Acknowledgment Acts in Task-Oriented Dialogue

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ABSTRACT

Acknowledgments serve an important role in establishing mutual knowledge and maintaining conversational coherence. In this paper, we refine and extend prior views of the description, purposes, and contexts-of-use of acknowledgment acts through empirical examination of the use of acknowledgments in task-based conversation. Our research method involves application of conversation analytic techniques, looking toward representations for computational models of dialogue. We present a catalogue of types of acknowledgment, based on a process model that explains instances of these acts in a corpus of task-based conversations. We identify a set of eleven functional factors that characterize the various types of acknowledgment act. We then present a structural classification of acknowledgments in the context of turns and exchanges. We distinguish three broad classes of acknowledgments (*other→ackn*, *self→other→ackn*, and *self-ackn*) and present a catalogue of 13 patterns within these classes that account for the specific uses of acknowledgment in the corpus. We discuss the implications, limitations and issues raised by the model.

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1. Introduction

Dialogue is an interactive achievement. Through communication in dialogue we take action, impart thoughts, express opinions and convey information. Communication has been described as "the physical signs whereby one individual can influence the behavior of another" (Cherry, 1957). More particularly,

- *Physical signs of communication* in terms of speech act theory (Austin, 1962; Searle, 1969), correspond to locutionary acts. These encompass both verbal (spoken utterances and other audible expressions such as sighs) and non-verbal actions (such as facial expressions and hand gestures).
- *Influencing the behavior of another* is the intended result of the communication. This influence may be to cause the hearer to hold a certain belief, to perform some action (either verbal or non-verbal), or to perform some combination of these. In speech-act terms, the force of the locution is called the illocutionary act, and the resulting effect of the illocutionary act on the hearer is the perlocution.

A successful communication can be regarded as one in which the actual perlocutionary effect of an utterance corresponds with the intended perlocutionary effect of that utterance. That is, a communication is successful if the result intended by the speaker is, in fact, brought about. From the speaker's standpoint, it may not always be apparent that an illocutionary act has had the intended perlocutionary effect. For example, the intended perlocutionary effect might be that the hearer hold a certain belief—and it may not be possible for the speaker to determine directly whether the hearer does hold this belief. Similarly, in telephone conversation the intended perlocutionary effect might be that the recipient perform a physical action, yet the speaker typically cannot monitor the hearer's non-verbal actions because the telephone lacks a visual modality.

Cooperating conversants rely on the feedback they receive to gauge whether communication was successful and to decide how to proceed. This feedback also constitutes communication. For a conversation to progress, each participant's utterances must be mutually understood as contributing to the dialogue (Clark & Schaefer, 1989). If the conversation lacks feedback that creates mutual understanding, the dialogue breaks down. Consider the following fragment of telephone speech:[2]

Example 1 (from corpus dialogue U3.1.1)

(1.1) A: Okay, uh, one moment while I compute your route. Okay, um, Bethesda Hospital is approximately seventeen miles away. Uh, the first thing you need to do is to go north on Sheridan one block and get on Highway 36 headed east.

(1.2) B: ((No response))

2. All examples are extracted from a corpus of telephone dialogues from a task-oriented "Wizard-of-Oz" protocol collection study described in Section 3.1. Transcription conventions include coding special information in parentheses: (...) denotes a short pause, (???) denotes hearing difficulties on behalf of the transcriber, and double parentheses (()) contain transcriber's comments. The examples in this paper are notated with the corpus dialogue reference number and each turn is numbered for purposes of reference.

(1.3) A: Okay?

(1.4) B: Okay.

This dialogue fragment shows party A attempting to communicate certain information to party B—namely, a set of directions to some destination. However, B fails to provide a verbal response. Was A's attempt at communication with B successful? Given B's failure to respond, it is not clear that B understood A's contribution. The potential causes of this conversational breakdown include at least these three cases:

- B may have understood A's contribution to be an installment (Clark & Schaefer, 1989) and was waiting for A to continue—in which case, B's resultant actions failed to agree with A's intentions that B should provide evidence of understanding.
- B may have attempted to communicate understanding by some non-verbal means such as head nodding—but such non-verbal signals were uncommunicated in the absence of a visual channel.
- B may not have been aware that A had even uttered anything.

Whatever the reason, it is clear there was some communicative breakdown because B did not communicate effective feedback when A was obviously expecting it.[3] Given the situation, there are several possible next steps for A, including: (1) continuation, (2) repetition and (3) confirmation. In continuing with the directions (i.e., presenting the next installment), A would assume that the previous directions were understood. Repeating the directions would assume that the previous directions were not understood. Confirmation would require no such assumptions; prompting the recipient to indicate whether or not the information was received is a compromising solution in terms of the amount of effort involved versus the potential for further miscommunication. Confirmation represents a form of conversational repair in which the recipient is given an explicit opportunity to enter a repair subdialogue.

This example illustrates the importance of mutuality of knowledge in building conversations. For communications to contribute to a dialogue, the conversants must share a sufficient set of beliefs about their interaction—or at least they must be able to infer that both parties share such beliefs to the degree appropriate to the conversational context (Clark & Marshall, 1981). The feedback that the hearer provides the speaker is a key element in achieving this mutuality. There is, however, a delicate balance to be reached between providing too little versus too much feedback. This balance is reflected in Grice's (1975) maxims of economy and quantity. Similar factors have been described in terms of least collaborative effort (Clark & Wilkes-Gibbs, 1987).

We seek to refine and extend prior views of the description, purposes, and contexts-of-use of acknowledgment acts through empirical examination of the use of acknowledgments in task-based conversation. In particular, we seek to describe systematically (1) the communicative value of an acknowledgment and (2) the circumstances of its use. We present a catalogue of types of acknowledgment. The catalogue is based on a process model of acknowledgment that explains

3. It does not make sense to attribute failure to any one party since communication is a collaborative process. Conversants are jointly responsible for ensuring that they hold mutual beliefs and assumptions about communication processes.

instances of these acts in a corpus of task-based conversations. The corpus contained 1107 instances of acknowledgment over 2499 turns.

In addition to intrinsic interest in discourse processes involving acknowledgment, our study is motivated by the need for better dialogue models in spoken-language understanding systems. Dialogue models contribute directly to the interaction by providing inter-utterance coherence. The model forms a basis for the system to generate a responsive communication. Thus fluent understanding and use of acknowledgments should produce more natural, more usable, and more robustly coherent conversations between humans and computers. In particular, a deeper understanding of how and why people use acknowledgments promises to improve spoken-language systems in at least the following ways:

- *Preventing miscommunication.* Acknowledgments are an important device for establishing mutual knowledge and signaling comprehension. Insights provided by conversational analysis will enable early detection and correction of cases of miscommunication and misunderstanding, thus preventing failure that would otherwise have been even more catastrophic.
- *Improved naturalness*. Acknowledgments are a prominent feature of human-human dialogue. Supporting the use of acknowledgments for both the system and the user will emphasize the "naturalness" of interfaces and improve their utility.
- *Dialogue control*. Humans cope with dialogue control (e.g., turn-taking) with seemingly little or no effort. Acknowledgments form an intricate relationship with dialogue control mechanisms. Understanding these control mechanisms is central to the development and success of spoken language systems in order to "track" dialogues and determine appropriate system actions.
- *Improved recognition.* To the extent that a dialogue model can narrow the range of possible contexts for interpretation of a user's utterance, a spoken-language system's speech recognition performance will be improved (Young et al., 1989).

We claim that acknowledgments are an important device for establishing mutual knowledge and maintaining conversational coherence. Acknowledgments are not merely insignificant linguistic artifacts carrying little or no content. Rather, we will show that they perform a variety of useful functions, including communicating the state of the conversants' comprehension. Evidence suggests that acknowledgments are more than mere accompaniment signals (Kendon, 1967) or backchannel behavior (Yngve, 1970; Duncan & Fiske, 1977).

Our research method involves the application of conversation analytic techniques in the service of representations for computational models of dialogue (cf. Frolich & Luff, 1990). Conversation analysis, as applied here, involves explanation of observed communicative behaviors in dialogue through explication of the conversants' utterances in terms of their contexts, goals, functions, and production. Systematic elements of the interaction are modeled as appropriate conversation acts. For this study, we coded the acknowledgments in the corpus in terms of dialogue function and then catalogued instances of the functional classes in terms of 13 structural patterns of exchanges between speakers.

2. Related Work

Functional studies of acknowledgments have examined their roles as maintainers of conversational coherence. Some of this work is top-down, in that it proposes a coherence role for all acknowledgments as a class; other work is bottom-up, in that it looks at individual instances of acknowledgment and tries to abstract functional roles. We will argue that these views are related because the functional roles can be extended to encompass uses described in the class-wide description.

