An Adjective-Based Embodied Knowledge Net

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Abstract. As the findings about the embodiment of language comprehension and some difficulties in the existing models of metaphor processing, this paper presents an adjective-based embodied cognitive net, which constructs the comprehension of knowledge in a novel view. Different from the traditional way that takes concepts as the core of knowledge comprehension, this paper views the emotions as the core and the motive power that human beings knowing the world. It is claimed that the adjective is the carrier of emotion in this paper, rather the concept. From the very nature, while getting a new thing, the first thing that comes to human's mind are the original descriptions(usually are adjectives) and then are the concepts. Thus, this paper constructs a net based on adjectives from concrete to abstract according to the embodiment. In this knowledge net, nouns are contained as the attachment to construct a mapping between adjectives and concepts.Specially, this paper gives the embodied emotion to the adjective to deal with the emotion inference and metaphor emotion analysis in the future work.

Keywords: adjective, emotion, embodiment, knowledge net.

1 Introduction

1.1 Embodiment

Recent researchers in cognitive science claim that knowledge obtaining and comprehension are embodied. [1] presented "embodied philosophy" and "embodied mind" and gave three hypothesis about embodiment:1)Mind is embodied; 2)Thought is unconscious; 3) The abstract concepts are mostly metaphorical. Lakoff emphasized the foundational effect of mind and cognition and claimed that the body, brain and environment are the cognitive basis of human's inference. This is the *embodied realism*, which holds the view of that the human's body is under a interaction related to their concept system. Based on the *embodied realism*,[2] pointed the effect of body's sight and action system to the cognitive language. [3] claimed that it is necessary to know the world with human's body. Since then, embodiment has been applied into language comprehension. [4] presented the embodied semantics and pointed that the language containing

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phonology and grammar is embodied. [2] discussed the embodiment of syntax in the view of the real world events. [5] considered that the specific events are converted to some abstract stories with the help of sensory modalities and body action, which are the basis of syntactic structure.

1.2 Emotion

Emotion is a controversial topic in psychology research.It is a basis of forceful conversation and divergence according to the earliest philosophers up to the present day [6]. As the development of NLP, the emotion of textual data is becoming more and more important and how to classify emotions in a large-scale text is becoming one of the topic in text analysis. [7] gave an emotion recognizing method by knowledge based artificial neural network. [8] gave an approach in estimating textual emotion using keywords based on searching. As the importance of metaphor in NLP and the findings in cognitive science, researchers realize that the metaphor is emotional and it is essential to contain emotion analysis in metaphor processing. Emotions in metaphorical expressions also reflect the cognitive nature of metaphors.

This paper constructs a novel adjective-based knowledge comprehension net in a view of embodiment. Different from previous work, this net focus on the embodiment of adjectives. We consider that during the process of human being knowing the world from childhood and the improvement of human society, adjectives gather human's cognition to the whole world. Given a new thing, human beings firstly come up with the descriptions of it ,which are usually adjectives instead of nouns. Thus, we claim that adjectives are more embodied than traditional point of concepts (nouns).

As human's cognition to the world is emotional, we consider that the adjectives are apparently emotional. Different from the traditional way that divides emotions into six primitive types (i.e. joy, love, surprise, anger, sadness and fear [9] or simply into negative, positive and neural, we quantify it with fuzzy value according to the adjectives' embodiment. We only give emotion values to the basic node adjectives in our net and the emotion values of deep node adjectives are obtained by emotion reference.

2 The Method

2.1 Our Viewpoint

Compared with the traditional view that concepts(nouns) are the basis of humans' cognition to the world, we hold that emotions are the core and motive power for human to know the new thing and whole world.Human beings contain these emotion in the descriptions(usually adjectives) of the things. Given a new thing, it is the descriptions which contain emotions that come up to humans' mind and then construct the concepts step by step. As to concepts, we view them as the attachments to adjectives(As showed in Figure 1).

Fig. 1. The central importance of emotions in humans' embodiment system and the relationship between emotions, adjectives and concepts(nouns)

2.2   Some Hypothesis

To construct such a knowledge net, we propose some hypothesis:

1) It is the adjectives that are the basis of humans' embodiment in knowing the world instead of concepts.

2) Humans' embodiment is from basic to esoteric. Originally, human beings know the world based on their embodied senses and then their imagination takes them to the deeper cognition.

3) Adjectives are the initial embodied descriptions to the new things and induce the appearance of concepts.

4) Emotions are contained in adjectives and they can be under the inference.

2.3   The Structure of the Net

According to the theory of embodiment, we consider that the five senses(i.e.tactile sensation, auditory sense, nose, sight, sense of taste) are the basis of embodiment. Thus, we take the adjectives of five senses as the nodes of our net. We employ the most direct sensory adjectives as the basic nodes of the net and expand them to the more esoteric ones as the second and third layers. This kind of expansion is based on the process that human beings knowing the new things from childhood to grow-up. We believe that the process is always deeper and deeper. Initially, when is a baby, a person cannot have any concept in his brain and given a "stone" as instance, the baby cannot know that it is called "stone" .He touches it and feels *adamant* and *cold*, which are the first description of "stone".Then he constructs the concept of "stone" in his mind and then nouns work in the process of cognition.

