

# Contribution Graphs in Multiparty Discourse

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## 1 Introduction

In a pair of important papers, Clark and Schaefer (1987, 1989) demonstrated that dyadic discourse could be characterized in terms of contributions, where a contribution consisted of a presentation and an acceptance. Their model, which grows out of the collaborative view of conversation, describes the structure of dyadic discourse through trees of contributions. A contribution tree represents a conversation as a collection of cooperative acts performed by the conversants. In this paper, we show how Clark and Schaefer's model can be adapted to account for the more complex contribution structures created by multiple conversants.

In the collaborative view, the active participation of conversants is required to achieve sufficient grounding of the discourse. The kinds of grounding acts that pairs of conversants use have been discussed by Clark and Wilkes-Gibbs (1986), Novick (1988), and Traum and Hinkelman (1992). The necessity of interactive use of such acts has been demonstrated by Schober and Clark (1989), who showed that overhearers did not achieve the comprehension levels of full participants in conversation; overhearers cannot prompt for elaboration when they have not achieved adequate grounding and cannot avoid possibly misleading over-elaboration when they achieve adequate grounding more quickly than “active” hearers. Likewise, speakers rely on feedback from hearers to control the form and extent of their linguistic production. For example, Oviatt and Cohen (1990) showed that speakers in the absence of feedback (because they were pre-recording instructions rather than presenting them “live”) tended to over-elaborate.

Schober and Clark (1989) did put a third conversant in the picture, but not as a full participant: The point of their experiment was to discover the effects of *not* participating. The clear import of their results, though, is that models of true multiparty conversation will have to account for presentation to and acceptance by multiple conversants. While Clark and Schober's active conversants did

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not have to take account of the overhearer, outside the laboratory the presence of an additional hearer could have an influence both on the content of utterances and on conversants' efforts to ensure that their contributions are adequately mutual. Consider, for example, two conversations involving two co-workers, one occurring when they are alone in a room, the other occurring when their mutual supervisor is also in the room. This example is minimal, in the sense that the third party does not yet actively participate in the conversation. In the case of active multiparty interaction, the conversants' actions are shaped by feedback from multiple sources.

To begin to account for such effects, we suggest in this paper that an adequate model of multiparty contributions should be able to account for at least three cases: (1) where acceptance of a speaker's contribution is a collaborative action by multiple hearers; (2) where a presentation is not accepted; and (3) where some of the conversants engage in side sequences. We will present a model of multiparty contribution based on extended definitions of contribution, presentation, and acceptance. We will then demonstrate the model by building contribution graphs using multiparty discourse from transcripts of the White House tapes in the Watergate scandal. We will conclude by considering problems with multiparty models and by outlining some open questions.

## 1.1 Contribution Models

We begin by considering the foundations of the dyadic model of contributions. We then describe some inherent limitations on interpretation of discourse using such a model. Our multiparty model, like Clark and Schaefer's dyadic model, will be subject to these limitations.

A contribution is anything that a person does during a conversation that both carries some content (content specification) and assists the participants in establishing a mutual belief that the observer believes that she understood the content of the presenter's act (grounding). Clark and Schaefer described the process of contributing as containing two phases, a presentation phase and an acceptance phase. Every contribution (except for the very first one) is both a presentation and part of the acceptance phase for some other contribution. However, a contribution belongs to the acceptance phase of a previous contribution if and only if it contains information directly related to the issue of hearing or understanding the previous utterance. More formally, Clark and Schaefer defined their terms as follows:

*Presentation Phase:* A presents utterance  $u$  to consider. He does so on the assumption that, if B gives evidence  $e$  or stronger, he can believe that B understands what A means by  $u$ .

*Acceptance Phase:* B accepts utterance  $u$  by giving evidence  $e'$  that she believes she understands what A means by  $u$ . She does so on the assumption that once A registers evidence  $e'$ , he will also believe that B understands. (Clark & Schaefer, 1989, p. 261)

Characterization of a contribution depends on understanding both the preceding and following discourse. This is because the researcher should conclude that a presentation was accepted only after the hearer displays a sufficient amount of evidence that the contribution was understood. Note that the amount of evidence required to convince the researcher that the contribution was mutually understood can only be an approximation of the actual amount of evidence that the participants required at the time. Because of this, it is quite possible that different researchers may well come up with different, though equally plausible, contribution trees for the same conversation. This has been the case in our experience; different coders of a single conversation frequently arrive at different trees. In fact, the conversants in the actual conversation are faced with a similar problem. A conversation does not have a single, neutral structure; rather, it reflects the (probably disjoint) beliefs of the conversants as they try to understand their interaction. The model does not require both participants to have the same view of the actual meaning of their contributions, but only to have at all times some sufficient level of evidence that their contributions are being understood. Accordingly, we claim that a contribution model of conversation is valid when the entire model is plausibly ascribable to one or more of the conversants.

## **1.2 Third Parties**

A first step in extending the contribution model to multiparty discourse begins with analyzing the effects of the presence of third parties on the interaction of dyadic conversants. Consider our example of the two co-workers conversing in a room where their supervisor is within hearing distance. Suppose that one or both of the co-workers make contributions that are said primarily for the benefit of the (possibly) listening supervisor. This is interesting in that if one or both of the workers cannot see the supervisor (or vice-versa), it may not be possible for them to gather evidence that the utterance was mutually understood. In the corresponding two-party case, presumably a speaker would either over-elaborate or give up in trying to converse with someone that did not respond to his contributions.

One might argue that the supervisor should not be considered to be a participant if she never contributes anything to the discussion. Perhaps the two primary conversants just consider her to be part of a common environment. What happens, then, if the supervisor joins the conversation, responding to one of the workers' utterances?

Similarly, how should we model conversants who do not actively participate in an ongoing conversation? In the Watergate tape transcripts, there are many conversations in which one or more of the conversants effectively drop out for long periods. For example in the conversation of March 22, 1973 (New York Times, 1974, 194-221), former Attorney General John Mitchell contributes only sporadically even though he is physically present throughout the interaction.