Clark and Schaefer (1989) suggested that acknowledgments are an important component of a larger framework through which communicating parties provide evidence of understanding. A dialogue can be decomposed into (possibly embedded) sequences of presentation and acceptance phases. In Clark and Schafer's view, the purpose of an acceptance phase is to communicate to the other party that a preceding presentation has been understood. Typically, each new turn indicates the acceptance (in terms of understanding) of the previous turn, while also serving as a presentation which in itself requires acceptance.[4] For more complex dialogue situations, such as conversational repair or side sequences, an utterance may indicate acceptance of an entire subtree rather than just the immediately preceding presentation. That is, certain contributions may be nested within others such that the overall structure of dialogue is hierarchical.

Acknowledgments are just one kind of evidence available to conversants for indicating acceptance of a presentation. According to Clark and Schaefer (1989), participants in a conversation have a range of means available. The accepting conversant provides evidence of understanding to the presenting conversant as a way of establishing the mutuality of the presentation. There are various forms of evidence of understanding that vary with respect to strength. They proposed a general framework consisting of the following five levels:

Evidence of Understanding

1. *Continued attention*: B continues to attend A, and therefore demonstrates continued satisfaction with A's presentation.
2. *Initiation of next relevant contribution*: B starts in on the next contribution, relevant at a level at least as high as the current one.
3. *Acknowledgment*: B responds with some acknowledgment (verbal or non-verbal).
4. *Demonstration*: B demonstrates all or part of what A was understood to mean (e.g., performing requested action).
5. *Display*: B displays verbatim all or part of A's presentation.

The strength of evidence of understanding increases across levels; thus, initiating the next relevant contribution (level 2) is considered a stronger form of evidence than continuing to attend (level 1) and displaying verbatim (level 5) stronger than simply acknowledging (level 3).

This study looks specifically at the use of acknowledgment, one of the five means of indicating understanding. In previous research, the function of acknowledgments has been most readily characterized in terms of attention, understanding and acceptance on the recipient's behalf (e.g.,

4. Actually, the idea of a turn-taking unit is much more complex than this suggests—for example, see O'Connell, Kowal & Kaltenbacher, 1990.

Fries, 1952; Kendon, 1967; Schegloff, 1982). In addition, it has been suggested that they serve to facilitate active participation in dialogues and promote "smooth" conversations (e.g., Dittman & Llewellyn, 1967; Duncan & Friske, 1977).

Schegloff (1982) described two main types of acknowledgment: continuers and assessments. Continuers, such as "uh huh," "quite," and "I see," act as bridges between units. Conversants use acknowledgments as continuers to signal continued attention and to display the recipient's understanding that the speaker is in an extended turn that is not yet complete. Moreover, continuers indicate the turning down of an opportunity to undertake a repair subdialogue regarding the previous utterance or to initiate a new turn. Assessments—such as "oh wow" and "gosh, really?"—are essentially an elaboration on continuers. That is, they occur in much the same environment and have similar properties to continuers, but in addition express a brief assessment of the previous utterance.

Empirical analysis of conversations has indicated that the occurrence of acknowledgments is not arbitrary. Acknowledgments mostly occur at or near major grammatical boundaries, which serve as transition-relevance places for turn-taking (Sacks, Schegloff & Jefferson, 1975; Hopper, 1992). In particular, work by Oreström (1983) and Goodwin (1986) suggested a tendency for continuers to overlap with the primary speaker's contribution, in such a way that they serve as bridges between two turn-constructional units. Assessments, on the other hand, are generally engineered without overlap. Goodwin suggested that conversants make special efforts to prevent assessments from intruding into subsequent units. That is, the speaker typically delays production of the subsequent unit until the recipient's assessment has been brought to completion.

Clearly, acknowledgments are an important device for providing evidence of understanding and for avoiding miscommunication between parties. Just as next-relevant-contributions include the entire range of potential task or domain actions, the task-based role of acknowledgments can be differentiated within their class as acceptances. Beyond continuers and assessments, we will demonstrate that acknowledgments incorporate a larger set of conversational actions, many of which relate to coherence of multi-utterance contributions.

3. Dialogue Analysis

In this section, we describe the task characteristics and the corpus used for this study, present a theoretical model of acknowledgment acts in task-based dialogue, and present an analysis of acknowledgment acts based on corpus material.

3.1. The Vehicle Navigation System Task

At a physical level, it is possible to distinguish between two classes of acknowledgment: verbal and non-verbal. By verbal acknowledgments, we mean interjections such as "okay," "yes," "uh huh" and "right." In contrast, non-verbal acknowledgments refer to kinesic expressions such as head nods, gestures and facial expressions. In this paper, we focus solely on the class of verbal acknowledgments, as non-verbal information would not be directly available to spoken-language understanding systems—especially for telephone-based interaction.

This study centers on the task of dialogue-based access to information (DBAI). In particular, the practical focus of this work is a prototype SLU system being developed by U S WEST Advanced Technologies for a vehicle navigation system (VNS). The system is intended to provide travel

directions to motorists by cellular telephone: the system interacts with the caller to determine the caller's identity, current location and destination, and then gives driving directions a step at a time under the caller's control.

Knowledge of verbal acknowledgment acts is relevant to dialogue-based information access tasks in general and to the VNS task in particular. Appropriate use and understanding of acknowledgment in dialogue should improve naturalness, robustness, and conversational control. When the system is giving directions it is important to be able to distinguish between acknowledgment acts (evidence of understanding and agreement) and clarification acts (evidence of miscommunication). From the system's standpoint, in order to achieve adequate performance in discrimination of this kind it is important for the dialogue model to furnish the speech recognizer with expectations as to what the caller's next utterance will be.

U S WEST Advanced Technologies conducted a Wizard-of-Oz experiment in which callers interacted with a person performing the information service—i.e., the role to be fulfilled by the computer system (cf. Brunner et al., 1992). The purpose of this study was to see how humans would perform the task, and so to give some impression of the baseline for a "natural" dialogue. In one of the experimental conditions, the wizard was free to hold an open dialogue and to issue unconstrained responses. Conversations were recorded and transcribed. In addition to the wizard, 21 participants served as users in the study. This set of task-specific dialogues were then used as a basis for the study of acknowledgments. The VNS dialogues are generally similar to other task-based conversations such as those reported by Grosz and Sidner (1986) and Cohen (1984), although the individual conversations that compose the VNS corpus tend to be shorter.

Certain task characteristics made the VNS task an attractive domain for study of acknowledgments, including information load and conversational structure. The VNS task has a relatively high information load. We anticipate that people rely more heavily on the use of acknowledgments when the task performance is sensitive to the ability to communicate information effectively. When conversants assess the mutuality of knowledge in their conversation, they do so to the extent required under the circumstances; differences in contexts may produce different requirements for certainty of mutuality (Clark & Marshall, 1981). Thus, we expect that acknowledgments are used more frequently in the VNS task than in some other dialogue situations (cf., Bates et al., 1993 (air-travel information); Zue et al., 1990 (useful information for out-of-towners); Price et al., 1988 (resource management)).

Typically, the dialogues followed a fairly well-formed structure. The wizard opened the dialogue with a welcome message and then prompted the user for information about their name, destination and start location. The wizard then computed the route and presented step-by-step directions to the users. Users were permitted to call back any number of times in the event that they required further assistance. When needed, the wizard and a user could enter repair subdialogues to correct misunderstandings.

In this dialogue structure, the information flow was initially from user to system and then from system to user. That is, first the user informed the system of his or her name, destination and start location, and then the system informed the user of directions from the start location to the destination. Typically, the wizard (representing the system) maintained the initiative throughout most of the dialogue; the major exceptions to this were user-initiated repairs. In general, there was a tendency for the wizard to keep the turn after issuing an acknowledgment, while the user typically ceded the turn.

The U S WEST VNS corpus provided a substantial basis for this analysis. As a whole, the corpus contained 2499 turns and 1107 acknowledgments. Common lexical realizations of acknowledgment included “okay,” “yes,” “yep,” “yeah,” “uh huh,” “right,” “all right,” “got it,” “fine,” “correct,” and “thanks.” Thirty-three of the 1107 apparent acknowledgments had adjacent or other nearby utterances that were unintelligible to the transcribers. The unintelligible contexts of these acknowledgments precluded adequate analysis and thus these cases were excluded from the study.

3.2. A Task-Based Model of Acknowledgment Acts

The generally accepted view of acknowledgments, as noted earlier, distinguishes between two classes—namely continuers and assessments (Schegloff, 1982). Indeed, there were many occurrences of continuers (and a few assessments) in the VNS corpus. However, our analysis suggests that acknowledgments perform functions beyond these two classes. For instance, we observed several instances of acknowledgment being used at the beginning of a turn by the same speaker. This contrasts with the notions of continuers and assessments which, by definition, occur as unitary productions in the context of extended turns by another speaker. Clearly, an acknowledgment occurring at the beginning of a turn is not serving as a prompt for the other speaker to continue.

