Corrective feedback and concept updates

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Here are a few examples of "corrective feedback":

A: That's a nice bear.
B: Yes, it's a nice panda.

Abe: I'm trying to tip this over, can you tip it over? Can you tip it over?
Mother: Okay I'll turn it over for you.

Adam: Mommy, where my plate?
Mother: You mean your saucer?

The first one is made up, the others are from (Clark and Wong, 2002).

We are interested in interactions such as these since we believe that dialogue interaction plays an important role in language acquisition (including language change and evolution as well as concept acquisition). Two agents do not need to share exactly the same linguistic resources (grammar, lexicon etc.) in order to be able to communicate, and an agent's linguistic resources can change during the course of a dialogue when she is confronted with a (for her) innovative use. For example, research on "alignment" shows that agents negotiate domain-specific microlanguages for the purposes of discussing the particular domain at hand (Clark and Wilkes-Gibbs, 1986; Garrod and Anderson, 1987; Pickering and Garrod, 2004; Brennan and Clark, 1996; Healey, 1997; Larsson, 2007) .

This paper presents work towards a formal theory of corrective feedback, and semantic coordination in general. It takes a view of natural languages as toolboxes for constructing domain-specific (formal) languages, and provides an analysis of linguistic content which is structured in order to allow modification of, and similarity metrics over, meanings.

According to the idea of natural languages as collections of resources, a "language" such as Swedish or English is really best regarded as a collection of resources (a "toolbox") which can be used to construct (formal) languages. Speakers of natural languages are constantly in the process of creating new language to meet the needs of novel situations in which they find themselves. Arguably, this view goes against some some implicit assumptions in traditional formal semantics. Nevertheless, in our theory we aim to maintain the insights and precision gained from the formal language view.

As an illustration of our approach, we provide an analysis of B's utterance above as a move of offering "panda" as an alternative for "bear", and as potentially triggering an update on A's concept for "bear" and "panda".

The semantic representation formalism we use is based on Type Theory with Records (Cooper, 2005). Without explicating all the details of the formalism, we would like to offer some glimpses of what a formal account of concept updates could look like. We assume that before B's utterance, A's concept of "bear" can be represented as follows

$[\text{bear}]^A_{zoo}=$

$$\begin{bmatrix} \text{REF} & : & \text{Ind} \\ \text{SIZE} & : & \text{size}(\text{REF}, \text{MuchBiggerThanMe}) \\ \text{SHAPE} & : & \text{shape}(\text{REF}, \text{BearShape}) \end{bmatrix}$$

A's take on the situation where B's utterance takes place is

$s^A=$

$$\begin{bmatrix} \text{DOMAIN} & : & \text{zoo} \\ \text{SHARED} & : & \begin{bmatrix} \text{FOO}=obj123 & : & \text{Ind} \\ \text{COM}=\left\{ \begin{array}{l} \text{nice}(obj123) \\ \text{bear}(obj123) \end{array} \right\} & : & \text{Set(Prop)} \end{bmatrix} \end{bmatrix}$$

This is intended to describe a situation at a zoo, where a bear-shaped object much bigger than A is in focus (FOO here stands for "Focused Object").

If we consider A's reasoning after B's utterance, assuming that B has not observed the word "panda" before, A also needs to create a panda-concept $[\text{panda}]^A_{zoo}$. One way that this can happen is that A creates "panda" concept by copying the "bear" concept (including the meaning component associated with the "zoo" domain):

$$[\text{panda}]^A := [\text{bear}]^A$$

Continuing our speculation, we assume A has observed that the use of "panda" in s refers to the focused object in s, and that its colour distinguishes it from previously observed bears. A now creates situated interpretation $[\text{panda}]^A_s$ of "panda", based on s^A and $[\text{panda}]^A_{zoo}$:

$[\text{panda}]^A_s =$

$$\begin{bmatrix} \text{REF}=obj123 & : & \text{Ind} \\ \text{SIZE} & : & \text{size}(\text{REF, MuchBiggerThanMe}) \\ \text{SHAPE} & : & \text{shape}(\text{REF, BearShape}) \\ \textbf{COLOUR} & : & \textbf{colour}(\textbf{REF, BlackAndWhite}) \end{bmatrix}$$

A then revises $[\text{panda}]^A_{zoo}$ with this situated interpretation s $[\text{panda}]^A_s$, which should result in

$[\text{panda}]^A_{zoo}{}' =$

$$\begin{bmatrix} \text{REF} & : & \text{Ind} \\ \text{SIZE} & : & \text{size}(\text{REF, MuchBigger...}) \\ \text{SHAPE} & : & \text{shape}(\text{REF, BearShape}) \\ \textbf{COLOUR} & : & \textbf{colour}(\textbf{REF, BlackAndWhite}) \end{bmatrix}$$

The above is a very brief glimpse of a formal account of how concepts can be updated as a result of language use in interaction. Such processes enable coordination of domain-specific microlanguages, or *registers*, involving a domain-specific grammar and lexicon, an ontology (a collection of concepts), and a mapping between lexicon and ontology.

There are many mechanisms for semantic coordination, some of which can be described as "corrective feedback": clarification requests, explicit corrections, meaning accommodation (observing instances of language use and silently adapting to successful instances) and explicit negotiation. Semantic coordination, in turn, is a kind of language coordination (other kinds include e.g. phonetic coordination). Finally, language coordination coexists with information coordination, the exchanging and sharing of information (agreeing on relevant information and future action; maintaining a shared view on current topics of discussion, relevant questions etc.). Arguably, the main point of language coordination is to enable information coordination.

Semantic coordination happens in dialogue; it is part of language coordination; and it is a prerequisite for information coordination. If we say that a linguistic expression c has meaning only if it is possible to exchange information using c, then semantic coordination is essential to meaning. A linguistic expression c has meaning in a language community when the community members are sufficiently coordinated with respect to the meaning of c to allow them to use c to exchange information. In other words: meaning emerges from a process of semantic coordination in dialogue.

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