

Modelling Language in Interaction

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Dialogue Modelling

My area of research falls under the heading of **Dialogue Modelling**:

- a fairly new field at the interface of (computational) linguistics, artificial intelligence, psychology, cognitive science, . . .
- concerned with language as it is used in conversation.

In particular, my interests focus on the semantic, pragmatic, and coordination-related aspects of dialogue. Methodologically:

- interest in empirical evidence (from corpora or experiments);
- interest in computational methods of enquiry and evaluation.

Research area connected to both the **Logic & Language** and **Language & Computation** groups at the ILLC.

Outline

- Brief overview of key aspects of dialogue modelling.
- Focus on a particular study of a phenomenon characteristic of language in interaction.

Language in Interaction

- Traditionally, (computational) linguistics has focused on analysing isolated sentences or written text.
- Dialogue Modelling is concerned with designing formal systems that model aspects of **conversation** – the most basic setting for **language use**.
- Conversation is a form of **interaction** and brings in extra challenges.
- Crucially, it involves **multiple participants**, which requires **coordination**.
 - * **content** coordination: utterances in a dialogue are connected to form a coherent discourse; speakers need to avoid misunderstanding.
 - * **interaction** coordination: turn-taking (who speaks when) and integration of language with other modalities (gestures, gaze, ...)
- The study of language in interaction is directly relevant to research on **Dialogue Systems**: artificial agents that can communicate using natural language.

Dialogue Modelling and Dialogue Systems

- Two different lines of research in the field of dialogue systems:
 - * an **applied**, engineering oriented line, that sees DSs as interfaces that are useful to get some tasks done
 - * a **theoretical**, foundational line, that sees DSs as computational models of language-capable agents and hence as tools for understanding human communication (cognitive science)
- Same dichotomy in AI, Computational Linguistics, etc.
- Like other computational models, DSs can make theories of particular conversational competences testable.
- DSs are **end-to-end agents**: they need to say something about all levels of language processing, from perception to understanding and production.
- Implementing DSs forces us to make decisions on how to deal in an operational way with aspects related to language use
~> *computational pragmatics*

A Dialogue Transcript

From Levinson (1983) on Conversation Analysis (Schegloff 1972).

B: I ordered some paint from you uh a couple of weeks ago some vermilion
A: Yuh
B: And I wanted to order some more the name is Boyd
A: Yes // how many tubes would you like sir
B: U:hm (.) What's the price now eh with V.A.T. do you know eh
A: Er I'll just work that out for you =
B: = Thanks
(10.0)
A: Three pounds nineteen a tube sir
B: Three nineteen is it =
A: = Yeah
B: E::h (1.0) That's for the large tube isn't it
A: Well yeah it's the thirty-seven c.c.s.
B: Er, I'll tell you what I'll just eh eh ring you back I have to work
out how many I'll need. Sorry I did- wasn't sure of the price you see
A: Okay.

Levinson (1983) *Pragmatics*, Cambridge University Press.

Schegloff (1972) Sequencing in Conversational Openings. In *Directions in Sociolinguistics*, pp. 346–380.

Another Dialogue Transcript

From the British National Corpus (KP5):

A: Did you get your tickets for Crowded House?

B: No!

There is not one ticket left in the entire planet!

So annoying!

C: Where for?

B: Crowded House.

My brother is going and he doesn't even like them.

A: Why doesn't he sell you his ticket?

B: Cos he's going with his work.

And Sharon.

A: Oh, his girlfriend?

B: Yes.

They are gonna come and see me next week.

A: Not Sharon from Essex?

B: No, she's Sharon from <laughing> Australia.

A: Oh, alright then.

B: That's the only reason I forgive him.

<laughing> Cos she's not born in this country!

Burnard (2000) *Reference Guide for the British National Corpus (World Edition)*, Oxford Univ. Computing Services.

Grounding, Feedback & Meta-communication

- During conversation, participants need to coordinate their interaction and make sure they understand each other.
- They need to give explicit **feedback**, signalling understanding or else requesting repair.
- **Grounding** is the process by which participants reach mutual understanding (Clark & Schaefer 1989, Clark 1996).
- Grounding takes place at a **meta-level**:

communicative acts	meta-communicative acts
B: I ordered some paint from you...	A: Yuh.
B: and I wanted to order...	
A: He's going with Sharon.	B: Oh, his girlfriend?
A: They are gonna come next week.	A: Yes.
A: There's not one ticket left.	B: Where for?
A: My brother is going...	A: Crowded House.