To account for the evidence provided by the VNS corpus, we propose to extend Schegloff’s classification scheme into a task-based model of acknowledgment acts. This model formalizes the meaning and usage characteristics of acknowledgments, based on an analysis of what acknowledgments mean and when acknowledgments are used in the VNS dialogues. The model establishes what acknowledgments indicate about the following aspects of conversation:

- Prior context (i.e., dialogue preceding an acknowledgment),
- Post context (i.e., dialogue that the speaker expects to follow an acknowledgment),
- Content of the prior context,
- Structure of prior context, and
- Turn-taking opportunities.

Broadly speaking, acknowledgments are responsive acts.[5] That is, they are usually uttered in (possibly partial) response to a production by another speaker. As we suggested in the introduction, acknowledgments are not merely insignificant linguistic artifacts carrying little or no content. Instead, they have an important role to play in communicating the state of comprehension and the structure of dialogue, especially with respect to mutuality of beliefs. Acknowledgment acts express beliefs and intentions of one conversant with respect to the mutuality of prior exchanges involving some other conversant. The intended perlocutionary effect of an acknowledgment act is generally the mutuality of some belief. That is, the conversant issuing the acknowledgment intends the other conversant believe that they are in a particular state of comprehension with respect to a belief and that the dialogue is in a particular state as a result.

So, for example, continuers serve to establish the mutuality of the original speaker’s presentation and also establish a mutual understanding between the conversants that the original speaker is in

5. A notable exception is the self-acknowledgment which will be discussed shortly.

the midst of an extended turn. The difference in the conversational state pre- and post-continuer is that (1) before the acknowledgment both parties knew the speaker's utterance had been produced and that the speaker would continue and (2) after the acknowledgment both parties knew that these beliefs were mutual. Of course, if the second party in fact does not hear the original presentation, then they do not produce an acknowledgment.

Functional Factors

More generally, we have identified eleven functional factors that characterize the various types of acknowledgment acts:

- *Hearing*: B indicates that she heard A's utterance. By implication, this also serves as an after-the-fact indication that B had been attending A. Beyond simply listening, hearing implies that the other party's presentation was actually received; under some circumstances, one could try to listen (and thus be attending) but not actually hear anything.
- *Understanding*: B indicates understanding of A's presentation. Clark & Schaefer (1989) discussed hearing and understanding in relation to evidence for miscommunication. For instance, it is possible to hear what was spoken but fail to understand it. In speech-act terms, acknowledgments can serve as an indication of recognition of the illocutionary force of an utterance as well as, for example, resolution of reference.
- *Agreement*: B signals agreement or intention to comply with A's presentation. For instance, an acknowledgment uttered in response to a request or directive indicates that the addressee intends to comply with the speaker's wishes. In speech-act terms, this represents intentions to satisfy the intended perlocutionary effect of an utterance. For some speech acts, however, it is not apparent whether is the person is agreeing or not. For example, for acts like *inform*, it is difficult to distinguish agreement from understanding.
- *Exchange completion*: Party A signals completion of an exchange initiated by herself. This indicates a suggestion of mutual belief that a contribution is complete. Here, an exchange is some adjacency pair involving both parties in a dyadic conversation.
- *Task completion*: Party A signals completion of a task performed by himself. This is related to an exchange completion but may not directly involve the other party. For example, the person who has been performing some non-dialogue task indicates that the task is now complete and is resuming the conversation.
- *No repair*: B indicates passing up the opportunity to repair A's presentation.
- *Prompt for continuation*: B invites A to continue with the next relevant contribution. A continuer (by definition) serves as a prompt for the other person to continue.
- *Exchange resumption*. Party A signals that they are about to resume an exchange having completed a subdialogue. In terms of a focus-space stack (Grosz & Sidner, 1986), resuming an exchange is characterized by the "pop" operation.
- *Exchange creation.* Party A indicates that they are about to begin a new exchange. In terms of a focus-space stack, this function is characterized by a "pop" followed by a "push" operation.

- *Turn relinquishment.* Party A indicates that he gives up the turn. This particular function is really only applicable in exchange-closing contexts. It is typically used by the exchange's initiator to conclude the exchange. That is, the person recognizes that it is their turn to talk but has nothing else to add to the current exchange. Therefore, it should be interpreted as a signal that the current contribution is complete and that it is the other party's turn to begin the next contribution. The important difference between this and the other exchange-completion functions already mentioned is that in this case the speaker always gives up the initiative.
- *Pre-utterance*: Party A indicates that he wants B's attention. A pre-utterance is an item placed at the beginning of a turn; unlike the other factors we have described, the pre-utterance factor displays little or no semantic content. It allows the speaker to secure the attention of the other party and reduces the potential for information loss (cf., pre-placed appositionals in overlapping turns (Hopper, 1992)).

We will provide examples in support of these factors in section 3.3. Note that not all of the factors occur in all instances of acknowledgment. Rather, which factors are relevant depends on the type of acknowledgment. Accordingly, we now consider types of acknowledgment and examine their pragmatic properties in terms of the factors we have identified.

Turn-Taking as Context

We begin by examining the role of acknowledgments in turn-taking. We look at the mechanisms of turn-taking and present a framework for classifying acknowledgments in terms of their turn context. We describe acknowledgments in terms of action scopes and structural classes.

From a turn-taking standpoint, there are a number of distinct possibilities for acknowledgment usage. If we consider the acknowledgment act as a separate presentation, then we can say that turn-taking opportunities exist both immediately before and after an acknowledgment. That is, for a turn immediately prior to an acknowledgment, either (1) the same speaker continues and issues the acknowledgment, or (2) the speaker changes, in which case there is a transition to a new turn that begins with an acknowledgment. Similarly, for a turn immediately following an acknowledgment, either (1) the person who issued the acknowledgment continues to speak or (2) the speaker changes. For convenience, we refer to the person who issues the acknowledgment as "Self" and the other person (assuming a dyadic conversation) as "Other." These turn-taking possibilities are summarized in Figure 1.

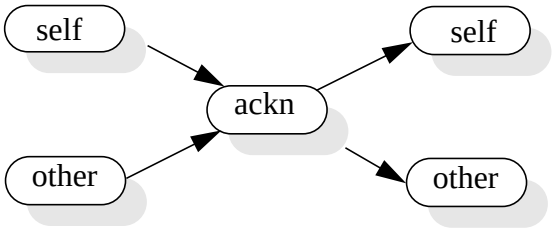

Figure 1. Acknowledgments in Turn-Taking

In real discourse, conversants often combine multiple forms of evidence of understanding in a single utterance. For example, in utterance U4.3.1, the wizard says "Okay. Then you want to go north on Speer Boulevard for one and one half miles to Alcott Street." Thus *other→ackn+self*

denotes[6] a turn transition occurring immediately prior to the acknowledgment, conversely, *self+ackn→other* denotes a turn-transition occurring immediately after the acknowledgment.

Action Scopes

What happens after a turn-transition is a matter of some interest. Clark and Schaefer's (1989) framework for evidence of understanding described ways in which the recipient can express understanding of the speaker's contribution. That is, it summarized the "actions" that may take place following a successful communication. Instead, we are concerned here with what actions may follow communication in general—successful or otherwise. Thus extending Clark and Schaefer's evidence-of-understanding framework, the range of possible actions for a new turn can be divided into two scopes: *antecedent* and *subsequent* actions. Antecedent actions refer to prior exchanges and include acknowledgment, display, and repair initiation. Subsequent actions are responsible for establishing a new exchange and include next relevant contribution, demonstration, and meta-utterance. These action scopes are summarized in Table 1.

Antecedent	Subsequent
Acknowledgment	Next relevant contribution
Display	Demonstration
Repair initiation	Meta-utterance

Table 1. Scopes of Action for a Turn

Beginning with the antecedent actions (other than acknowledgment), in this framework a display action is the repetition of a significant part of the preceding conversant's utterance. A repair action is a request for clarification, possibly leading to a repair sub-dialogue. Turning to the subsequent actions, a next-relevant-contribution action advances the dialogue in accordance with some overall dialogue schema of the task. A demonstration action is not necessarily verbal; for instance it could be a physical action in response to a request such as "Please hand me those pliers." A demonstration can be regarded as a form of next relevant contribution in that it may be the next logical action in performing the conversation's overall task. Meta-utterance actions involve "talk about talk" as opposed to "talk about task"—utterances concerning the control of the conversation rather than the actual task. We refer to an exchange that consists of meta-utterance actions as a *meta-exchange*.

Structural Classes

Another way of looking at the role of acknowledgments in the context of turns is to consider the basic structural context of exchanges. We begin by reviewing the concept of an adjacency pair (Schegloff & Sacks, 1973; Clark & Schaefer, 1989). An adjacency pair is formed by two consecutive utterances that have a canonical relationship, such as question-answer and greeting-greeting. An acknowledgment can be produced as the second phase of an adjacency pair or

6. The notation of the class names indicates turns as separated by arrows. Acts combined within a turn are joined with a plus symbol. *Other* and *self* refer to non-acknowledgment acts by the respective conversants.

following a complete adjacency pair; in each case, the utterance may contain multiple acceptances. Of course, an acknowledgment can be produced also as a single turn that does not relate to an adjacency pair. Thus, based on exchange structure one can distinguish three broad classes of acknowledgments:[7]

- *Other→ackn*, where the acknowledgment forms the second phase of an adjacency pair;
- *Self→other→ackn*, where Self initiates an exchange, Other (eventually) completes the exchange, and Self then utters an acknowledgment; and
- *Self-ackn*, where Self includes an acknowledgment in an utterance outside of an adjacency pair.

