complexes of propositions have obvious functional similarities with 'Paraplates' (Wilks: 1975), 'Scripts' (Schank and Abelson: 1975) and

'Frames' (Minsky: 1975). Adding to the expanding terminology, our version is known as 'metalingual definitions'.

Metalingual definitions serve to define abstract terms ('mistake'), themes ('tragedy') and plans (used by Furugori (1974) in his robot planner). The distinctions are more terminological than substantive, their functions are interchangable; in other contexts a plan could be a theme, a theme an abstract term, etc.

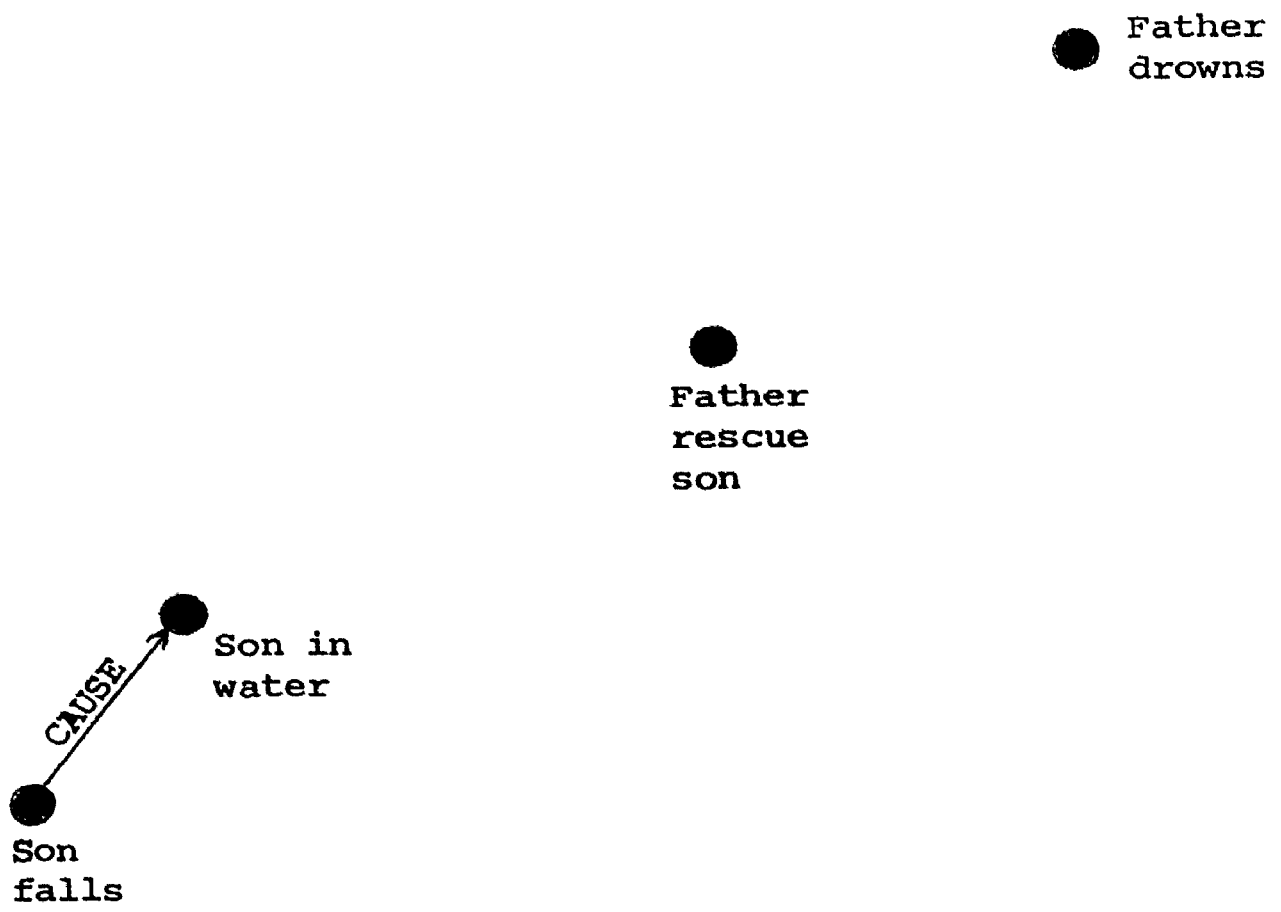
When an abstract concept has a metalingual definition, a matching discourse may be rewritten in terms of that concept. For example, 'buy' has such a definition, say '$person_1$ gives object to $person_2$, $person_2$ gives money to $person_1$'. To properly make the transduction to '$person_2$ buys object from $person_1$', there must be a case frame for 'buy' linked to concepts in its definition. A proposition produced by abstraction is structurally indistinguishable from a proposition that was in the original discourse, and can be subject to any encyclopedic process, including further abstraction. Conversely, if a proposition contains a concept having a metalingual definition, then the proposition can be decomposed into a complex of propositions patterned on the definition.