In a previous study of multiparty discourse, we simulated agents—including overhearers—in the domain of air traffic control (Novick & Ward, 1993). We found it necessary to include such “overhearer” agents in our conversational models in order to account for pilots' responses to dia-

logue that wasn't explicitly directed toward them. We modeled inactive participants in the conversation from the time that they became able to overhear the active participants, so that the computational agents' belief states would reflect the appropriate conversational context. In that study, however, the active conversants were assumed to be unconcerned with the grounding needs of the overhearing agents, even when the active conversants were aware of the overhearers. In the current work, we consider the more complex grounding requirements of multiple active conversants.

Accordingly, in Section 2 we consider multiparty effects in the case of both inactive (overhearing) and active hearers. In Section 3 we extend the dyadic contribution model to account for these effects and show the extended model's representation of excerpts of multiparty discourse from the Watergate corpus.

## 2 Grounding

When conversants collaborate to ground their conversation, they rely on evidence of understanding presented in the acceptance phase of contributions (Clark & Schaefer, 1989). The strength of evidence required for assuming mutuality of a belief varies according to the conversants' requirements for certainty in the particular context of the conversation (Clark & Marshall, 1981).

What strength of evidence is required by a speaker with multiple hearers? What evidence of understanding do hearers provide when they are not the direct addressees of an utterance? The answer to these questions depends on the degree of involvement of the conversants in the conversation. A surreptitious overhearer would give no evidence of understanding; likewise, a speaker who was in fact aware of a surreptitious overhearer would expect to receive no evidence of understanding. What is more, the aware speaker who wanted his utterances to have the force of unawareness would not even look for evidence of understanding. Returning to our example of the co-workers and their overhearing supervisor, a speaker who did not want the supervisor to know that the utterance was for her benefit might be deliberate in not trying to collect any evidence as to whether the supervisor understood the content of the utterance.

Indeed, although it seems that the two co-workers would still need to ground the speaker's contribution, the speaker's goal of in effect communicating to the supervisor is met if the co-worker-hearer's response is a plausible acceptance. The speaker may not have the goal that the other co-worker understand the utterance and therefore would not require evidence from the listening co-worker that she understood. As in the general case, the listening co-worker has several choices in responding to an utterance not addressed to her. She can:

1. Request a repetition if she did not hear the utterance;
2. Request clarification if she did not understand the utterance;
3. Acknowledge that she understood the utterance; or

#### 4. Do nothing.

More commonly, though, all of the conversants are full, known participants in the discourse. In these circumstances, cooperating conversants will provide enough evidence of understanding to enable a speaker to conclude reasonably that his utterance has been sufficiently understood.

In what ways are these patterns of multiparty interaction different from the dyadic case? The levels of evidence of understanding required depend on characteristics of multiparty conversation that are as yet poorly understood. In particular, we do not know if multiparty conversation leads to stronger or weaker requirements for evidence of understanding. Is the evidence sifted or summed? The possible cases include:

- **Stronger requirement for evidence of understanding.** A speaker may require more evidence from some hearers because he cannot watch everyone at once and hence cannot register more subtle feedback such as backchannel cues and continued attention. In this case, hearers may offer relatively stronger evidence as compensation for the speaker's loss of this feedback. For example, hearers may initiate relatively more side sequences to insure that they really do understand.
- **Weaker requirement for evidence of understanding.** A speaker may require less evidence from any one hearer, as long as he receives enough evidence in total to convince himself that he was understood. In this case, hearers may offer weaker evidence, believing that the speaker will believe in mutual understanding as long as there is enough aggregate evidence. Hearers acknowledging may initiate fewer side sequences, either because they are more inclined to believe that they understand if those around them do, or because there is some other social pressure that discourages them from revealing their lack of understanding.

These are clearly open areas for study; the results would be useful for not only for cognitive modeling of discourse but also for design of technology for support of mediated multiparty communication. In section 3.2 of this paper, we begin to address the case of multiple active conversants by examining contribution structures in examples from actual multiparty conversations.

### 3 Extensions for Multiparty Discourse

We now turn to the problem of extending the contribution model to cover to the presentation and acceptance structures that routinely occur in multiparty interaction. We will begin by adapting and augmenting the definitions of contribution, presentation and acceptance. Then, using this new multiparty model, we will construct interpretations of representative samples of discourse that show (1) acceptance of a speaker's utterance as a collaborative action by multiple hearers; (2) presentation without any acceptance; and (3) conversants engaging in side sequences

### 3.1 Multiparty Model

In redefining contribution, presentation and acceptance for multiparty conversation, we will attempt to be specific enough to account for observed patterns of interaction while being general enough to accommodate differing effects of multiparty interaction on the strength of evidence expected by the conversants. Thus we define *contribution* as follows:

*A contribution* is an action by a speaker that has content intended to be conveyed to at least one hearer and that assists some subset of the conversants in establishing mutual belief.

This definition allows description of situations that involve passive hearers who may not consistently either give or require evidence that a particular contribution was understood.

Similarly, the definition of *evidence* must also be modified to reflect the fact that there may be some observers who believe that a contribution is directed at them and others who do not. If a non-addressee hearer understands the speaker's utterance, she may believe that the speaker does not require evidence of understanding of a particular strength from her; the hearer thus has a free choice with respect of evidence to convey. Situations may also arise where a hearer believes that she was the addressee but still does not feel compelled to respond with evidence of understanding of the conventionally expected strength. For example, suppose our example supervisor is criticizing an employee in circumstances where the conversants can be overheard by other employees. The supervisor and the other employees may both know that the demonstration is targeted at them as well as the unfortunate subordinate, but the other employees may not feel that the supervisor expects them to present conversational evidence of understanding.