In the *other→ackn* class, the exchange is a basic adjacency pair; Other's act will be composed of a single turn. In the *self→other→ackn* class, the exchange initiated and eventually acknowledged by Self may be composed of multiple turns, with multiple utterances by both Self and Other. In the *self-ackn* class, the acknowledgment occurs in a single, extended turn by Self that may contain multiple utterances.

Instances of any class may be embedded in an instance of *self→other→ackn*. These embeddings can lead to repeated acknowledgments as the embeddings are "popped." We present examples of this in Section 3.3.4.

This model accounted for every one of the 1074 analyzable acknowledgments in the U S WEST VNS corpus. We identified 605 instances of *other→ackn*, 392 instances of *self→other→ackn*, and 77 instances of *self-ackn*.

Pragmatic Framework

So far, we have identified eleven functional factors that characterize the various types of acknowledgment acts, antecedent and subsequent action scopes, and three structural classes of exchanges. We are now in a position to integrate these into a comprehensive pragmatic framework that describes the function of acknowledgments in task-oriented discourse. For each combination of action scope and structural class, we can identify the functional factors that may apply to acknowledgments. The framework is presented in Table 2.

3.3. A Catalogue of Acknowledgment Acts in Task-Based Dialogue

In this section, we elaborate the structural classes of acknowledgment through a catalogue of patterns of speech acts that occur in each class. This catalogue provides broad coverage of patterns typically encountered in task-oriented discourse. The speech-act patterns in the catalogue are derived from utterances in the VNS corpus. We explicate each pattern with a predicate representation and provide examples of the pattern in the corpus. We also consider cases of embedded exchanges, in which basic patterns are used to build more complex patterns. We found at least two instances of every reported pattern in the corpus.

The speech-act patterns describe the context of acknowledgments in terms of exchanges. Each act in an exchange is represented in terms of speech-act verbs based on the set described by

7. As in our earlier discussion, Self is the party producing the acknowledgment; Other is the other party.

	Other→Ackn	*Self→Other→Ackn*	*Self-Ackn*
Antecedent	Hearing Understanding Agreement No repair	Understanding Exchange completion	Task completion
Subsequent	Continuation by self Prompt for continuation by other	Resumption of antecedent exchange by self or other New exchange by self or other Relinquish turn	Resumption of antecedent exchange by self New exchange by self or other Pre-utterance

Table 2. A Pragmatic Framework for Acknowledgment Acts

Wierzbicka (1987). The meaning of the acknowledgments depends on the functional factors appropriate to the particular context. Table 3 summarizes the speech-act patterns in the catalogue.

Other→Ackn	*Self→Other→Ackn*	*Self-Ackn*
inform→ackn inform→ackn+mrequest request→ackn+inform mdirect→ackn preclose→ackn	inform→ackn→ackn request→inform→ackn mrequest→inform→ackn mdirect→ackn→ackn	inform+ackn+inform mrequest+ackn mdirect+ackn

Table 3. A Summary of Speech-Act Patterns for Structural Classes of Acknowledgment

3.3.1. Other→Ackn

Acknowledgments in the *other→ackn* class relate principally to the immediately antecedent utterance as opposed to the prior exchange, which is covered by the *self→other→ackn* class. In Clark and Schaefer's (1989) terms, Self's acknowledgment in the *other→ackn* class serves as the acceptance phase for Other's presentation. Canonical *other→ackn* patterns include *inform→ackn*, *inform→ackn+mrequest*, *request→ackn+inform*, *mdirect→ackn* and *preclose→ackn*.[8] In each of these cases, the first turn is by Other and the second turn is Self's acknowledgment. In some cases, Self's turn also extends to include other significant utterances.

8. The *mrequest* and *mdirect* acts are forms of meta-act in which the speaker initiates a clarification subdialogue or otherwise explicitly addresses the control of the conversation; *mrequest* and *mdirect* are not speech-act categories listed by Wierzbicka (1987) but have been developed by the authors following Novick's (1988) meta-act analysis.

Inform→Ackn

The *inform→ackn* pattern covers cases where Other performs an inform act and Self responds with an acknowledgment of that act:[9]

(a.1) inform(Other, Self, <belief>)

(a.2) ackn(Self, Other, [act(1)])

In the following example[10] of an *inform→ackn*, the wizard gives directions to the user, who acknowledges these directions. This acknowledgment, which Schegloff (1982) would call a continuer, includes both antecedent and subsequent scopes because it both (1) indicates hearing and understanding and (2) prompts for continuation.

Example 2 (U6.3.1)

(2.1) Wizard: On Evans, you need to turn left and head West for approximately three quarters of a mile to Clermont.

(2.2) User: **Okay**.

(2.3) Wizard: And, um, on Clermont you turn left, heading South for about two blocks to Iliff.

Here, the "okay" at turn 2.2 indicates the user's acceptance of the wizard's utterance. That is, the acknowledgment implies that the user understood information given by the wizard—more emphatically than a simple next-relevant-contribution response. Use of the acknowledgment would be strong evidence of understanding in Clark & Schaefer's (1989) terms. An important point to stress here is that the wizard cannot rely on the user necessarily having received the information that was actually conveyed or formed the intended interpretation. Rather, the wizard is left with the user's response indicating that the user was apparently satisfied with the wizard's original presentation.

The *inform→ackn* exchange is extended when the acknowledgment is accompanied by a verbatim response. That is, the hearer may qualify understanding by repeating part or all of the speaker's presentation (i.e., the inform act). In fact, this kind of response constitutes combined evidence of understanding and so represents a stronger form of acceptance than an acknowledgment alone. Since a verbatim response communicates what information was received, it allows the speaker opportunity to initiate a repair if necessary. *Full verbatim* communicates to the speaker precisely what information was received, while *partial verbatim* communicates the gist of things (usually just focusing on the end of the presentation). Here is an example:

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9. The conversants' acts are enumerated for ease of reference in acts later in the exchange. Thus (a.1) is Other's inform act and (a.2) is Self's acknowledgment of Other's inform act. In Self's act (a.2), "act(1)" refers to Other's (act a.1). In our presentation of speech acts, the predicates have functor and arguments as follows: <act>(<actor>, <addressee>, <content>). The predicates can be used recursively where appropriate, such that <content> is specified in terms of other predicates.
10. In the examples, the acknowledgment of principal interest is underlined.

Example 3 (U6.1.1)

(3.1) Wizard: And on Highway 36 you go East for about four and one half miles to (...) Interstate 25. And then on Interstate 25, you'll be doing South for about nine and one half miles to Broadway. (...) And on Broadway, you'll go South for one and a quarter miles to Jewell Avenue.

(3.2) User: To Jewel, **okay**.

(3.3) Wizard: Uh, and then Jewell is, uh, one block after Colorado Avenue.

There was a notable preference in the sequential order of combined evidence of understanding. In the majority of cases, the verbatim precedes the acknowledgment. Our analysis of acknowledgments does not extend to explaining this effect; one hypothesis might be that the strongest evidence of understanding is usually presented first and that pragmatic considerations might override this preference. Of course, acknowledgments need not necessarily accompany verbatim responses. It is possible for a verbatim response to occur without an acknowledgment altogether. Such circumstances are beyond the scope of this study, however.

Another form of exchange closely related to the *inform→ackn* case is a self-correction (Schegloff, Jefferson & Sacks, 1977) followed by an acknowledgment. In the following example, the user informs the wizard of the start location and the destination, and the wizard acknowledges that information. The user goes on to interrupt the wizard with a self correction of the start location, which the wizard then acknowledges.

Example 4 (U6.1.1)

(4.1) User: I need to get to Nineteen Ninety South Cherokee from, um, I-36 and Sheridan Boulevard.

(4.2) Wizard: Okay, um, all right, one-

(4.3) User: Actually it's U.S. 36 and Sheridan Boulevard.

(4.4) Wizard: **Okay**, good, uh, one second while I compute your route here.

Technically the user's turn at 4.3 is both a form of repair initiation and an inform act because the user provides new information in place of information already established. Both of the wizard's acknowledgments thus fall into the *inform→ackn* class.

Inform→Ackn+MRequest

The *inform→ackn+mrequest* class represents a significant functional variation on the *inform→ackn* class just considered. It covers cases where Other performs an inform act, Self responds with an acknowledgment of that act and then goes on to seek clarification of the content of the inform act. Requests for clarification are kinds of meta-act because they are concerned with aspects of dialogue control rather than the task itself. That is, requests for clarification are concerned with the specifics of old information rather than seeking to elicit largely new information—unlike request-inform acts for example. We will use the term *clarify* to represent the class of acts that have this special character.