## 4. An Example.

A schematic analysis of (6) shows the inference system in operation, resulting in a structure that satisfies the criteria of coherence.

At each step we will indicate the encyclopedic knowledge used in the inference, and the current state of the discourse. The original discourse propositions are indicated by ● and inferred propositions by ○

Step 0. Initial State.

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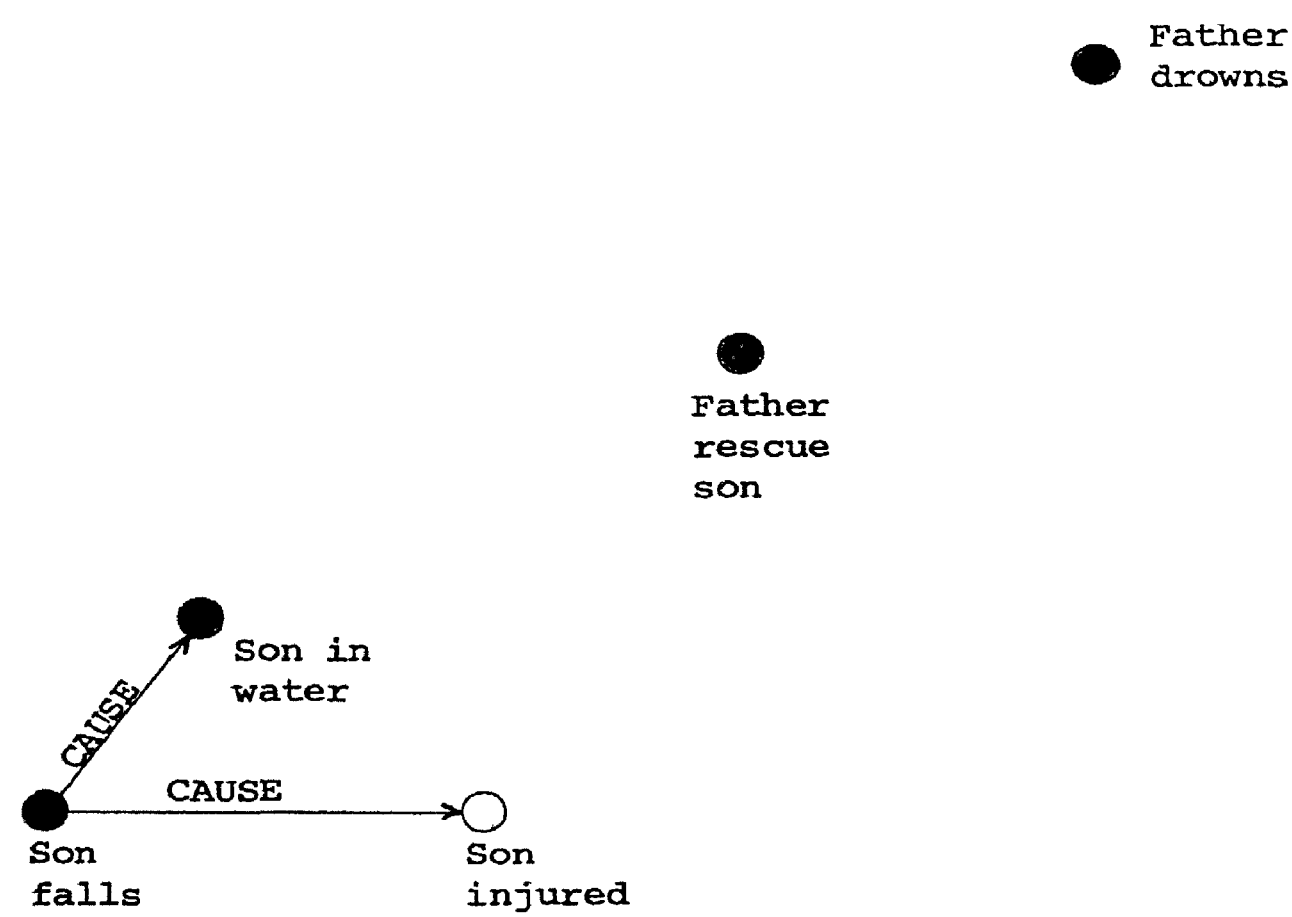
Step 1. Fall causes injury.