Accordingly, we differentiate between evidence that is of the strength normally sufficient to indicate understanding by an addressee and evidence where strong indication of understanding is not normally required. Let the hearers of A's utterance  $u$  be represented as  $B_1, \dots, B_n$ . Then

*Primary Evidence* is evidence  $e'$  presented by hearer  $B_i$  where she believes that she was an intended addressee of A's. That is,  $B_i$  believes that A requires evidence from her to believe that they mutually understand  $u$ .

*Secondary Evidence* is evidence  $e'$  presented by hearer  $B_i$  when she believes that she was not an intended addressee of A's and/or she believes that A does not require primary evidence of understanding.

To accommodate multiple hearers, the notions of the presentation and acceptance phases are extended from the dyadic definitions:

*Presentation Phase:* A presents utterance  $u$  for some subset of  $B_1, \dots, B_n$  to consider based on the assumption that if that same subset of hearers collectively gives enough primary evidence  $e$ , he can believe that they understand what he meant by  $u$ .

*Acceptance Phase:* For all hearers  $1 \leq i \leq n$ ,  $B_i$  accepts utterance  $u$  by giving either primary or secondary evidence that she understands what A means by  $u$ . She does so on the assumption that if A registers the evidence, he will believe that A understands.

These definitions are based on the following general assumptions about the nature of multi-party interaction:

1. The speaker need not ensure that non-addressees understand the presentation.
2. A hearer may believe that she is an addressee even if she is not addressed directly by the speaker.
3. A hearer, even when she believes that she is an addressee, may present less-than-normally strong evidence of understanding if (a) other addressees present normally strong evidence and (b) the hearer believes the other addressees' understanding is sufficiently mutual.

Thus from the speaker's perspective it is only important that some sufficient proportion of the addressees understand. From the hearer's perspective, it is sufficient to present evidence that she believes she understands if she were an addressee and if not enough other hearers presented evidence that they believe in the same interpretation of the presentation.

The major consequences of these new definitions are that multiparty contribution structures contain contribution nodes with more than two children, and that there may be presentation phases without an acceptance phase. In Clark and Schaefer's dyadic model, contributions always had two children—the presentation and acceptance phases. But the binary tree structure of the contribution nodes was a consequence of having only two conversants: who else could accept? In multiparty discourse all of the hearers have the possibility of accepting. Accordingly, the contribution nodes in the contribution graphs we construct in Section 3.2 will show multiple acceptances in a single contribution. Conversely, some presentations that would initiate a contribution have no acceptances at all. This arises when one or more later acceptances effectively turn an early acceptance into a dead-end.

Moreover, the multiparty graphs shed additional light on what it means to contribute to a conversation. In dyadic discourse, contributions are always the joint product of the two conversants. A contribution requires both presentation and acceptance, so both parties must participate in its creation. At the same time, there are no other parties to the conversation, so every contribution in the conversation is the product of the two conversants alone. In multiparty conversation, however, the conversation as a whole is the product of all of the participating conversants. Within the discourse graph, each contribution may be the product of one, two, or more conversants. Attempted contributions that are dropped (as superseded by other acceptances, for example) are produced by a single conversant. Side-sequences are typically produced by a pair of conversants; the contributions in the side sequences can be identified as their creations.

## 3.2 Application of the Model

Representations of contributions following our multiparty model can be constructed from observed conversational interaction. As in Clark and Schaefer's (1989) original studies, the contribution structures reflect patterns of grounding rather than focus. We will illustrate application of the model to three excerpts of a conversation from the "Watergate" tapes corpus (New York Times, 1974). In the contribution graph diagrams that present our analysis, the conversants are President Nixon (P), chief of staff H. R. Haldeman (H), chief domestic affairs adviser John Ehrlichman (E), and presidential counsel John Dean (D). In our notation, squares represent contributions, triangles pointing right are presentations, and triangles pointing left are acceptances. Primary evidence of understanding is shown with unbroken lines; secondary evidence of understanding is shown with dotted lines. We have annotated the figures with initials representing the contributors, the presenter, and the accepters; the symbol '@' stands for all of the conversants. Use of the notation is illustrated in Appendix A through detailed application to excerpts from the Watergate conversations.

In this conversation then-President Richard Nixon and members of his staff are discussing how to deal with the unfolding crisis that eventually drove Nixon from office. The discourse excerpted for Figure 1 occurred at the beginning of a meeting in the Oval Office on March 21, 1973 (New York Times, 1974, 181-182). The discourse analyzed in Figure 2 and Figure 3 occurred later in the meeting (New York Times, 1974, 184-185). The conversants confronted the problem that the investigation of the Watergate break-in has gotten out of their control because both the District of Columbia and the United States Senate have started investigations. Nixon is concerned that the investigations will lead to the White House; he would like to figure out how to insulate as many people as possible from prosecution. Dean builds a scenario for an independent White House investigation that would take the heat off the President.

The extended definitions of contribution, presentation and acceptance suggest that there are three principal cases where multiparty discourse diverges significantly from the dyadic model. The first case involves acceptance of a speaker's utterance as a collaborative action by multiple hearers. This situation could occur because the speaker has directly addressed multiple hearers, some of whom rely on each other to produce sufficient evidence of acceptance; secondary evidence might be provided by one hearer and then primary evidence by another hearer. Collaborative acceptance can also occur where a non-addressee retakes the initiative to provide normally strong evidence of acceptance, thus leading to multiple acceptances of a single presentation. Finally, multiple addressees could each produce normally strong evidence of acceptance.

The second case of difference in multiparty discourse involves contributions that have a presentation without any acceptance. This occurs as a consequence of multiple acceptance: an utterance that accepts a presentation may lose its opportunity to be accepted in turn if another accepting utterance follows it. The corpus contains examples of this occurring in cases where the



“dropped” utterance contains primary evidence of understanding as well as where the utterance contains secondary evidence of understanding.