(a.1) inform(Other, Self, <belief>)

(a.2) ackn(Self, Other,[act(1)])

(a.3) mrequest(Self, Other, clarify(Other, Self, <belief>))

Here the acknowledgment indicates partial understanding and general acceptance of a presentation. Our observations suggest the existence of two levels of understanding:

Full understanding, when the hearer receives the contribution with all its particulars and is able to make sense of it.

Partial understanding, when the hearer recognizes which kind of act is being used but may be unclear as to some specifics.

Thus an acknowledgment signalling full understanding will typically be followed by the next relevant utterance (from either party). In contrast, a partial-understanding acknowledgment will typically be followed a request for clarification. For example, a hearer may experience difficulty hearing or remembering information and combine the acknowledgment act with a request for clarification. Lloyd (1992) described several categories of clarification request, including non-specific request for repetition, specific request for recognition, specific request for confirmation and specific request for specification. Accordingly, there is potential for many different forms of *inform→ackn+mrequest*, depending on the kind of clarification involved.

Example 5 (U4.3.1)

(5.1) Wizard: Okay. Then you want to go north on Speer Boulevard for one and one half miles to Alcott Street.

(5.2) User: **Okay**. I want to go right on Speer?

(5.3) Wizard: It will be a left.

In this example, the repair is a potential request for specification. That is, the user's clarification at 5.2 ("I want to go right on Speer?") focuses on information which was missing from the surface structure of the original inform act but which is potentially available—namely "right" instead of "north." The user's acknowledgment is an example of partial understanding.

Request→Ackn+Inform

The *request→ackn+inform* class covers cases where Other requests information from Self, then Self acknowledges the request before attempting to satisfy it:

(a.1) request(Other, Self, inform(Self, Other, <belief>))

(a.2) ackn(Self, Other, [act(1)])

(a.3) inform(Self, Other, <belief>)

Clark and Shaefer (1989) suggested that providing an answer (i.e., an inform act) in response to some presentation entails three types of evidence for understanding: (1) turning down the opportunity to repair indicates understanding of the presentation; (2) initiating an answer shows recognition that the presentation was in fact a question (i.e., a request for an inform); and (3) formulating an answer displays understanding of the particular question asked—that is,

specifically what information was required. The placement of an acknowledgment between the initial request and corresponding inform act provides an indication as to the Self's state of comprehension and intentions. In particular, it signals that Self heard and understood the request and suggests that they intend to comply with request. Consider the following example:

Example 6 (U3.1.2)

(6.1) User: And, uh, how far is Colorado?

(6.2) Wizard: **Okay**. Um, its about one mile to Colorado Boulevard.

In fact, *request→ackn+inform* is a particular case of a more general class in which a request for an arbitrary action is followed by an acknowledgment and then the action. That is, inform is one of many possible intended perlocutionary effects that a speaker might acknowledge. The general case, then, would be *request→ackn+<action>*. For instance, the response to the request "Please pass me the pliers" might be "Okay" followed by the physical action of passing the pliers.

MDirect→Ackn

In a *mdirect→ackn* exchange, Other directs Self to perform some action (physical or otherwise) that relates to the control of the conversation and Self acknowledges the meta-directive:

(a.1) direct(Other, Self, <action>)

(a.2) ackn(Self, Other, [act(1)])

In the following example, at 7.3 the wizard issues the directive "Wait" to the user. This is followed by an explanation for the command. The user at 7.4 then uses an acknowledgment to indicate understanding and agreement—that is, intention to comply with the directive.

Example 7 (U4.1.1)

(7.1) Wizard: Okay. And the next step is go south on Speer Boulevard for two and three fourths miles to Emerson Street.

(7.2) User: ((Long pause)) Okay.

(7.3) Wizard: Wait. There's a correction to that.

(7.4) User: **Okay**.

(7.5) Wizard: Off of Speer Boulevard turn onto Downing Street.

Preclose-Ackn

Conversations do not simply end; instead they are typically brought to a close (Schegloff & Sacks, 1973). As part of this process, conversants work together to establish that it is appropriate to terminate the conversation. Initiating a closing section is referred to as *pre-closing*. This involves conversants taking turns: (1) to indicate that they have nothing more to add to the conversation; and (2) to invite the other party opportunity to do the same. That is, a pre-closing exchange represents an attempt by conversants to establish the mutual belief that the conversation is complete. Note, however, that a pre-closing exchange does not necessarily result in the conversation ending, since the other party may in fact choose to "re-open" the conversation.[11] It turns out that acknowledgments are commonly used in pre-closing exchanges:

(a.1) preclose(Other, Self)

(a.2) ackn(Self, Other, [act(1)])

In the following example, the user initiates the closing section by saying “Thank you” at 8.2. This represents the first phase of the pre-closing exchange. It suggests that the user has no more immediate task-related needs and so implies the conversation is complete (from the user’s standpoint at least). The wizard’s acknowledgment at 8.3 is the second phase of the pre-closing exchange. It represents an acceptance act at two levels: (1) in terms of a thanks-acceptance adjacency pair (Clark & Schaefer, 1989); and (2) understanding and acceptance of the user’s pre-closing act:

Example 8 (U4.3.1)

(8.1) Wizard: Okay. Call back if you need any more help.

(8.2) User: Okay. Thank you.

(8.3) Wizard: **Okay**.

(8.4) User: Bye-bye.

3.3.2. Self→Other→Ackn

Acknowledgments in the *self→other→ackn* class relate to the previous exchange, rather than just the previous utterance. Broadly speaking, they express the current state of the dialogue in addition to embodying the functionality of *other→ackn* acknowledgments. That is, they explicitly mark the completion of the antecedent exchange and indicate that the dialogue will either enter a new exchange or resume an existing exchange. Furthermore, *self→other→ackn* acknowledgments signal understanding and acceptance of both the previous exchange and the previous utterance. The canonical forms of the *self→other→ackn* class include *inform→ackn→ackn*, *request→inform→ackn*, *mrequest→inform→ackn* and *mdirect→ackn→ackn*.

Instances of the *other→ackn* class are composed of an adjacency pair initiated by Other and concluded with an acknowledgment by Self. In contrast, instances of the *self→other→ackn* class typically are composed of an exchange initiated by Self and followed with an acknowledgment by Self. The exchange in an instance of the *self→other→ackn* class may contain embedded instances of any class. Thus, for example, a *request→inform→ackn* may contain, as part of the *inform*, a *mrequest→inform→ackn*. We now examine each of these classes as they occurred in the VNS corpus.

Inform→Ackn→Ackn

The VNS corpus contained several instances of consecutive acknowledgment exchanges. One such usage is characterized by the *inform→ackn→ackn* class. This covers cases where Self performs an inform act, Other responds with an acknowledgment of that act, then Self also responds with an acknowledgment:[12]

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11. In contrast, a “successful” pre-closing exchange is typically followed by a farewell-farewell adjacency pair (Clark & Schaefer, 1989) in which conversants exchange “Goodbyes”.
12. In this pattern, exchange(1, 2) refers to the adjacency pair composed by Self’s mrequest and Other’s inform

(a.1) inform(Self, Other, <belief>)

(a.2) ackn(Other, Self, [act(1)])

(a.3) ackn(Self, Other, [act(1), exchange(1, 2)])

Clearly, the second acknowledgment is doing more than simply acknowledging receipt of the first acknowledgment. It is an acknowledgment of the completed *inform→ackn* exchange. In the following example, the wizard is giving directions to the user in installments. The user issues a continuer indicating acceptance of the directions and that they intend for the wizard to continue. The wizard then acknowledges before continuing with the next installment. Here the acknowledgment at 9.3 is an explicit marker for the fact that the previous installment is complete and that a new installment is about to begin:

Example 9 (U4.3.1)

(9.1) Wizard: The street right before Alcott Street is Zuni Street, on Speer.

(9.2) User: Okay.

(9.3) Wizard: **Okay**. And when you get to Alcott, turn left.

When acknowledgments are used as continuers, it is straightforward for the user to detect that the wizard is in middle of an extended turn because the destination is mutually known. Thus, it is reasonable for the user to assume that the wizard will continue giving directions until the directions end with the destination.

Request→Inform→Ackn

The *request→inform→ackn* class covers cases where Self requests an inform act of Other. Other then performs that inform act and Self acknowledges. Note that the acknowledgment in this case follows a completed request–inform adjacency pair:

(a.1) request(Self, Other, inform(Other, Self, <belief>))

(a.2) inform(Other, Self, <belief>)

(a.3) ackn(Self, Other, [act(2), exchange(1, 2)])

Earlier, we mentioned that question-answer adjacency pairs can be regarded as special cases of request/inform adjacency pairs (Searle, 1969). In the following example, the wizard requests the user's start location. The user satisfies this request by communicating the desired information and the wizard then acknowledges. Here the acknowledgment at 10.3 serves to indicate acceptance (that is, receipt, understanding and agreement) of the user's inform act and is a signal that the request initiated by the wizard at 10.1 has been satisfied and thus the exchange is complete.