Clark & Schaefer (1989) Contributing to discourse. *Cognitive Science*, 13:259–294.

Clark (1996) *Using Language*. Cambridge University Press.

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Dialogue vs. Discourse

Language in spoken dialogue has characteristic features. For instance:

According to the British National Corpus word frequency lists:

	spoken dialogue	written discourse
I	30k p.mil. (the most freq.)	9k p.mil. (16th most freq.)
you	27k p.mil. (2nd most freq.)	7k p.mil. (20th most freq.)
it	25k p.mil. (3rd most freq.)	11k p.mil. (10th most freq.)

- In discourse, most pronouns are **anaphoric**: they refer to entities that have been introduced previously into the linguistic context.

(1) **The Prime Minister of New Zealand** visited the US **yesterday**.
This was the first time **she** had come to New York since 1998.

- In dialogue, the most common pronouns are **exophoric** (deictic): they refer to entities in the extralinguistic dialogue situation.

(2) A: **I** think the application needs to be sent in by next week.
B: Yes, **I** know. Could **you** please take care of that?

First & Second Person Pronouns

Classic picture of deictic/indexical personal pronouns:

- First person pronoun **I** refers to the speaker – OK.
- Second person pronoun **you** refers to the hearer – really??

The 2nd person English pronoun **you** has different interpretations, which often correspond to different pronouns in other languages:

- (3) Sometimes **you** have meetings where the decision is already taken.
Soms heeft **men** bijeenkomsten waar de beslissing al genomen is.
- (4) Do **you** want an extra sheet of paper?
Wil **jij** / Wilt **u** een extra blaadje?
- (5) Hope **you** are all happy!
Ik hoop dat **jullie** allemaal blij zijn!

What are the factors that play a role in disambiguating ‘*you*’?

- interesting linguistic question
- useful for machine translation, automatic summarization, information extraction, addressee detection (e.g. in human-robot interaction), ...

Investigating English 'you' in Multi-party Dialogue

Sketch of the methodology employed in our study:

- 1) Corpus of utterances containing the pronoun 'you'.

Ca. 1000 utterances randomly taken from the AMI Meeting Corpus: freely available corpus of dialogues among 4 participants, containing transcriptions, audio, and video. [corpus.amiproject.org]

- 2) Each 'you' instance is manually annotated with an interpretation:

generic / deictic plural / deictic singular – referent

↪ These are the dependent variables we want to be able to predict.

Distribution in our data set:

generic	plural	singular
49%	18%	33%

Investigating English ‘you’ in Multi-party Dialogue

Sketch of the methodology employed in our study:

- 3) We consider several factors (features of the utterance containing the pronoun and of the dialogue context) that may play a role in the disambiguation. \rightsquigarrow These are the variables we'll use for prediction.
- 4) We try to automatically predict the right interpretation of ‘you’ given the features taken into account.
 - * To address the linguistic question, we investigate the predictive power of each factor.
 - * To assess how useful this would be for applications, we calculate the accuracy achieved in disambiguating the pronoun.

Frampton, Fernández, Ehlen, Christoudias, Darrell, & Peters (2009) Who is You? Combining Linguistic and Gaze Features to Resolve Second-Person References in Dialogue. *Proc. of EACL*, Athens, Greece.

Fernández, Frampton, Peters, & Purver, Second-Person Pronoun Resolution in Multi-party English Dialogue. Manuscript under submission.

Generic Uses

What factors contribute to assign a generic interpretation to 'you'?

- The **dialogue act** type of the utterance containing the pronoun: generic uses rarely appear in questions (although they may (6)-(7))
- Generic uses are more common in **hypothetical/conditional** contexts (9) and in those utterances containing **frequency adverbs** like '*always*', '*usually*', '*often*' (8)
- **Prosody**: generic uses tend to have lower average pitch.
- These are not hard rules, but defeasible constraints.

Some instances annotated as "generic" in our data set:

(6) How do **you** wear this thing?

(7) Um, how many solar cells do y- do **you** need?