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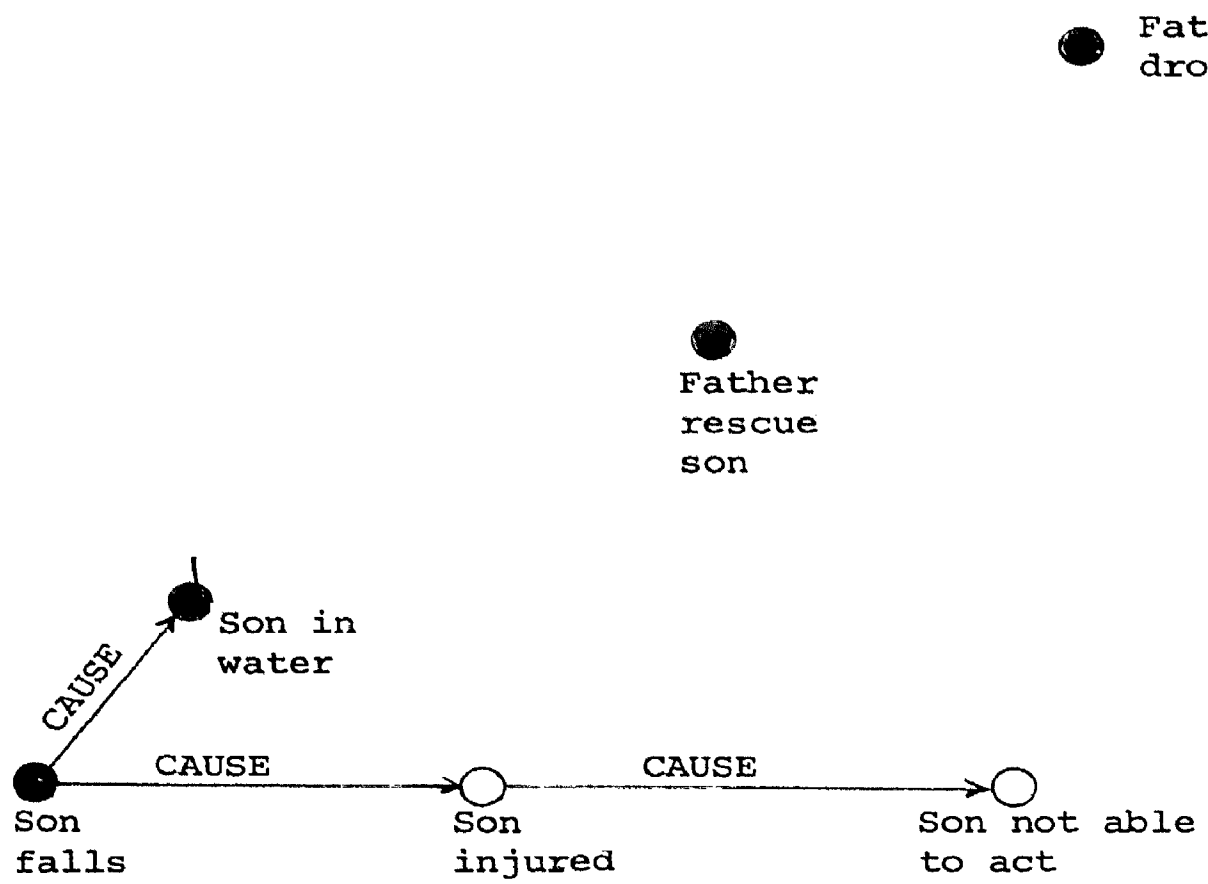
Step 2. Injury causes inability to act.

