Introduction to Cognitive Science: Notes

VIII: Discourse is Transparent to Planning

- Readings for this section: *Power 1979:107-130.

VIII: Discourse is Transparent to Planning

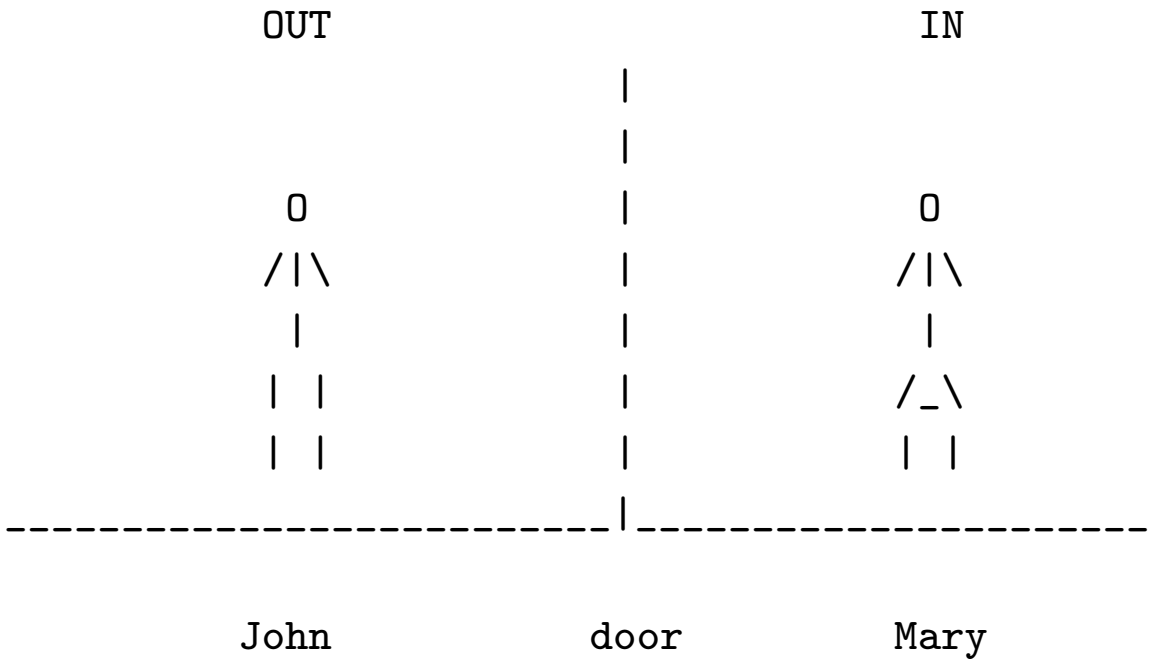
- Discourse meaning arises from the interaction of sentence semantics or literal meaning with the context and mental state of language users.
- Discourse meaning is essentially *dynamic*: one sentence *changes the context* in which the next sentence is understood.
- For example, by saying “Think of a number”, a speaker makes a hearer add a referent to their representation of the things that are being talked about. This referent can act as the meaning of a pronoun. For example, the first speaker can continue: “Square *it*”.
- A *Speech-Act* consists in the use of an utterance by a speaker to make a hearer change their state of mind in this way. Both utterances above are speech acts of *ordering*. *Reference*, such as the act of making a hearer bring to mind a *referent*, such as a number, by using a *referring expression*, such as *it*, is also a speech act.

Speech Acts

- We distinguish between the *proposition* that the speech-act concerns, such as *You thinking of a number*, and the speech-act *type*.
- The most common types of speech acts are *stating*, *questioning*, and *directing*, which are signalled by the declarative, interrogative and imperative constructions *You thought of a number, Did you think of a number? Think of a number!*.
- Austin (1962) distinguished a number of further more specialized speech acts, such as *promising*, *naming*, and *making a contract*. These types are often marked by specific *verbs*, as in: *I promise to pay the bearer £1*, *I name this ship the "Nice Work If You Can Get It"*, and *I do*.
- Notice that these are not statements. For example, they cannot be denied by saying *#No you don't!*

Plan-Based Machine Conversation: Power (1979)

- The Universe:



- The Situation:

1. JOHN is OUT, MARY is IN, the DOOR is SHUT.
2. JOHN can see, MARY cannot.
3. JOHN BELIEVES that if you move, nothing changes.
4. MARY BELIEVES that if you move, and the door is open, you change position.
5. JOHN has the goal of getting IN. MARY has no particular goal.

- The Conversation:

1. JOHN: Mary.
2. MARY: YES.
3. JOHN: I want to suggest a Goal.
4. MARY: GO AHEAD.
5. JOHN: Will you help me get in?
6. MARY: BY ALL MEANS.
7. JOHN: Shall we make a plan?
8. MARY: JOHN.
9. JOHN: Yes.
10. MARY: MAY I ASK YOU SOMETHING?
11. JOHN: Go ahead.
12. MARY: ARE YOU IN?
13. JOHN: No.
14. MARY: SHALL WE MAKE A PLAN?
15. JOHN: OK.
16. MARY: JOHN
17. JOHN: Yes.
18. MARY: MAY I ASK YOU SOMETHING?
19. JOHN: Go ahead.

20. MARY: CAN YOU MOVE?
21. JOHN: Yes
22. MARY: JOHN.
23. JOHN: Yes.
24. MARY: MAY I ASK YOU SOMETHING?
25. JOHN: Go ahead.
26. MARY: IS THE DOOR OPEN?
27. JOHN: No
28. MARY: I SUGGEST THAT WE GET THE DOOR OPEN AND THEN YOU MOVE.

- Note the non-hierarchical, reactive, nature of the dialogue. Johns initial plan gets interrupted by Mary and is never reactivated. It is the *goal* of the conversation that persists and keeps it on track.