(8) Often **you** need to know specific button sequences to get certain functionalities done.

(9) If **you** submit the application by November **you** get a discount.

Deictic Uses and Participant Roles

Can we stick to the classic picture that deictic uses of 'you' refer to the hearer?

- Goffman criticises the inadequacy of the classic speaker-hearer dyadic model and proposes a finer-grained classification:

All hearers that perceive a speech act have some participation status:

- * **unratified** participants: do not participate in the conversation
overhearers and **eavesdroppers**
- * **ratified** participants: those allowed to participate in the conversation
addressed recipients and **unaddressed recipients**

- According to Goffman, addressed recipients or **addressees** are:

those participants “oriented by the speaker in a manner that suggests that his words are particularly for them, and that some answer is therefore anticipated from them more so than from the other ratified participants”

Goffman (1981) *Forms of Talk*, University of Pennsylvania Press.

Deictic Uses and Participant Roles

Can we then assume that deictic *'you'* refers to the addressee(s)?

- Perhaps more appropriate to say that it refers to a subset of an utterance's addressees:

Addressed to a group:

(10) Tomorrow we can all discuss the report *you*_[sg] sent.

- In our context (4-party meetings) all hearers are ratified participants: distinguishing between **addressed** and **unaddressed** ratified participants can be tricky:
 - * low inter-annotator agreement deciding whether there is only 1 addressed participant or more (annotators \approx overhearers)
- Not surprisingly, disambiguating between **singular** and **plural** interpretations of *'you'* is not easy ...

Singular vs. Plural 'you'

What factors contribute to interpret 'you' as plural or singular?

- Obviously, some **lexical clues**, such as vocative names:

(11) John, I think **you** should take care of the reservations

(12) Do **you** guys have any further questions?

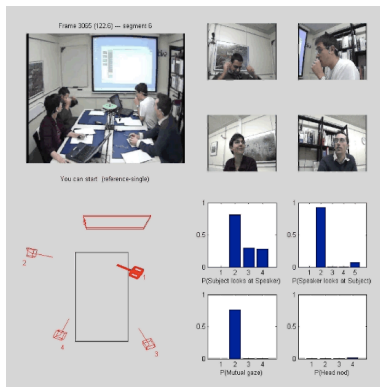
(13) Are **you** all ready?

- Certain **dialogue act** types tend to be addressed to individuals:
 - * especially reactive acts such as (dis)agreeing, clarifying, answering
- There are no reliable prosodic differences in this case.
- What about extralinguistic factors such as **gaze**?

Singular vs. Plural 'you'

Visual focus of attention can be detected automatically from head orientation rather reliably.

- Speakers tend to look at their addressees – specially towards the end of an utterance
- The **speaker's gaze direction** is a great clue to identify the referent of singular 'you'
- When the speaker does not focus her gaze on any participant, the interpretation tends to be plural



Investigating 'you': Conclusions

- Personal pronouns are understudied but very common in dialogue.
- In English, the 2nd person pronoun 'you' is highly ambiguous. What factors play a role in its disambiguation?
 - * Prosody: generic uses have lower pitch.
 - * The type of dialogue act favours particular interpretations.
 - * Some lexical clues favour particular interpretations.
 - * Gaze (and hand-gestures) guide the interpretation of singular uses.
 - * Differences in number may be underspecified in some situations?
- If we were to automatically disambiguate 'you' for practical applications, how well would we do?

Sketch of results (see paper for details):

	baseline	best result
gen./deictic	51% (deic.)	87% (+36%)
sing./plural	65% (sing.)	86% (+21%)
sing. referent	56% (prev. spk)	86% (+30%)

Summing Up

- Dialogue modelling is an interdisciplinary research area that aims at modelling aspects of conversational interaction.
- As a field of study, it is amenable to empirical, formal, and computational analyses.
- This is only a brief sketch of the topic. If you want pointers to further references on dialogue modelling, please contact me.
- Some resources:
 - * **SIGdial**: www.sigdial.org
Conference of the Special Interest Group on Discourse and Dialogue
 - * **SemDial**: www.illc.uva.nl/semdial
Workshop Series on the Semantics and Pragmatics of Dialogue
 - * **Dialogue & Discourse**: www.dialogue-and-discourse.org
New international online journal