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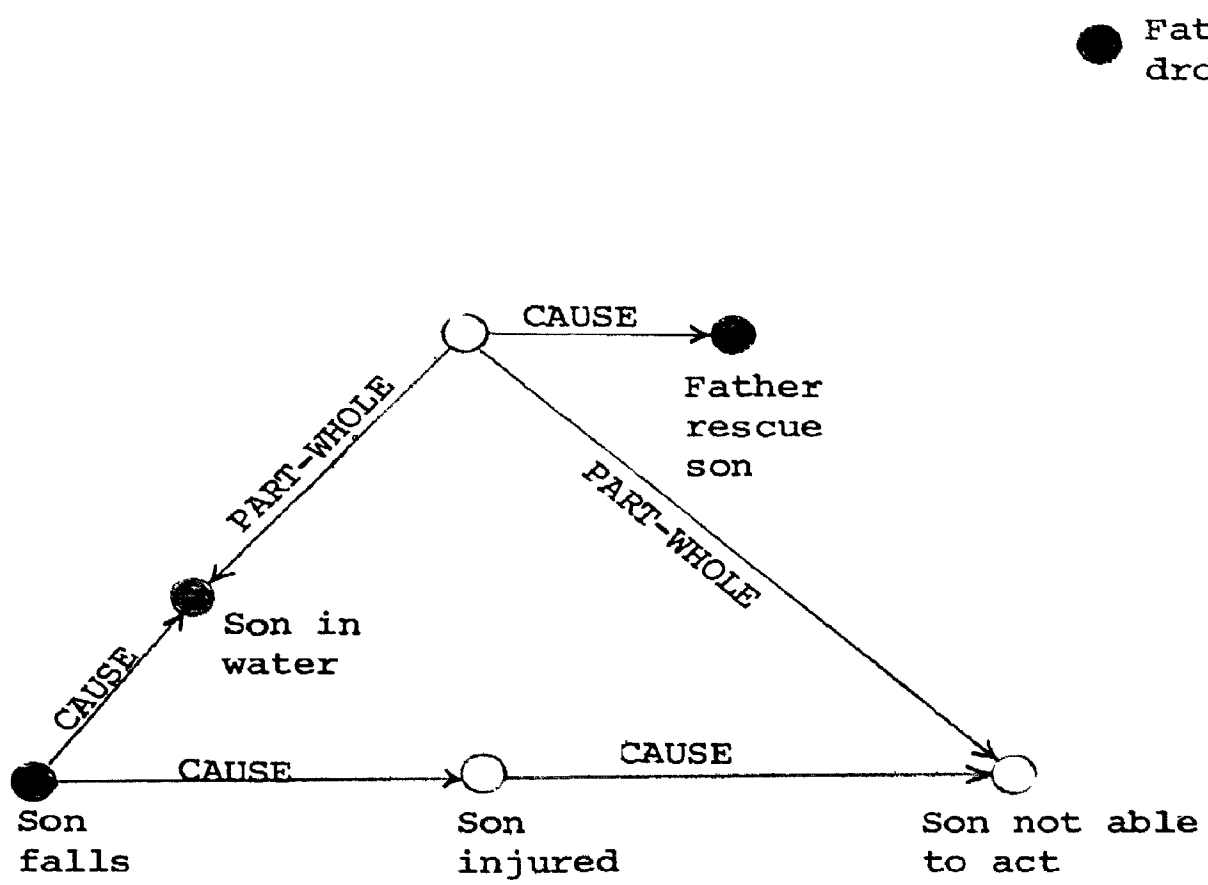
Step 3. In water and not able to act causes rescue.




Conjunction is indicated by Part-whole relations. Note that a link to one of the original propositions has been established.