The third case of difference in multiparty discourse involves the engagement of some conversants in side sequences. The contributions that constitute such side sequences are the product of the relevant conversational subgroup. In some cases, the side-sequence involves repair for the benefit of members of the contributing subgroup. In other cases, the side-sequence is produced for the benefit of an outside hearer, like a performance.

In our analysis of the Watergate excerpts, we will illustrate each of the three cases. We will also show that some multiparty conversations have structures that may be represented by traditional contribution trees in a straightforward manner.

**Collaborative acceptance.** Figure 1 illustrates collaborative acceptance of a presentation by multiple conversants using both primary and secondary evidence of understanding. Most of the acceptances are primary, in that they provide normally strong evidence by an addressee. However, after Ehrlichman completes his turn saying

I think you have to figure that that is out of the picture. I just don't believe that we can do that. It can't be carried off.

he is waiting for the president to accept his presentation with primary evidence of understanding. Instead, what he gets first is secondary evidence from Haldeman via initiation of a next relevant contribution, which is a weak form of acceptance. It is not until after Dean and Haldeman's subdialogue on immunity in a special panel that the President responds to Ehrlichman with acceptance:

Well, let's take the Grand Jury now, without immunity, and what are your ideas for getting out of it?

At this point, Ehrlichman gets his primary evidence that the President understood his completed utterance. Thus in this excerpt, Nixon's question (“In a Grand Jury?”) is accepted two ways: first through a colloquy between Nixon and Ehrlichman that clarifies the utterance that Nixon was questioning, and then through a secondary acceptance from Haldeman. Ehrlichman's presentation (“I think you have to figure...”) is also accepted in two ways: first, through the Ehrlichman-Nixon clarification colloquy, and second by Nixon's final, responsive utterance.

**Dyadic-like structures in multiparty discourse.** Figure 2 illustrates that straightforward exchanges can occur in multiparty discourse. In this excerpt, the conversation is jointly advanced by three conversants. Each presentation is accepted by a single utterance, although different conversants produce different acceptances. For example, Haldeman's first utterance is to all of the other conversants because he is echoing and supporting Nixon—effectively trying to persuade the others and working out, via play-argumentation, a possible rationale for a proposed position. Nixon's last utterance is presumably addressees to Dean because (a) Dean has been presenting the

outline of the problem and (b) Dean is the Presidential counsel, tasked with handling such difficulties.

In this conversation, Clark and Schaefer's binary contribution-tree model would produce a plausible structure. We note, though, that the authorship of the different contributions goes unstated in the dyadic model; this overlooks the complexity of the joint creation of the discourse.

**Side sequences and unaccepted presentations.** Figure 3 illustrates how the multiparty model handles side sequences and unaccepted presentations. In this excerpt, Dean is creating a possible scenario for a top-level White House investigation; he dreams up the justification, referring to himself in the third person. With Nixon's help early on, Dean and Haldeman spin out the scenario and its possible consequences for Nixon's benefit. This side sequence runs from Dean's utterance “Now is the time...” until Nixon brings the conversation back to the central question with his utterance beginning “The point is....” This contribution of Nixon's is the acceptance of the long subdialogue that begins with Dean's long contribution proposing the scenario.

In this excerpt there are three instances of multiple acceptance and two instances of presentations not accepted. Nixon's initial presentation is accepted by Haldeman's next utterance and by Dean's next utterance. Dean's long turn (“Now is the time...”), in which he begins to concoct the scenario, is accepted by utterances from both Haldeman and Nixon. Haldeman's—presumably sarcastic—utterance (“Lie?”) is a presentation without acceptance. Haldeman's next utterance also goes unaccepted, as his acceptance of Nixon's addition to the scenario (“And it isn't going to come out of the Committee.”) is superseded by Dean's continuation of the main theme.

In each of these excerpts, the amount of information available to the conversants was much greater than that available to the authors. The conversants had access to prosodic, non-verbal, and contextual information that must have made the evolving structure of the discourse readily apparent to them. The power of this information is made clear by the contrast between the time the actual conversation probably took—perhaps a couple of minutes—and the time it takes to produce a plausible contribution graph—many hours.

## 4 Conclusion

In this paper, we have adapted Clark and Schaefer's (1989) model of dyadic discourse to account for the more complex contribution structures created by multiple conversants. In particular, we distinguished primary and secondary evidence of understanding, and extended the definitions of presentation and acceptance to account for collaborative acceptance. We showed that in actual multiparty discourse there are instances of collaborative acceptance, unaccepted presentations, and side sequences; the multiparty contribution graph model we proposed can account for these phenomena.

