

Pragmatics and Agent Communication Languages

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August 3, 2006

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Problem Statement

- Pragmatics as a discipline is an important part of the study of natural language and human communication (Szabó 2005). Its successes have influenced those working on Agent Communication Languages (ACLs).
- *The Problem:* Equivocal use of terminology across the traditions has spawned criticism that threatens to impede the flow of influence, to the detriment of both ACL pragmatics (ACLP) and natural language pragmatics (NLP).
- *The Proposal:* By supplying a systematic, structural account of NLP that can serve as an interface between NLP and ACLP, we can dissolve the criticism and keep the flow of influence obstacle free.

Background #1: NLP

- ‘Pragmatics’ was introduced alongside syntax and semantics by Charles W. Morris. These can be understood as different levels of persistence across utterance events.
- It concerns the use and interpretation of language; more specifically, it is the study of those aspects of utterance meaning that do not reduce to the strict, non-contextual truth conditions of the sentence uttered.
- These aspects constitute *pragmatic content*, which is introduced by the speaker into what is typically an episode of communication, to be decoded by the listener. (It is sometimes referred to as “speaker meaning”.)
- This content depends on the speaker, listener, the utterance, and the context within which the utterance is produced.
- Pragmatics is often cashed out in ways that depend on mental states, but this is not essential to NLP.

Background #2: ACLP

- ACLs serve as the media for information exchange between agents acting in pursuit of goals. These exchanges are complicated by a number of factors, including linguistic complexity, resource limitation, and epistemic incommensurability.
- Pragmatics promises assistance with these. Adding structure to ACL communication at the level of use provides a vehicle for *implicit* information, supporting inferences that decrease linguistic complexity and increase efficiency.
- ACLs, such as later version KQML, Arcol, and COLA, emphasize pragmatics. They realize pragmatics in the form of *speech acts*, typically drawn against a mentalist background.

Considering Singh

- In “Agent Communication Languages: Rethinking the Principles,” M. Singh argues for a *social agency* model that replaces individualism and mentalism with socialism and behaviorism as the foundation for ACL semantics.
- Instead of modeling communicative exchanges with a BDI architecture, Singh recommends thinking of agents as members of societies, individuated by protocols, in which the agents play specified roles.
- So conceived, ACLs would be more flexible, public, and complete, increasing both design and execution autonomy.

Singh's Argument

- P1. ACLs should be flexible, conventional, public, and complete.
 - P2. Certain prominent ACLs emphasize *pragmatics* by imposing “considerations external to the language proper” as constraints on the application of the language (Singh 1998, 42).
 - P3. If an ACL is pragmatic, then it imposes constraints that depend on a prior commitment to mentalism.
 - P4. If an ACL is mentalist, then:
 - it is not flexible, since it depends on satisfaction of a number of mentalist constraints (e.g., being cooperative, believing what you say, etc.).
 - it privileges personal meaning, cashed out in terms of mental states, over conventional meaning.
 - it will be private, dependent on the perspective of the speaker, and not public.
 - It will be incomplete, covering only a limited number of applications.
 - 5. Given P1 and P4, an ACL should not be mentalist.
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- 6. Given P3 and 5, an ACL should not be pragmatic.

Interpreting Singh's Argument

- In the wake of this argument, Singh recommends that we “avoid pragmatics” and “consider context”, among other things (45).
- The target of this recommendation is the designer who wishes to create an ACL that supports message verification in contexts where cooperation cannot be assumed. If the ACL is dependent on the satisfaction of mentalist pragmatic requirements, this will in general be unverifiable, rendering the ACL inapplicable. Here, ‘pragmatics’ does not include speech acts, but rather constraints on their use.
- From the perspective of NLP, though, this is a mistake—both the mental and social models are thoroughly pragmatic. To the practitioner of NLP, the call to “avoid pragmatics” and “consider context” is incoherent.

The “Two Worlds” of Pragmatics

- *World 1: NLP*
 - Natural language analysis is the original home of pragmatics, giving rise to areas such as Speech Act Theory, Discourse Analysis, Relevance Theory, etc.
 - In NLP, the principal dimensions are *truth* and *context*. An element of meaning is pragmatic just in case (a) it is not a constituent of the *truth condition* of an utterance but is nevertheless a part of what is communicated, or (b) it is dependent for its expression on context; otherwise, the element is semantic (Bach 2004).
 - These dimensions are (arguably) orthogonal, generating significant debate about the logical geography of semantics and pragmatics.
 - *Opening Question*: Does the element of meaning attach to the sentence type or the sentence token, produced as an utterance in context?

The “Two Worlds” of Pragmatics

- *World 2: ACLP*
 - Pragmatic elements have been borrowed from NLP and introduced into ACL design, typically to enhance positional languages by increasing linguistic efficiency.
 - In ACLP, the principal dimensions are *mental states* and *communication environment*. The former are used in formal models of the agents and serve to frame sincerity (e.g.) as a constraint on agent communication, while the latter constrains the legitimacy of certain message types. (The latter is not necessarily *context*, formally understood.)
 - An element of meaning is pragmatic just in case it (a) concerns the use and/or interpretation of a message by the participating agents, and (b) is data drawn from the environment and so goes beyond the language; otherwise, it is semantic.
 - *Opening Question*: Does the element of meaning require identification of a non-linguistic environment via the underlying communication intention?