Example 10 (U2.1.1)

(10.1) Wizard: Okay and uh, what's your starting location?

(10.2) User: I'm at 36th and Sheridan at the Park-n-Ride.

(10.3) Wizard: **Okay**, one moment please.

We have already established that a request for an inform is in fact a specific case of a more general form, namely a request for an action. Indeed, this general form captures other possible uses of acknowledgment. One such case observed in the VNS corpus is a request for a request, which gives rise to the *request→request→ackn* class:

(a.1) request(Self, Other, request(Other, Self, <action>))

(a.2) request(Other, Self, <action>)

(a.3) ackn(Self, Other, [act(2), exchange(1, 2)])

In the following example, the wizard asks how they can be of assistance. The user responds at 11.2 with what on the surface appears to be an inform act, but what is actually an indirect request for the wizard's help in reaching their destination. The wizard's acknowledgment at 11.3 indicates not only that they understood the user's request but also implies a commitment that the wizard will attempt to satisfy the user's request:

Example 11 (U4.1.1)

(11.1) Wizard: How can I help you?

(11.2) User: Um, I want to go to destination one eleven Emerson.

(11.3) Wizard: **Okay**. And where are you starting from?

MRequest→Inform→Ackn

Another kind of request of interest is the meta-request. The mrequest-inform adjacency pair is regarded as a meta-exchange because it is concerned with the process of conversation (namely, that of achieving certain communicative goals) rather than the underlying discourse purpose itself. Here we are interested in situations where an acknowledgment follows a mrequest-inform exchange, giving rise to the *mrequest→inform→ackn* case. Because the *mrequest→inform→ackn* case is similar in structure to the *request→inform→ackn* case already discussed, we will not go into in great detail:

(a.1) mrequest(Self, Other, inform(Other, Self, <belief>))

(a.2) inform(Other, Self, <belief>)

(a.3) ackn(Self, Other, [act(2), exchange(1, 2))]

Note that although *mrequest→inform* is regarded as a meta-exchange, we specify only the request as a meta-act because the *inform* is directly responsive to the *mrequest*. Here is an example of the *mrequest→inform→ackn*:

Example 12 (U4.2.1)

(12.1) Wizard: Would you like me to repeat anything?

(12.2) User: No. That's fine.

(12.3) Wizard: **Okay**. Call back if you need any more help.

Meta-requests may also initiate clarification subdialogues. The *mrequest→inform→ackn* class covers cases where Self requests clarification of a belief. Other clarifies Self's belief with an

acknowledgment and then Self acknowledges. Here, as in the case of *inform→ackn →mrequest*, "clarify" is treated as a special case of the inform act:

(a.1) mrequest(Self, Other, clarify(Other, Self, <belief>))

(a.2) clarify(Other, Self, <belief>)

(a.3) ackn(Self, Other, [act(2), exchange(1, 2)])

In the following example, at 13.2 the user seeks to confirm certain information provided by the wizard, so they issue a form of clarification request—namely, a specific request for confirmation (Lloyd, 1992). At 13.3 the wizard clarifies that the user's belief is correct. The user then issues at 13.4 an acknowledgment marking the end of the repair subdialogue and so allowing the dialogue to get back "on-track." The user-initiated repair means that the user has effectively taken the initiative from the wizard (for this subdialogue at least). Thus, after the wizard's acknowledgment at 13.3 the initiative remains with the user. An additional function of the user's acknowledgment at 13.4, then, is to communicate to the wizard that the user wishes to make no further clarifications and so relinquish the initiative and give up the turn:

Example 13 (U7.2.1)

(13.1) Wizard: Turn right, going south on Colorado Boulevard, and go three and a half miles to Yale Avenue.

(13.2) User: Yale?

(13.3) Wizard: Uhuh, that's right.

(13.4) User: **Okay**.

MDirect→Ackn→Ackn

Following in a similar theme to the meta-exchanges just considered, we have the *mdirect→ackn→ackn* case. This covers situations in which Self issues a directive, Other acknowledges that they intend to comply with the directive, and Self (eventually) acknowledges the completed exchange:

(a.1) mdirect(Self, Other, <action>)

(a.2) ackn(Other, Self, [act(1)])

(a.3) ackn(Self, Other, [act(2), exchange(1, 2)])

In the following example, the wizard at 14.1 issues a directive to the user, which effectively instructs them to wait so that the wizard can perform some non-verbal sub-task. At 14.2 the user signals that they intend to comply with the directive. There is then a long pause during which the wizard executes the sub-task. The wizard then re-enters the conversation at 14.3 beginning with an acknowledgment. Here the acknowledgment serves as an attention-seeking marker. That is, the wizard indicates completion of the sub-task and signals that they are about to resume the dialogue.

Example 14 (U6.1.1)

(14.1) Wizard: Okay, good, uh, one second while I compute your route here.

(14.2) User: Okay, thanks.

(14.3) Wizard: ((Long pause)) **Okay**, um, your destination is approximately sixteen miles away.

3.3.3. Self-Ackn

Self-acknowledgments occur when Self issues an acknowledgment following some action (either verbal or physical) performed by Self. These are not responsive acts, unlike other acknowledgment usages considered; however, they are still closely tied with the idea of establishing mutual beliefs. There are a few cases of interest, including *inform+ackn+inform*, *mrequest+ackn*, and *mdirect+ackn*.

Inform+Ackn+Inform

The first case of interest is where Self uses an acknowledgment in the middle of an extended turn. Consider the following example:

Example 15 (U5.3.1)

(15.1) Wizard: All right, um, the first thing you need to do is go South on Logan Street for one and a half miles to Evans Avenue. Then turn left on Evans Avenue and go one and a quarter miles to South Josephine Street. **Okay**, then you'll turn left on South Josephine Street. Nineteen Forty South Josephine is within the first block.

This particular self-acknowledgment is very similar to a continuer—indeed it may be regarded as a *self-continuer*. The wizard's acknowledgment in this example represents a sort of temporizing, a chance for the wizard to "catch his mental breath." For the user, this sort of "Okay" thus signals that the wizard intends to continue his turn. This is functionally distinct from a meta-request of the form "Okay?" because there is no rising intonation and the wizard does not wait for a response. In fact, use of a self-acknowledgment at the end of a turn would be peculiar.

MRequest+Ackn

The next case of self-acknowledgment occurs in the context of a failed conversational repair. We found several examples like the following:

Example 16 (U3.2.2)

(16.1) User: Yeah, (???) Broadway.

(16.2) Wizard: Florida and Broadway? (...) **Okay**, one moment. ((long pause)) Okay, um, (...) it looks like it's approximately four blocks farther north to Mississippi. And then at Mississippi you'll be turning left and continuing west for three quarter miles to Lipan Street.

This is a case where the actual perlocutionary effect of a repair utterance does not match the conversant's intended perlocutionary effect. The conversation has already broken down to the extent that one conversant feels a need to repair—and then this attempt at repair passes unfulfilled. At 16.2, the wizard requests a clarification of information supplied by the user; the rising intonation and short pause indicate that the wizard expects the user to reply. However, the user fails to clarify so the wizard continues, beginning with an acknowledgment. Apparently the wizard's request for clarification was mistaken by the user for a display (verbatim) response. The fact that the wizard then continues suggests that he inferred that the information he sought to confirm must have been correct, as the user did not initiate his own repair in response to a perceived display. The wizard's acknowledgment thus represents the acceptance act that would have occurred had the wizard not needed to seek confirmation.

MDirect+Ackn

The wizard's second acknowledgment in Example 16 is an instance of *mdirect+ackn*. This pattern is a variation of *mdirect→ackn→ackn*, where Other's acceptance of Self's *mdirect* is omitted. The function, that of task completion, is identical to the *mdirect→ackn→ackn* case.

3.3.4. Embedded Exchanges

We noted earlier that exchanges can be nested. This can lead potentially to variations in patterns of acknowledgments. In particular, it is possible to observe cascades of acknowledgments as nested exchanges are "popped" one by one. Simple acts may be replaced by more complex exchanges, so that an inform act may be replaced by an exchange that accomplishes an inform via a sequence of informs, clarifications and acknowledgments. In this section we will consider variations that were encountered in the VNS corpus. The first case is where an *inform→ackn→ackn* replaces the *inform* act in an *inform→ackn* sequence:

(a.1) inform(Other, Self, <belief>)

(a.2) ackn(Self, Other, [act(1)])

(a.3) ackn(Other, Self, [act(2), exchange(1, 2)])

(a.4) ackn(Self, Other, [act(3), exchange(1, 2, 3)])

In the following example, there are three successive acknowledgment acts. The first acknowledgment at 17.2 is accompanied by a verbatim response by the user. It is the second phase of the *inform→ackn* adjacency pair, indicating understanding and acceptance of the wizard's *inform* act in which a direction was clarified. The second acknowledgment, issued by the wizard at 17.3, marks the completion of the *inform→ackn* exchange. That is, the wizard recognizes that it is his or her turn yet has nothing more to add, so indicates passing up the turn with an acknowledgment. The third acknowledgment, issued by the user at 17.4, is associated with the user recognizing that the wizard has finished clarifying directions; the user thus acknowledges this embedded *inform* act. The user then indicates satisfaction and approval of the wizard's directions with the assessment "Sounds good."