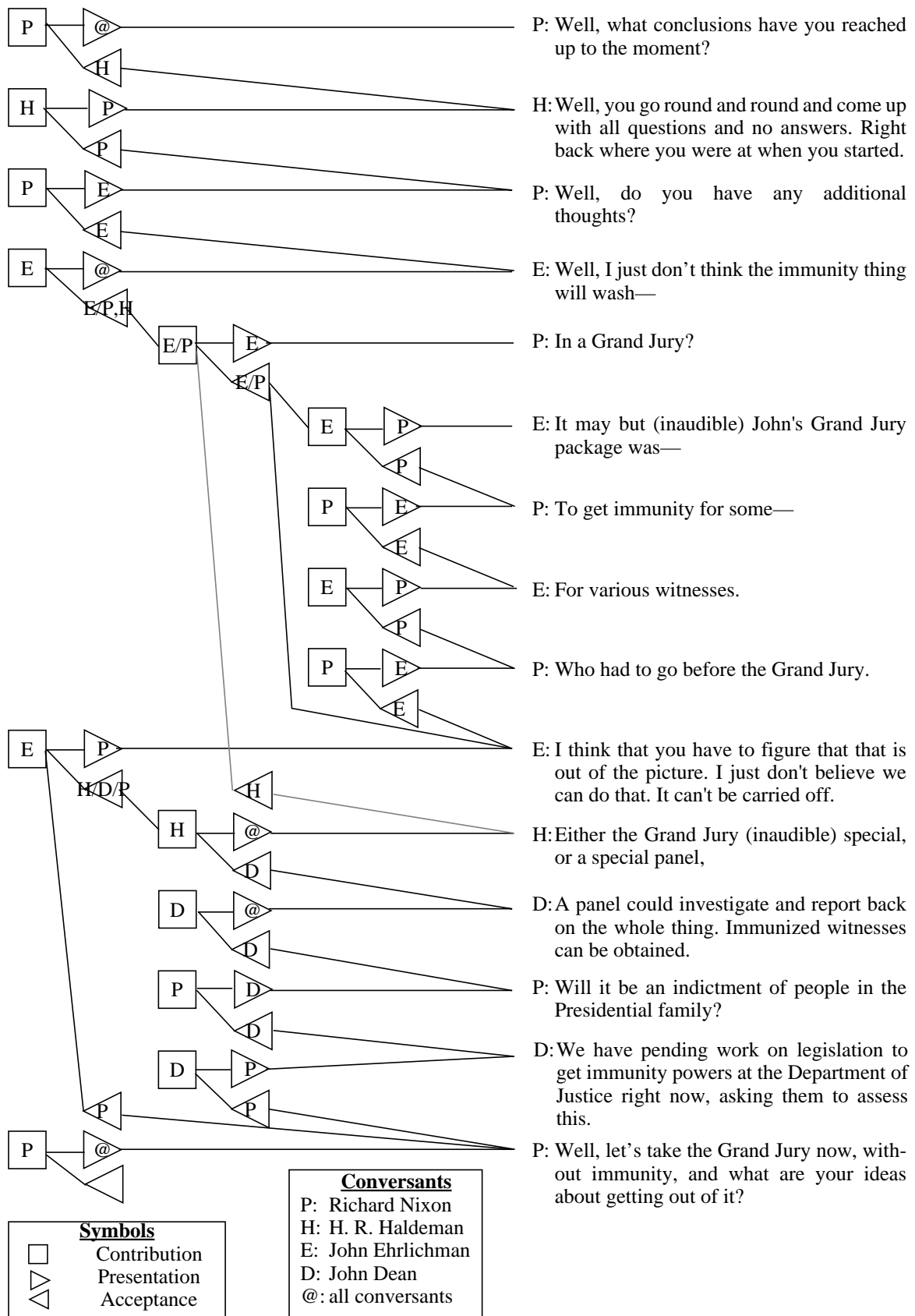
Our model, while accounting for the principal elements that we have distinguished, is far from a comprehensive explanation of multiparty discourse. There are many open issues, some of which we have already touched upon. Other open issues include:

1. How is the content of a presentation affected by the presence of multiple hearers, each of whom the speaker may wish to leave with a different interpretation of the act?
2. How does the level of evidence required by the speaker change when there are several hearers present?
3. Do speakers aggregate acceptance of their presentations or do they still require independent levels of acceptance from each addressee?
4. How do speakers and hearers adapt their conversational skills in the presence of multiple targets for mutual gaze?

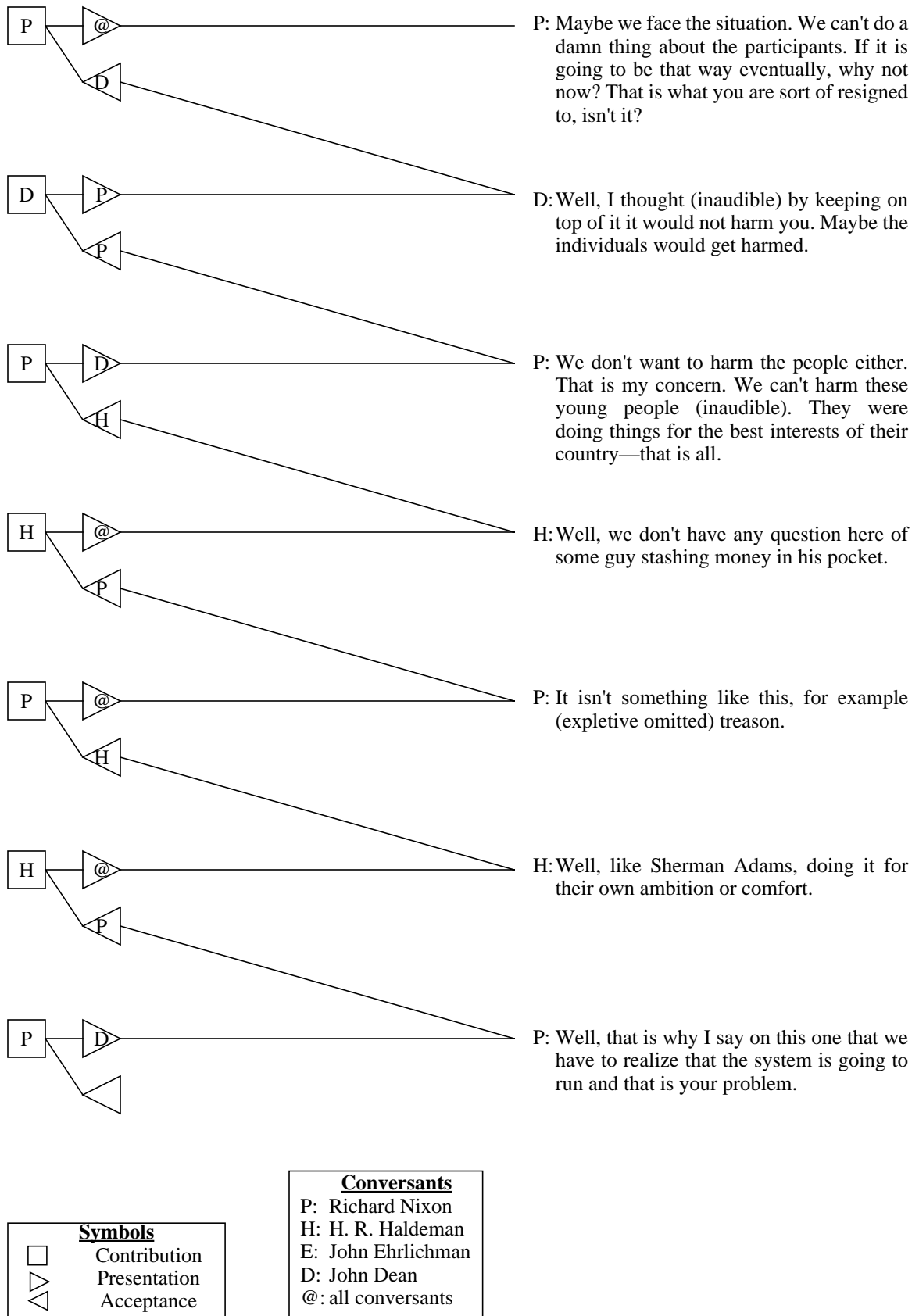
Despite the limitations of their dyadic origins, Clark and Schaefer's fundamental ideas of presentation, acceptance and contribution continue to account for conversational structure. Their own "contribution" forms the basis of the extended model for multiparty discourse presented here.