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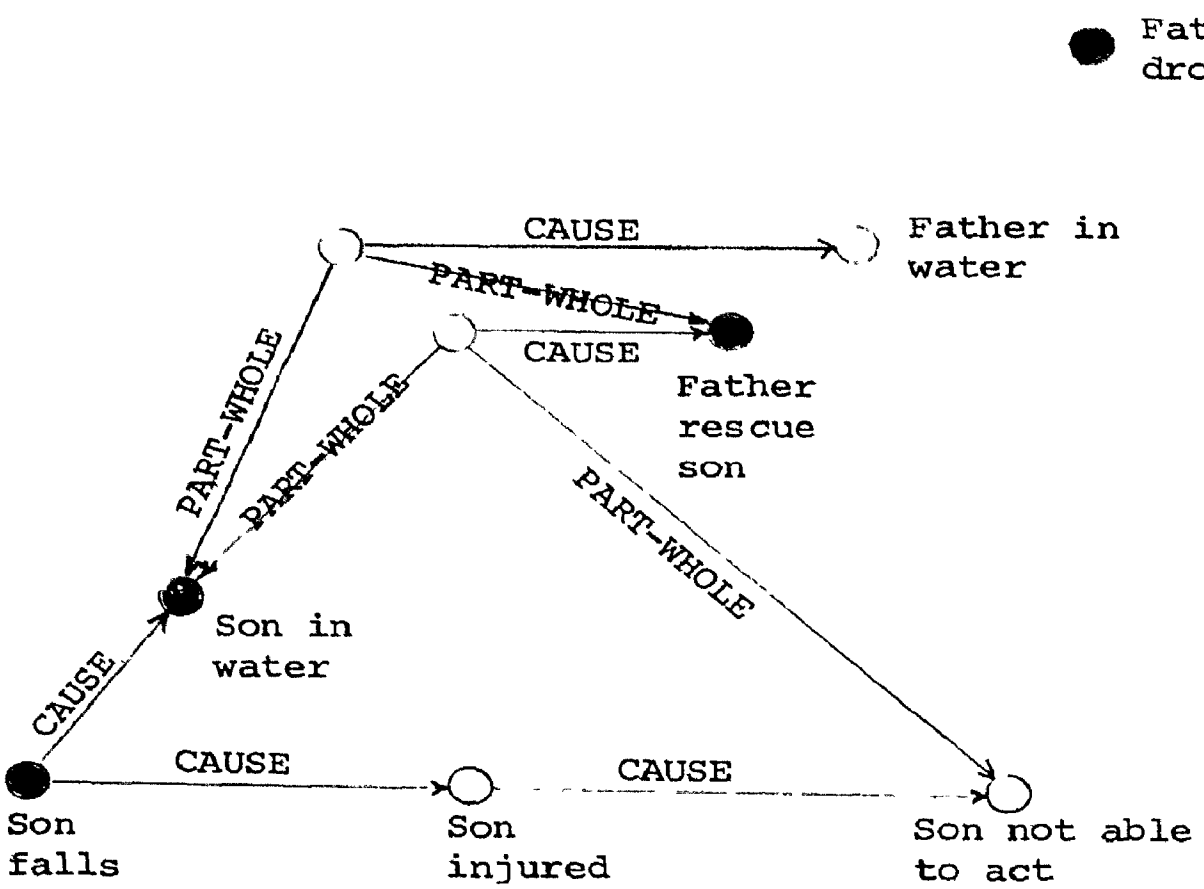
Step 4. To rescue someone who is in water it may be necessary to be in water.