Examining the Worlds

- *Points of Contact:*
 - There has been acknowledged interchange between NLP and ACLP.
 - Both take pragmatics to concern the use and interpretation of language.
 - Both acknowledge the relevance of the agents, the utterance, and the context.
- *Points of Conflict:*
 - The direction of fit between language and theory is different.
 - Context is controlled in ACLP and uncontrolled in NLP.
 - Speech acts (e.g.) are pragmatic in natural language analysis and semantic in ACL analysis.

An Interface for NLP and ACLP

- There are significant differences between the way in which ‘pragmatics’ is used in NLP and ACLP.
- Were there no interaction between these domains, this would not be a problem; however, the ACLP literature is rife with references to classic work in NLP that has influenced ACL design decisions.
- Given this, careful investigation into the points of contact and conflict would appear necessary so as to align the models on both sides of the divide.
- We offer an interface that can be used to align NLP and ACLP, thereby clarifying just where pragmatics can help and where it can hurt.

The Pragmatics Wastebasket

- Focusing on NLP, we find that pragmatics is often used as a “wastebasket”, collecting in a non-systematic way any aspect of meaning that cannot be integrated into one’s semantic model (Kadmon 2001). The result is a collection of topics without a clear structure:
 - Speech Acts
 - Communicative Inference
 - Context Sensitivity
 - Presupposition
 - Focus
- Pragmatics is used in a similar way in ACLP, although the contents are different.
- We supply a framework that systematizes this motley collection and serves as an interface between NLP and ACLP.

The Interface Model

- We take utterances to be temporally extended events involving the production of linguistic items by agents in context.
- Thus, utterances comprise four elements:
 - A context
 - An event
 - A linguistic item
 - An agent
- *Pragmatics* concerns those aspects of the total significance that are not attributable to the linguistic type that is instantiated in this event.

Interface #1: Context

- This is the general environment within which the utterance occurs.

Dimensions of Context / Types of Context	<u>Internal</u>	<u>External</u>
<u>Linguistic</u>	Previous utterances produced by agent of U .	Previous utterances produced by other agents in C .
<u>Individual</u>	Psychological set of the agent of U .	Psychological sets of the other agents of C .
<u>Social</u>	The conversation C that contains U .	The cultures and institutions that involve C and its agents.

Interface #2: Event

- This is taken to be a temporally extended causal process.
- As such, it is constrained by a variety of causes:
 - *Structuring causes*: these include causal factors that are necessary for **U** but are not sufficient for it. These are found at all levels of context.
 - *Triggering causes*: these are the causal factors that are directly and immediately responsible for setting the event in motion. These are located in the individual internal context and include specific psychological attitudes execution of which yield **U**.
- Its temporal extension is individuated by the linguistic item uttered.

Interface #3: The Linguistic Item

- An utterance event involves the production of a linguistic item.
- The linguistic item produced is a token of a type, and semantic analysis will focus on what aspects of the total signification associated with the utterance are attributable to the type.
- The item token is individuated in the first instance either phonologically or graphically, in the second syntactically, and then semantically, where these are understood as different levels of persistent structure.
- This item will often be a sentence, but it need not be.
- We can think of this as the content of the *locutionary act*.

Interface #4: Agent

- The agent **A** produces the event in context.
- Thus, it is **A** that connects context to event, binding them together into an utterance.
- We can understand the agent *individually* or *socially*:
 - *Individual agents*: An individual agent produces **U** by executing an intention contained in its psychological set.
 - *Social agents*: A social agent produces **U** as part of a social performance, conditioned and constrained by the roles that constitute a specific communication protocol.
- One can take either of these to be the unit of analysis in pragmatics.

Conclusions #1: Unification

- The model is underspecified and preliminary, but as described, it provides a foundation for both semantic and pragmatic analysis.
- It also supports unification of the pragmatic topics identified above:
 - In focusing on utterances, we make speaker meaning central, thereby building speech acts into the model from the start.
 - Context is equally basic, enabling context sensitivity as a path to efficiency and flexibility.
 - Presupposition is a structuring cause of **U**, as seen from the individual context.
 - Conversational inference is an interpretive effect of **U**, seen from the individual context.
 - Focus is a mode of **U**, associated with its phonological profile.

Conclusions #2: Systematization

- The model also supports systematic alignment of NLP and ACLP.
- *Difference in Emphasis:* The semantics/ pragmatics distinction in natural language analysis lines up with the content language/ACL distinction in ACL design. The semantics/pragmatics distinction in ACL design lines up with different levels of pragmatic analysis in natural language analysis.
- *Comprehension:* The Interface Model accommodates the content language/ACL/conversation policy distinction without loss.
- *Lessons for NLP:* The semantics/pragmatics distinction could be perspectival, with the former applying to whatever level you happen to be formalizing and the latter to aspects that are contextual.