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**Figure 1. Collaborative Acceptance by Multiple Conversants**



**Figure 2. Dyadic-like Structures in Multiparty Discourse**

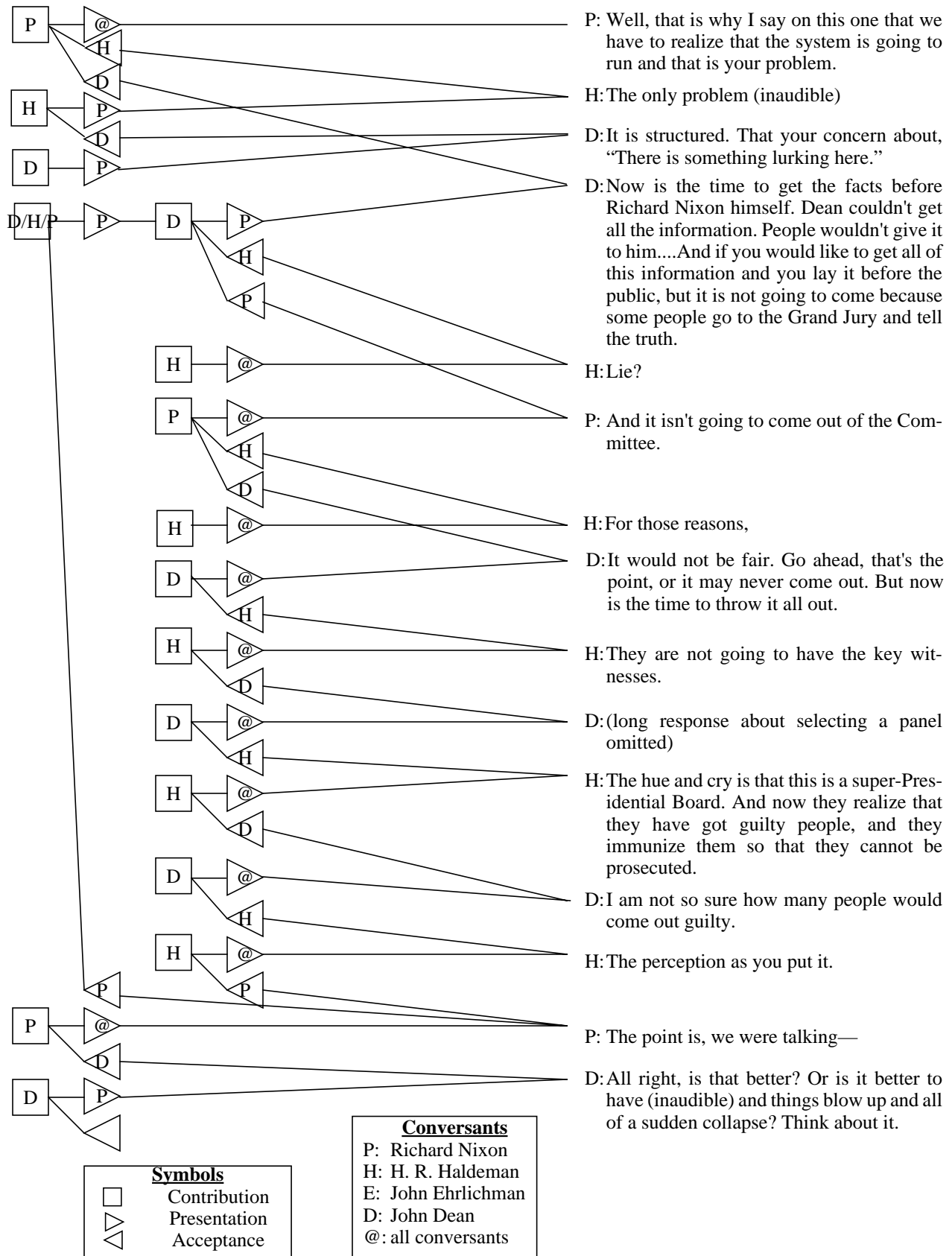


Figure 3. Side sequences and unaccepted presentations

## Appendix A

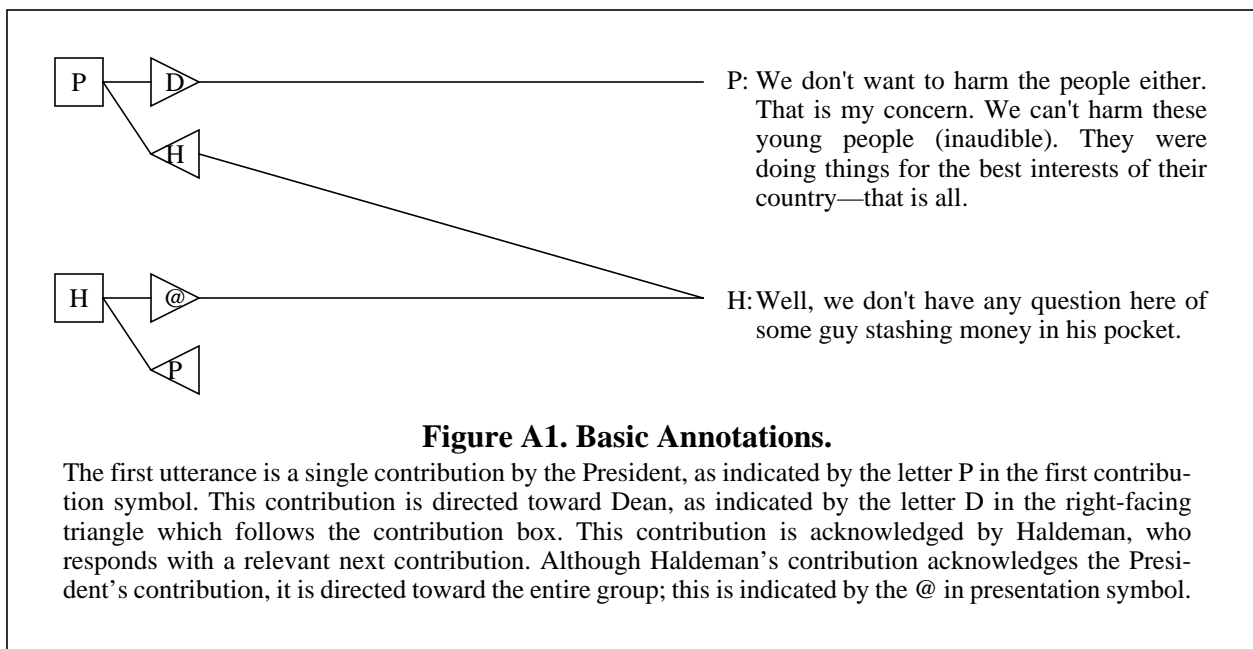
### Multiparty Contribution Graphs

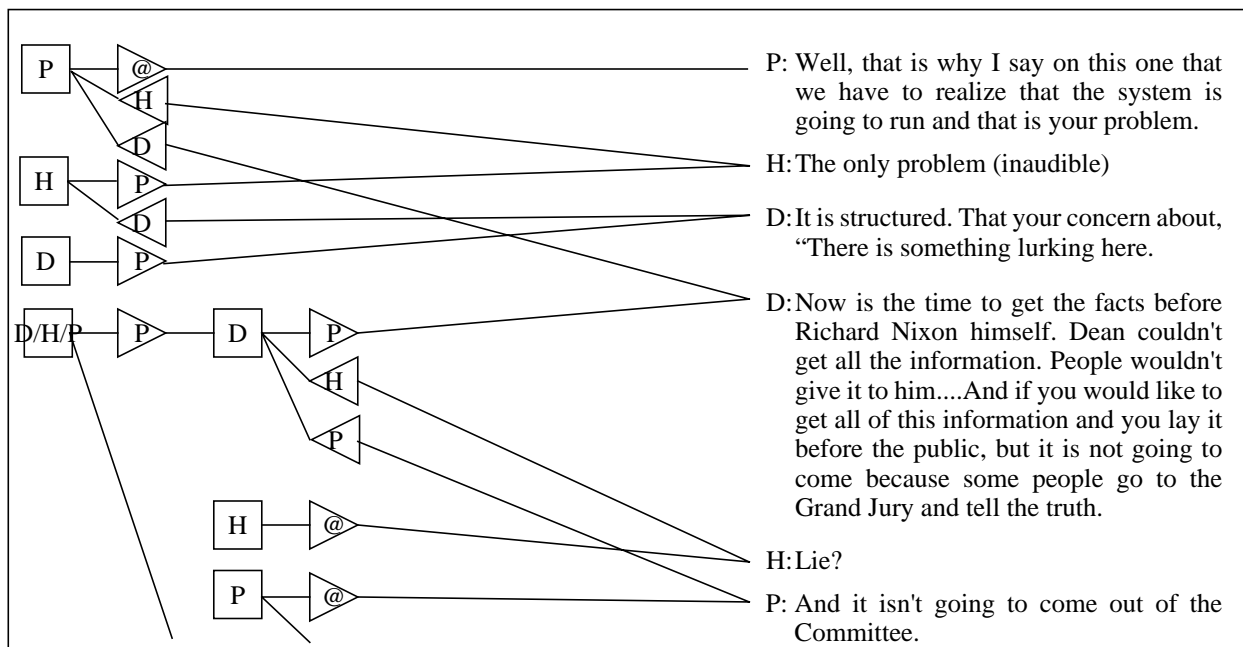
In this appendix we summarize and illustrate our notation for multiparty contribution graphs.

#### Basic Annotations

In a conversation, speakers take turns, sometimes imperfectly coordinated, making contributions to the shared dialogue. During each turn, a speaker makes one or more contributions to the ongoing conversation. Contributions are characterized in terms of presentations and acceptances, i.e., lines go from boxes (contributions) through right-pointing arrows (presentations) to the utterance text, and from boxes through left-pointing arrows (acceptances) to earlier boxes (previous utterances). As in Clark and Schaefer's (1989) contribution tree notation, a square represents a contribution, a triangle pointing right represents a presentation, and a triangle pointing left represents an acceptance.

In Clark and Schaefer's original notation, there was no need to indicate the intended recipient of a contribution; with only two conversants, the recipient is trivially clear. In multiparty conversation, however, an contribution may be directed to or accepted by multiple persons. To depict this in our analysis, we annotate these basic symbols with the initials of the conversant(s) responsible for the contribution, presentation, or acceptance; the symbol '@' stands for the entire group. The basic annotation symbols are illustrated in Figure A1.