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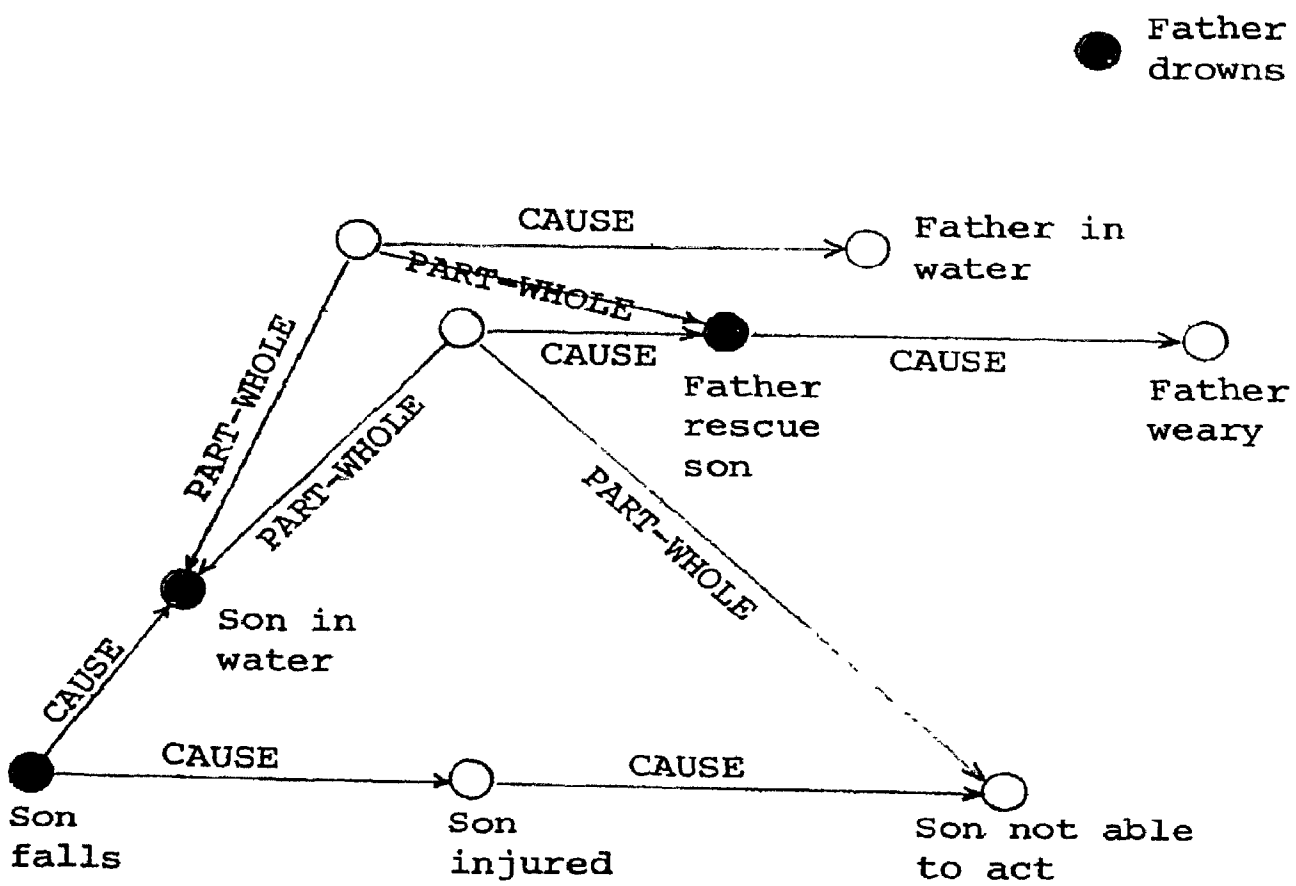
Step 5. Acting can make you weary.