Example 17 (U6.2.1)

(17.1) Wizard: Okay, it was, um, on Evans it's three and three quarter miles to Jasmine.

(17.2) User: Three, **okay**.

(17.3) Wizard: **Okay**.

(17.4) User: **All right**, sounds good.

The second case of interest is where an extended *mrequest→inform→ackn* segment replaces the *inform* act in another *mrequest→inform→ackn* segment. We reiterate that *clarify* is a special case of *inform.*

(a.1) mrequest(Self, Other, inform(Other, Self, <belief>))

(a.2) mrequest(Other, Self, clarify(Self, Other, <belief>))

(a.3) clarify(Self, Other, <belief>)

(a.4) ackn(Other, Self, [act(3), exchange(2,3)])

(a.5) ackn(Self, Other, [act(4), exchange(1, exchange(2, 3, 4))])

Example 18 also illustrates a succession of acknowledgment acts. In this case, the user has acquired the initiative and has presented a series of clarification requests to the wizard from 18.2 to 18.8. The wizard's acknowledgment at 18.9 confirms the user's belief as correct. The next acknowledgment is by the user at 18.10 indicating completion of the extended clarification exchange. That is, the user holds the initiative but has nothing more to add, so indicates passing up the turn with an acknowledgment. Finally, the acknowledgment at 18.11 indicates that the wizard's *mrequest→inform* exchange is complete and that he is about to generate the next installment.

Example 18 (U9.2.3)

(18.1) Wizard: Should I repeat anything right now?

(18.2) User: (???) go up to Lincoln and take a right?

(18.3) Wizard: Uhuh.

(18.4) User: Uh, to 20th?

(18.5) Wizard: Right.

(18.6) User: Um, take a left on 20th?

(18.7) Wizard: Right.

(18.8) User: Up to Welton?

(18.9) Wizard: **Right**.

(18.10) User: **Right**.

(18.11) Wizard: **Right**, then it's about, um, from the information I have, it looks like, um, when you get to 20th Street, that, uh, off of Lincoln, it kind of jogs to the left. (...) So that will be your left onto 20th from Lincoln, (...) and one block you'll get to Welton, where you take a right.

4. Discussion

The classes and patterns of acknowledgment from the U S WEST VNS corpus raise broad issues. First, how do this model and its supporting evidence relate to prior accounts of acknowledgment? Second, how does the model inform the collaborative view of conversation? And third, how does lexical realization of acknowledgments affect their interpretation? We explore each of these issues in turn.

4.1. Occurrences of Acknowledgment

Where are acknowledgments found? For dialogues in information-exchange tasks such as providing travel directions to motorists, acknowledgments tend to flow in the opposite direction from the passage of domain information. There are certain cases, typically self-acknowledgments, where this does not hold but these can be viewed as "non-responsive," in that they do not occur in response to an action by another party. Rather, they serve mainly as place-holders to maintain the current state of the dialogue with respect to initiative. We also found that acknowledgments typically occur at the head of a turn. We believe that this is caused by the fact that such acknowledgments contain an antecedent scope that accepts the previous presentation. It is usual to accept the preceding presentation before making a new contribution, especially in telephone conversations (Stenstrom, 1984). Acknowledgment is a relatively economical form of acceptance and is often used to indicate explicit acceptance in combination with a weaker form of acceptance.

Both Schegloff (1982) and Goodwin (1986) have suggested that acknowledgments occur primarily at or near turn transitions. Moreover, they note that continuers commonly overlap turn endings. However, this does not appear to be the general case in the VNS corpus—in fact, we found very few instances of overlapping acknowledgments. The reason for the low incidence of overlapped acknowledgments may involve the nature of the VNS task. The dialogues are not particularly chatty—especially when compared to conversations from the London-Lund corpus (Svartvik & Quirk, 1983)—because they are so task-focused. Mostly, the users give locations and the wizard presents routing information. The directions have a high information content and are often lengthy. For dialogues with high task content, producing overlapping speech is likely to impair the ability to hear and to process the other participant's utterance. Also, it is more difficult to anticipate what words will be uttered next when contributions have a high information content. Moreover, lengthy presentations (especially routing information) may cause a delay during which the recipient processes the presentation to ensure comprehension. Thus while it may be the case that overlap occurs commonly in general dialogue situations, we expect our findings to be widely characteristic of task-based dialogues across many domains.

Similarly, the VNS task does not lead to situations where the conversants are likely to agree or disagree about a proposition. Accordingly, we found few instances of acknowledgment used as assessment, as described by Pomerantz (1984).

The corpus did contain some fairly complex uses of acknowledgment that stretched the model's descriptive capacity. For example, complex embeddings of exchanges can lead to cascaded acknowledgments in a single turn:

Example 19 (U6.3.1)

(19.1) Wizard: And Bethesda Hospital should be there.

(19.2) User: **Okay**. (...) **All right**, **sounds good**, thanks.

In this dialogue fragment, the user's "Okay" at 19.2 accepts the wizard's preceding *inform* act, and his subsequent "All right" indicates completion of the overall exchange resulting from his original request for directions. The user's phrase "sounds good" might be viewed as an assessment reiterating satisfaction with the outcome of the dialogue.

In another case, acknowledgment is thrown into the breach of conversational breakdown:

Example 20 (U7.1.2)

(20.1) User: I was going towards, you know, I was going from 1st Avenue towards here and that's Colorado, so I want to go back.

(20.2) Wizard: That's right.

(20.3) User: So I make a left onto Alameda and then I make a right onto Colorado or a left?

(20.4) Wizard: Um. Let's see, 1st Avenue. (...) Let's see, um, on my map it shows that Alameda and 1st Avenue are parallel.

(20.5) User: I don't know how that can be because I just turned, I'd been going straight. I mean, it curved and stuff, but I'd been going straight. (???) Alameda. Okay. I passed Harrison, Monroe...

(20.6) Wizard: Uhuh. So did you pass Monroe second?

(20.7) User: Monroe.

(20.8) Wizard: After 1st. **Okay**. So you're heading west now it looks like. And if you go the other way on Alameda...

(20.9) User: Uhuh.

(20.10) Wizard: You'll run into Colorado, and you'll take a left.

In this dialogue fragment, the user and the wizard reach an impasse when their models of the street layout seem to diverge significantly. This breakdown becomes apparent in the context of a repair initiated by the user at 20.3. The next few turns exchange repair attempts with little success until the wizard finally abandons the current repair subdialogue in the middle of his own turn at 20.8. The wizard uses acknowledgment to indicate shift in focus from the old repair subdialogue to a new repair subdialogue. Although this case fits the *inform+ackn+inform* pattern, the actual pragmatics of the acknowledgment remain problematic.

4.2. Acknowledgment as Evidence of Understanding

One of the striking features of the VNS corpus is the presence of sequences or cascades of acknowledgments. We have observed similar patterns in other dyadic, task-based conversations. We address this phenomenon by contrasting our account of acknowledgment with Clark and

Schaefer's (1989) contribution-tree model and by discussing, in light of the models, why such sequences occur.

Clark and Schaefer presented five levels of acceptance (of which acknowledgment is one level) but did not differentiate functions within each level. Our more elaborated model of acknowledgment provides internal detail and can account for observed patterns of interaction not predicted by Clark and Schaefer's model. In particular, Clark and Shaefer's *strength of evidence principle* states that participants expect that, if evidence E_0 is needed for accepting presentation U_0, and E_1 for accepting the presentation of E_0, then E_1 will be weaker than E_0. That is, demonstration should be accepted by acknowledgment, next-relevant-contribution or continued attention, and acknowledgment should be accepted by next-relevant-contribution or continued attention. However, we found several cases where the strength of evidence principle does not seem to apply because there were cascaded acknowledgments. The number of cascaded acknowledgments depends on the level of nesting, who initiated the subdialogue and who, after the subdialogue is complete, is the "natural" person to continue the conversation. Some such acknowledgments may be used where one party thinks that they are supposed to have the turn but does not yet have anything to say.