**Figure A2. Multiple Contributions and Acceptances**

This excerpt from Figure 3 illustrates the notation used for presentations and acceptances involving more than one conversant. P's first utterance is directed to all; H initially accepts it by offering an objection. D first responds to H's contribution then, in a consecutive contribution, responds to P's prior utterance. This second contribution is presumably addressed to P, but with P's acceptance the subsequent contributions in the subdialogue are directed to @ as P turns D's spinning of a scenario into a group effort. H's utterance "Lie?" we class as sarcasm and thus as a sort of meta-comment addressed to @. It is not accepted, and the conversation continues as P accepts and adds to the scenario D has proposed.

### Multiple Contributions and Acceptances

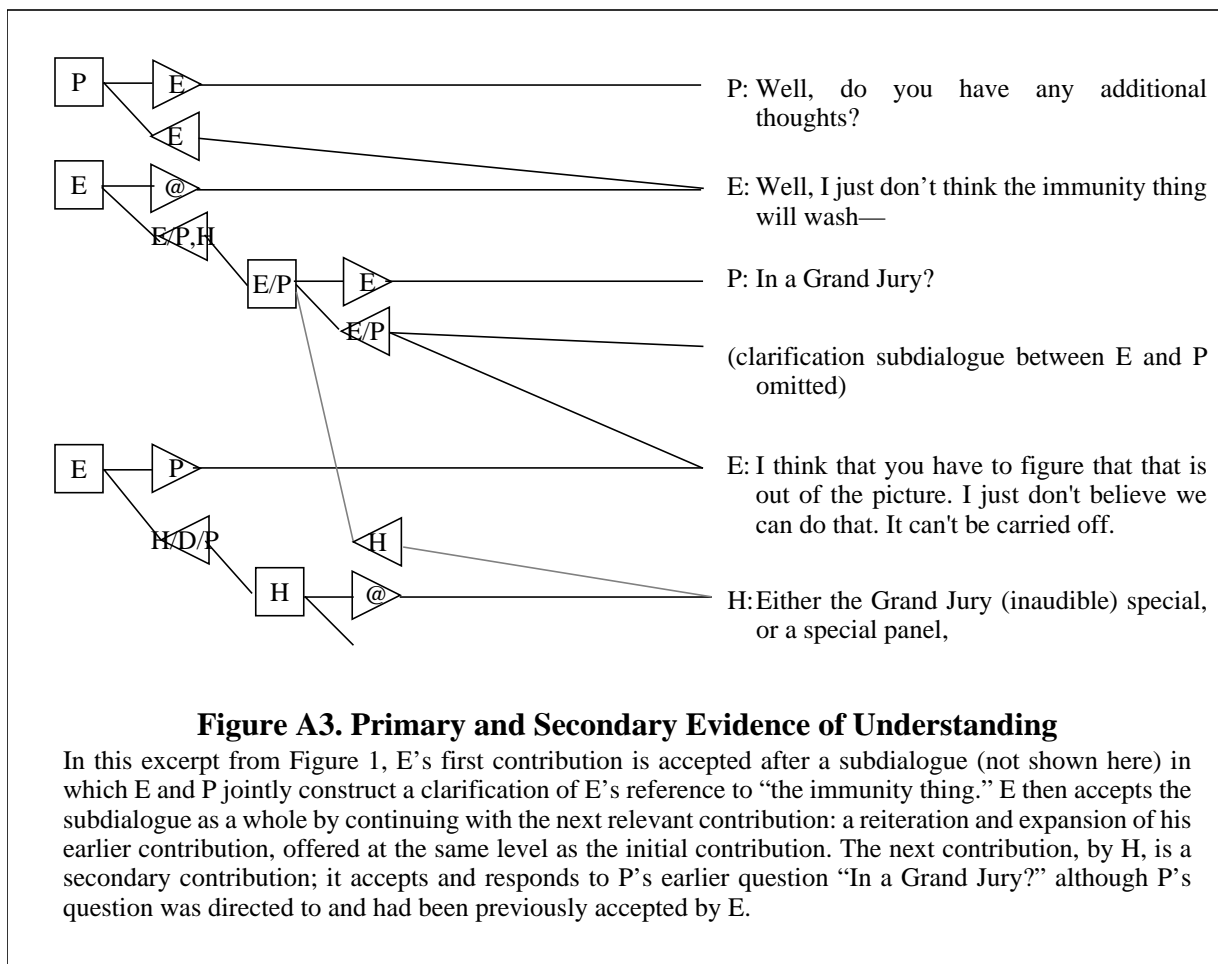
During a single turn a speaker may make multiple presentations, possibly directed at different hearers. This is shown in the analysis by breaking the utterance into multiple blocks of text and annotating each as a separate contribution.

A single contribution may accept multiple contributions. When this occurs, the contribution will have several acceptance lines connecting its text to the contribution symbols for the relevant contribution. Similarly, multiple conversants may accept a single contribution. Multiple acceptances will then feed into a single contribution symbol.

Multiple conversants may collaborate in constructing a single contribution. The contribution is annotated with the initials of all of its direct participants, separated by slashes.

These cases are illustrated in Figure A2.





### Primary and Secondary Evidence of Understanding

An acceptance is considered to be primary evidence of understanding when it is offered by one of the intended addressees of the presentation. Primary evidence of understanding is shown by using a solid line to connect the acceptance symbol with the contribution box and the text.

An acceptance is considered to be secondary evidence of understanding when it is offered by someone other than the intended addressee or when the original presentation has already been adequately accepted. Secondary evidence of understanding is shown with dotted lines.

When an acceptance has been constructed jointly by several conversants, the acceptance box is annotated with the initials of the contributing conversants. The initials of conversants offering primary evidence of understanding are separated by slashes; the initials of conversants offering only secondary evidence of understanding are appended with commas.

These notations are shown in Figure A3.