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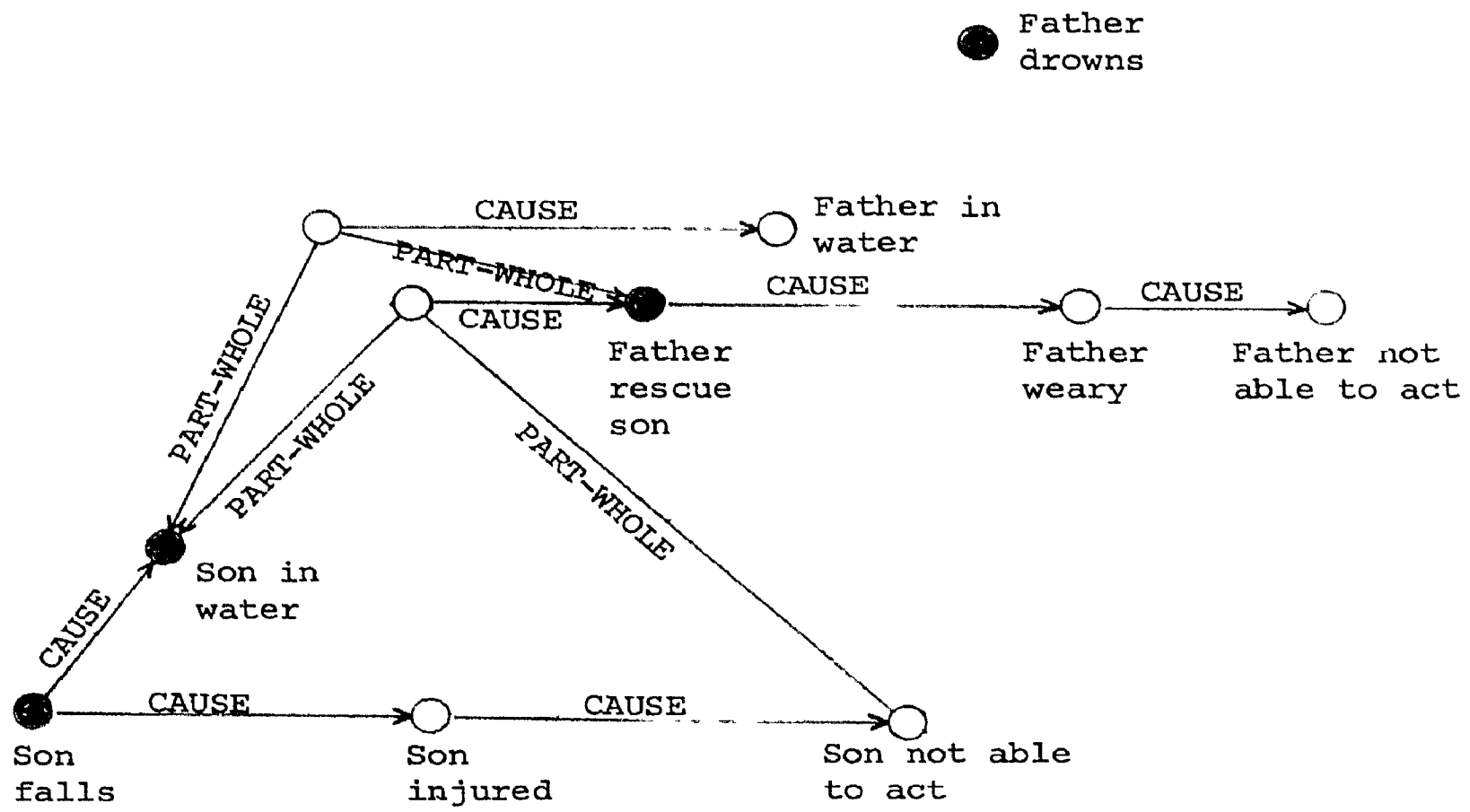
Step 6. If weary then unable to act.