The occurrence of sequences of acknowledgments may be due to an interaction between the process of acceptance and the characteristics of the telephone modality. Note that not all acceptance levels described by Clark and Shaefer may be available to a conversant given the conversant's conversational goals. Continued attention is problematic as a form of acceptance over the telephone. The presenting speaker will be unable to distinguish acceptance from non-acceptance because both would be realized as silence. Another reason that some levels of acceptance may be unavailable is that the conversational task may impose constraints. For example, if one conversant wants the other conversant to continue along their current path, one cannot use a next-relevant-contribution as a form of acceptance—even though all other acceptance forms might work. One cannot substitute a certain weaker form of acceptance for continuers because the point of a continuer is to induce the other party to continue; acceptance via next-relevant contribution would be antithetical to the conversational goal. In some cases, task-based constraints on the use of acceptance levels is more direct. For example, in air traffic control dialogues involving interaction among flight crews and controllers, the standard communication protocol requires that the conversants use explicit acceptance operators at the display level (see, e.g., Ward, Novick & Sousa, 1990a, 1990b).

As Clark and Schaefer (1989) observed, a single turn may contain multiple forms of acceptance at different levels. For instance, acknowledgments may be accompanied by other forms of evidence for understanding such as display (see Examples 3 and 17). Acknowledgment accompanied by a next-relevant contribution occurs frequently (see Examples 4 through 12 and 14 through 19); this level of occurrence is consistent with other large corpuses of task-oriented dialogue that we have coded for acknowledgment. In terms of evidence of understanding, a turn transition may correspond to an acknowledgment followed by continued attention, while keeping the turn may correspond to an acknowledgment followed by the next relevant contribution.

Finally, we note that acceptance as a representation of understanding may require a more subtle structure to account for the degrees of understanding (that is, partial and full), as observed in the VNS corpus. In their acknowledgments, conversants may convey evidence of the degree of certainty of the mutuality of understanding (cf. Clark & Marshall, 1981). Moreover, expression of these degrees may not be available at all acceptance levels. For example, in telephone

conversations, continued attention does not permit communication of such fine-grained distinctions. In visual modalities, however, facial expression may carry this sort of information in such forms as a quizzical look or a knowing glance.

4.3. Lexicalization and Ambiguity

Acknowledgments in the VNS corpus, as in other conversations, are embodied in locutions. While a complete account of the lexicalization of acknowledgment is beyond the scope of this study, we wish to stress the evident difficulty of generation and interpretation of specific utterances as acknowledgments. In particular, lexical ambiguity gives rise to potential errors in interpretation.

Ambiguity in lexicalized acknowledgments is apparent at two levels. First, as our model suggests, acknowledgments are ambiguous with respect to function. That is, we identified eleven various functions of acknowledgment, which raises the issue of how to distinguish among them. Our speech-act patterns may be of some help here. Second, at a lexical level, certain word forms have functions outside of acknowledgments. This raises the issue of how to determine whether a particular lexical item is an acknowledgment or something else altogether. Prosody may provide valuable disambiguation clues in some cases, such as distinguishing questions from other forms of response (e.g., “Right?” vs. “Right!”).

Example 21 illustrates some of the problems of ambiguity in interpretation of acknowledgments. This example shows a range a different usages for “Right,” only some of which are acknowledgments. In the wizard’s turn at 21.1, “right” is a temporal adverb. In 21.2 and at the end of 21.11, “right” is a direction. In 21.5, 21.7, 21.9, 21.10 and at the beginning of 21.11, “right” is an acknowledgment. This example serves to underline some of the difficulties faced by those seeking to develop “naturalistic” SLSs.

Example 21 (U9.2.3)

(21.1) Wizard: Should I repeat anything **right** now?

(21.2) User: (???) go up to Lincoln and take a **right**?

(21.3) Wizard: Uhuh.

(21.4) User: Uh, to 20th?

(21.5) Wizard: **Right**.

(21.6) User: Um, take a left on 20th?

(21.7) Wizard: **Right**.

(21.8) User: Up to Welton?

(21.9) Wizard: **Right**.

(21.10) User: **Right**.

(21.11) Wizard: **Right**, then it's about, um, from the information I have, it looks like, um, when you get to 20th Street, that, uh, off of Lincoln, it kind of jogs to the left. (...) So that will be your left onto 20th from Lincoln, (...) and one block you'll get to Welton, where you take a **right**.

5. Conclusion

In this paper we have described the functions, scopes, and structures of acknowledgments in task-based dialogue. We presented an exhaustive catalogue of patterns of acknowledgment that accounted for all analyzable instances in a corpus of task-oriented telephone dialogues. We considered the relation of the model to prior accounts of acknowledgment, to the collaborative view of conversation, and the consequences of lexical realization for interpretation. We now turn to the model's implications for incorporating acknowledgment into computer-based spoken language systems. We further consider a range of related issues for future research.

5.1. Computational Implications

Why is a conversation-analytic study of acknowledgment useful in the development of spoken language systems? SLSs developers face the dual challenges of creating both domain-based dialogues and repair-oriented dialogues. Lacking systematic mechanisms for natural maintenance of mutuality, SLSs tend to rely on domain structures—producing rather stolid interaction. The most advanced systems incorporate repair acts, but are unable to relate the repairs to the main dialogue structures in a natural way. The acknowledgment model described in this paper provides a systematic method of maintaining mutuality of knowledge for both domain and control information.

More concretely, using this model SLSs can account for acknowledgments by both user and system. The corpus evidence suggests that users' utterances in unconstrained dialogues contain many instances of acknowledgment. In interpreting these utterances, identification of the appropriate acknowledgment function affects the state of the dialogue model and thus plays an important role in determining an appropriate response by the system. In producing such responses, the acknowledgment model can provide structurally appropriate utterances. The fundamental idea is to produce contextually appropriate acknowledgments that advances the dialogue seamlessly with respect to both domain and control functions. That is, the system needs to give the right signals at the right time.

The evidence of the U S WEST VNS corpus suggests that understanding and production of domain and control utterances are closely linked; they thus cannot be implemented as independent mechanisms in an SLS. For example, giving directions involves presenting large amounts of information for which an installment approach often proved effective. Typically the user was given the opportunity to choose the style of presentation of directions, either step-by-step or all at once. The choice of presentation method by the conversants was a dynamic one: in cases where it became apparent that the user was experiencing difficulties with either hearing or understanding directions, the wizard often resorted to the step-by-step approach. This form of repair changed the process of interaction so that the comprehension of each installment was verified before proceeding with the next.

The conversants in the VNS corpus displayed relatively higher rates of use of acknowledgment in repair situations or when unplanned events arose (e.g., the user had gotten lost). Intuitively, people make more effort to establish mutual knowledge when it is apparent that miscommunication has occurred than at other times; their certainty criterion for mutuality (Clark & Marshall, 1981) is raised as a result of the need for repair. This suggests that a facility for acknowledgment is an important element in the development of robust SLSs because use of acknowledgment is most critical precisely when the conversation has gone awry.

5.2. Research Directions

Finally, we now look at possible directions for research that would use, test, and extend the model of acknowledgment developed in this study. Although we have presented a comprehensive catalogue of acknowledgment types and structures, there remain many open issues relating to both the implementation and theory of acknowledgment as a computationally representable interactive system.

We are currently developing computational operators that embody the model of acknowledgments, for use in a dialogue system. The operators reflect the structural classes. We expect that choice of when to apply the operators will be a difficult question. The implemented system should provide a basis for testing the model across domains other than VNS.

Other research questions include:

- What are the prosodic and temporal characteristics of acknowledgments? This is a potentially important issue for design of SLSs. (See Pierrehumbert & Hirschberg, 1990.) For instance, in addition to knowing when to expect an acknowledgment, it is important to know how long to wait before initiating a repair. Example 22 (reprised from Example 1) shows party A initiating a clarification repair after party B fails to provide any explicit form of acceptance:

  Example 22 (from corpus dialogue U3.1.1)

  (22.1) Wizard: Okay, uh, one moment while I compute your route. Okay, um, Bethesda Hospital is approximately seventeen miles away. Uh, the first thing you need to do is to go north on Sheridan one block and get on Highway 36 headed east.

  (22.2) User: ((No response))

  (22.3) Wizard: **Okay?**

- What is the relation between the function of an acknowledgment, the exchange pattern in which it is used, and the lexical choices with which it is realized?
- What are the effects of modality on use of acknowledgments? For instance, how does acknowledgment usage differ between face-to-face and telephone conversations? Can differential use of acknowledgment account for the inter-modality differences observed by O'Conaill, Whittaker and Wilbur (in press)?
- What is the relationship of acknowledgments to information flow? We would expect that most acknowledgments would be produced by the party receiving information. In the VNS domain, this would predict that in the first phase of a typical dialogue most acknowledgments should be produced by the wizard because he is receiving information from the user; in the second phase the wizard is giving route information to the user, so we would expect to see most of the acknowledgments being produced by the user.
- What is the relationship between repairs and information flow? What is the relationship between repairs and acknowledgments? We would expect that acknowledgments would be produced mainly by the party initiating the repair because she would then be confirming the other party's responsive utterance. Are these anticipated effects consistent across different domains and different tasks?

As the answers to these questions emerge, we expect that spoken language systems will be able to incorporate increasingly sophisticated models of acknowledgment that will lead to dialogues that display the naturalism and robustness of "ordinary" conversation.

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