1. JOHN: Mary
2. MARY: YES
3. JOHN: I want to explain something.
4. MARY: GO AHEAD.
5. JOHN: If you move, nothing happens.
6. MARY: I DISAGREE. IF YOU MOVE, WHEN THE DOOR IS OPEN,

YOU CHANGE POSITION.

7. JOHN: I see.
8. MARY: I SUGGEST THAT WE GET THE DOOR OPEN AND THEN YOU MOVE.

- After further planning in order to find a way of getting the door open, they construct a plan and John changes position to IN by moving. But its not that simple...

1. JOHN: Mary.
2. MARY: YES.
3. JOHN: I want to tell you something.
4. MARY: GO AHEAD.
5. JOHN: I have moved.
6. MARY: I SEE.
7. JOHN: Lets assess the result of my action.
8. MARY: OK.
9. JOHN: I have changed position.
10. MARY: JOHN
11. JOHN: Yes
12. MARY: I WANT TO TELL YOU SOMETHING.

13. JOHN: Go ahead.
14. MARY: YOU ARE OUT.
15. JOHN: I disagree. I have changed position.
16. MARY: YES
17. JOHN: I am now in.
18. MARY: RIGHT.

- Power in 1979 *Linguistics* gives a complete commentary on this example. See further work: Houghton and Isard (1987); Cassell *et al*. (1994).

Indirect Speech Acts

- The most interesting thing about speech acts is that their effects are rarely if ever confined to their literal meaning.
- If I say “Your shoelace is undone”, stating a true fact about the world that I believe you are unaware of, you are unlikely to merely add the corresponding proposition to your store of knowledge about the world, perhaps murmuring “How true”. In fact, you are likely to take action to change the world in a way that makes it *no longer* true. Of course this was my intention all along
- Thus a speech act of type *statement* has the effect one of type *directive*.
- Speech act theory refers to such utterances as “indirect” speech acts or “conversational implicatures”.

Conversational Implicature

- Grice (1975) explained the effect of conversational implicatures in terms of certain fundamental Principles of cooperative action, of which the most important is the *Maxim of Relation*: “Make your conversational contribution relevant”.
- According to Grice, and followers such as Sperber and Wilson (1986), my utterance “Your shoelace is undone” has its effect because you ask yourself in what way it conforms to Relation, and come up with the idea that it would be relevant if it was really a directive to tie your shoes.
- It seems possible that one could entirely bypass the maxim of Relation and the notion of an indirect directive via a *pragmatic* implicature using an LDEC analysis.

Pragmatic Implicature

- Having your shoes untied entails a danger of tripping. It also affords tying them. Tying your shoes until there is no danger of tripping makes them done.

  (1) $\neg tied(shoes(x)) \Rightarrow danger(trip(x))$

  (2) $\neg tied(shoes(x)) \Rightarrow affords(tie(x, shoe(x)))$

  (3) $\{affords(tie(x, shoe(x)))\} danger(trip(x))$
  $\multimap [(danger(trip(x))?tie(x, shoes(x)))^{+}] tied(shoes(x))$

- I know you know this, so I know that when I tell you your shoes are untied you will realize the danger and do the right thing.

- Thus, Relevance is implicit in the LDEC action representation itself.

Conversational Implicature as Pragmatic Implicature

- The most amusing variety of conversational implicature, first analyzed by Grice (1975) arises when speakers achieve indirect effects by saying things that are blatantly in violation of maxims like Relation:
- For example, suppose you cheat me, and I respond by saying “You’re a fine friend!”. Grice would say that by uttering an obvious falsehood, and flouting Relation, I cause you (by a mechanism that is not entirely clear) to consider the possibility that I mean the *opposite* of what I said, namely that you are *not* a fine friend.
- Again, we can reduce all this to pragmatic implicature from the world knowledge that cheating someone implies not being their friend.

Conversational Implicature as Pragmatic Implicature

- You can always cheat someone, but if someone is your friend, and you cheat them, they stop being your friend:

  (4) $affords(cheat(x,y))$

  (5) $\{affords(cheat(x,y))\} \wedge friend(x,y) \multimap [cheat(x,y)]\neg friend(x,y)$

- When you check the truth of my statement against what you know, you will detect a contradiction and need to do "belief maintenance."
- You will ask why you believe you are *not* a friend to me. The above rule explains that you believe it because you cheated me when you *were* a friend. This makes you feel bad
- I know you know this, and that making you come up with the explanation yourself will make you feel *worse* than if I accuse you directly.
- Again, Relevance is implicit in the plan-based action representation itself.

Interim Summary

Since the grammar describes language as action to start with:

- Language production is planning (and planning is derivation in the grammar)
- Language understanding is plan recognition (this also is just derivation in the grammar)
- Dialogue management is plan-based collaboration (applying directly to the representations delivered by NLG and NLU)
- Competence grammar = syntax, denotational semantics, dynamic semantics (but all processing integrates context and pragmatics)

Interim Summary (contd.)

- It's not surprising that the language faculty is grounded in this way in planning, tool use, and action as a group. These skills have been evolved over a long period, and are what distinguishes primate evolution, and among primates, our own. There is evidence of this at the level of:
  - Representation: The existence of "mirror neurons" in macaques in areas homologous to Broca's in humans shows the lineage of the ability to represent other's actions as equivalent to one's own, and infer from action to goal. (See Sommerville *et al.* 2005)
  - Inference: Mechanisms that take account of object-oriented information when planning and recognizing plans, including such information about others' abilities in this regard (tool concepts, including potentially recursive propositional attitude concepts)
  - Learning: Reward mechanisms for successful knowledge coordination ("peekaboo" games)

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