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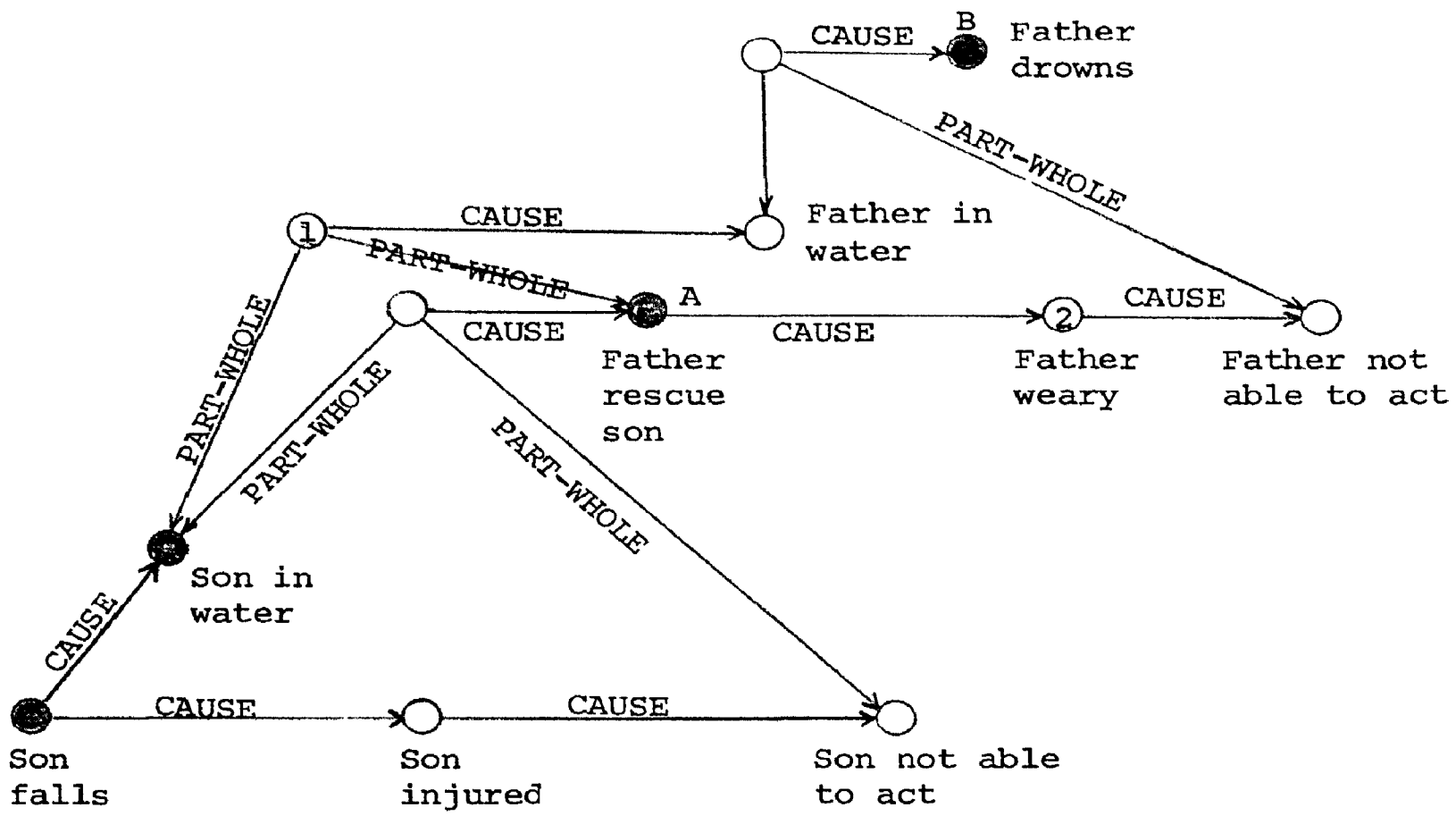
Step 7. If in water and not able to act then drown.




A link to the final proposition of the discourse is made. Corefer-

entiality conditions prevent 'son in water' and 'Father not able to act' conjoining to satisfy the conditions on this inference.

Note that the antecedent condition on this inference is the same as at step 3. Both resultant situations are possible, and are noted. The system can select either. However, the wrong choice does not lead to a connected structure, and a back up to the alternative has to be made.

The discourse now has an inferred causal structure connecting all the original propositions.

From a thematic analysis of drowning stories in general (Phillips: 1975), the common theme can be described as 'giving a cause for the person being in the water, and giving a cause for the victim not being able to act (thereby not being able to save himself)'. This theme fits the discourse by virtue of propositions ① and ②, which stand in causal relations to 'being in the water' and 'not able to act' for the victim. The theme 'tragedy' is defined as 'someone does something good and dies as a result of this action'. The father's rescue of his son and subsequent demise satisfy this theme (Ⓐ and Ⓑ). For the story to be coherent, these themes must not overlap; in fact we see that the 'drowning' theme is properly contained by 'tragedy'.

## 5. Discussion.

The analysis is so organized that the themes are determined in a bottom up manner, as are all generalized facts used in the analysis. Though not presently implemented, it should be possible to use potential themes, ones for which only some component propositions have been found, in a predictive manner.

The complexes of propositions, in metalingual definitions of themes and elsewhere, are really not that complex. The ones in the example contain only a few propositions. Each has only the essentials of the situation. The final structure arises from many small pieces of knowledge rather than from one monolithic aggregate. This seems to be a more natural organization, as each of the simpler structures can be freely applied in many contexts, rather than being bound to one situation.

The discourse judgement is relative to the knowledge of the hearer. Whether the inferences are those intended by the author is another question. Ideally they should be, or differences should be unimportant. A misleading inference indicates poor writing by the author; he has misjudged the knowledge of his audience.

Directing inferences on a discourse towards the goal of judging it coherent provides a normalized version of the discourse, if the process is successful. The normalized structure can form the basis for further processing: content analyis, stylistic analysis, etc. It may also provoke various questions, for example, we could ask if the inferences were correct; we have the 'rescue' situation applying to the father, but he wasn't rescued, why not.

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