Anger is heat - conceptual metaphors of emotions in a robotic study

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Abstract: Natural language processing requires not only background knowledge but also a sense of feelings. It is difficult for artificial intelligence to understand the natural feeling. In psychological viewpoints, emotions have changing nature to be transmutative states, like liquid in a container. A clue to treat it in an artificial way can be found in linguistics, which means that word sense disambiguation and semantic polysemy are treated to make a consistent representation of the concept in the form of category and metaphors. Throughout recent research studies of agent-based universal color categories, we explore a way to treat emotional feeling and expressions in the framework of human-robot interactions.

Keywords: composite categories, cognitive universals, cross-cultural similarities, brain-Inspired robotics, linguistic relativism

1. Introduction

Without the same physiological structure and nature of humans, sensations and emotion may not be created inside artificial systems. In the history, intelligence was an ideal goal of comprehensive ability for thinking based the logical reasoning. However as Antonio Damasio [1][2] suggested, sensations and emotion are necessary parts to consist the intelligence. Interestingly, we found various representations on sensations and emotion in literature, and the divergence of words has been applied to explain a situation of what happens currently and a person attempt to do something against, in a form of linguistic metaphors. In an agent-based study, Belpaeme and Bleys (2005) [3] tackled this kind of problem by focusing on "universal color categories," which is inspired from the question of how different persons share the same name of colors [4][5][6][7]. There is no guarantee of the existence of color recognition processes a priori in the brain. People receive cultural influences and accumulate their own personal histories from their childhood. Thus, they consider that what we share is a link or map from stimuli (in a context) to the internal representation as a specific color name. Name is not the point but the process of making a new category (as a name of concept) is the important point. Such actions to recognize something and name is a solution of how we establish an universal representation sharing with others, which originally comes from personal feelings or internal representations.

2. What Robots Can Do and Cannot Do

Tripathi et al. [8][9] discussed on their articles of how difficult is it for robots to know threats and risks without biological feelings. Children develop to be intelligent by acquiring the ability to know or link between indefinable uncomfortable senses and interpretable stories, even if it is a guess and myth. To maintain home safety [9] has a similarity on the theory of universal color categories, in the viewpoint of making a map. If self-learning can be simplified as a map formation, even includes fluctuations and dynamical change depending on the task and environmental relationships, the process of making a new category is of interest because it may reach a point beyond conventional neural networks to determine a N-hyperplane for data segregation.

3. Category and Metaphor in Language

Belpaeme and Bleys (2005) [3] focused on the universal color categories obtained from a constrained acquisition process. They noted that human perceptual categories exhibit a remarkable cross-cultural similarity and denied innate representation and innate developmental program. From available experiences and evidences, they offered an alternative explanation of how it realizes, such as the universality of color categories based on linguistic transmission that is constrained by universal biases. They proposed a computational model to test the hypothesis (Table 1 and 2) and demonstrated a similar emerging process as the cultural acquisition of color categories with an appropriate (not weak and not strong; to be mild as they said) constraints on perceptions and categorical representations.

We attempt to consider an extension of the model to the human-robot communication to share a feeling in the shared space and task (Figure 1).

FIGURE 1 A Scene of Human-Robot Communication

4. Concluding Remarks

We attempted an extension of the model by Belpaeme and Bleys (2005) [3] for human-robot verbal communications, including two aspects: 1) guessing a hidden topic and specify a map presumably a similar map between the robot and the human counter part, 2) moving from a topic to another topic as a exploration process in conversation, which we do usually for understanding a common framework surrounding topics. We hypothesized that the two actions are a minimum set of sharing processes to communicate each other and building the internal representation on a concept. Conceptual metaphor is a clue.

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1: Agent A chooses a topic o_t from the context $O = \{o_1, \cdots, o_N\}$
2: Agent A perceives each stimulus in the context by constructing an internal representation for it: $\{o_1, \cdots, o_N\} \rightarrow \{r_1, \cdots, r_N\}$
3: For each internal representation r_i, the best matching category is found. This is the category which has the highest output for r_i of all the categories available in the category repertoire of A and which we will denote by $c_i: \{r_1, \cdots, r_N\} \rightarrow \{c_1, \cdots, c_N\}$
4: If the best matching category for the topic is unique: count$(c_t: \{c_1, \cdots, c_N\}) = 1$, the game succeeded, otherwise it has failed.
5: If the game failed, the agent adds a new category or adapts the best matching category c_t

TABLE 1 Procedures in Discrimination Game (A, O) by Belpaeme and Bleys (2005) [3]

speaker A_S		hearer A_H
Choose topic o_t		
plays the Discrimination Game for o_t		
the Discrimination Game succeeds and return c^S		
utters t^S	$\rightarrow t^S \rightarrow$	hears $t^S = t^H$
		finds category c^H for t^H
		finds o_h closest to c^H
see o_h	$\leftarrow o_h \leftarrow$	points to o_h
$o_t = o_h$		
update s^S using $\begin{cases} s_{ij} = \min(s_{ij} + \delta, 1) \\ s_{kl} = \max(s_{kl} - \delta, 0) \end{cases}$ in row i		
and column j with $k \neq i, l \neq j$. (Eq. 1)		
points to o_t	$\rightarrow o_t \rightarrow$	see o_t
		update s^H using Eq.1
		adapts category c^H to r_t using $c_t \leftarrow c_t + \alpha(r_t - c_t)$ (Eq. 2)

TABLE 2 Algorithm of Guessing Game (A_S, A_H, O) by Belpaeme and Bleys (2005) [3]

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