As showed in Figure 2, we divide the net into three layers: the first layer contains humans' initial descriptions to the given things and they are the first embodied impressions in childhood; the second layer contains more abstract or deeper descriptions and infers that the development of humans' cognition contains some imagination ; the third layer contains the psychological descriptions based on humans' totally imagination and it is the final cognition to the world.

In the first layer, it contains humans' initial descriptions (e.g. Giving a stone to a baby, he must feel it "cold" and "hard" through his tactile sensation and constructs such impressions in his brain, and then he constructs the concepts of "stone", instead of knowing that "it is a stone" at the first time.). Thus, we consider that the adjectives come to one's mind firstly and then concepts,when given a new thing. The adjectives are the motive power for human beings to know the world.
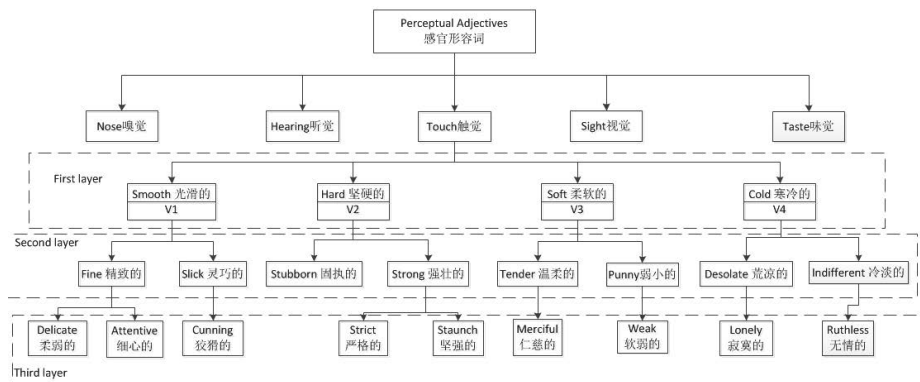
Fig. 2. Net of tactile sensation in five senses: the layer structure and parts of the adjective nodes. v_1-v_4 are the fuzzy emotion values given to the adjectives in first layer.

In the second layer, the adjectives are more abstract than the ones in the first layer and they are induced by the first layer with a little imagination in the process of humans' cognition. As to the third layer, it is totally the production of humans' imagination. Usually, the metaphors arise in these two layers. As showed, we give the fuzzy value of emotions to the adjectives in the first layer and the ones in the second and third can be induced by emotion inference.

Figure 2 is only a small subset of the total net, besides the sense of touch, the other four sense are also contained in our net.

2.4 Nouns as Attachments to the Net

Considering the effects of concepts in the process of humans' cognition, even though we don't take them as the key of this process, we consider that they can be attachments to the adjectives. Same as the emotions, we only give the concrete nouns and the abstract ones can be obtained by inference. As showed in Figure 3.

2.5 Applications and Expansibility

The first and major application of our knowledge net is metaphor comprehension. For instance, giving a metaphorical expression *Woman is water*. We can easily extract the properties of *woman* are " tender , beautiful and so on" and the property of *water* are "soft, cold, smooth and so on" . Apparently, in our net, *soft* is the father node of *tender*, which means the identification of this metaphor is that *Woman is tender*.

With this knowledge net, we realize the inference in emotion analysis of given text. Different from the existing approaches to divide emotions into six primitive types or simply positive, negative and neutral, we give them fuzzy values in the
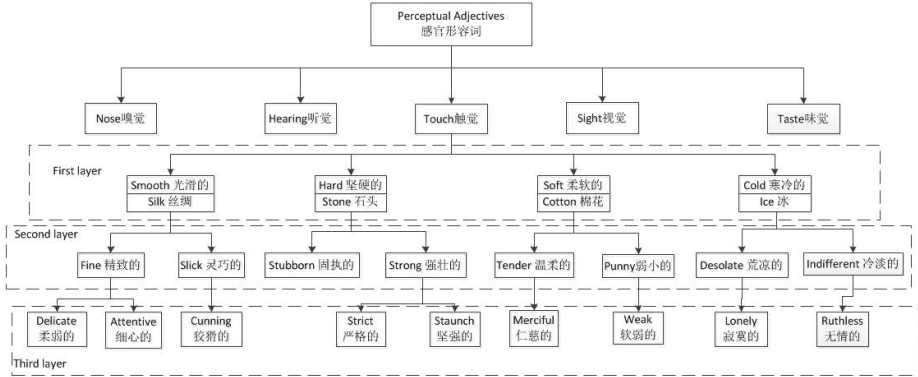
Fig. 3. Concepts as attachments to the adjective net

view of embodiment. The fuzzy values in this paper are not pure meaningless value, but contain semantics which can express the original cause and the development of emotions. Applying such fuzzy values makes it more explicit to emotion inference and emotion computing.

What is more, this knowledge net is not limited by language or culture. It can be expanded to different languages (e.g. Chinese, English), cultures and contexts.

3   Reliability Analysis

3.1   The Reliability of Layers Division

We using MRC Psycholinguistic Database Machine Usable Dictionary (Coltheart,1981) to test the consistency and reliability of our knowledge net. The MRC Psycholinguistic Database Machine Usable Dictionary (Coltheart,1981) includes 150837 words rated with the abstractness by human subjects in psycholinguistic experiments[10].The rating range from 158(highly abstract) to 670(highly concrete). We test the words in each layer of our net with the degree of MRC,and it indicated that the net agree with the human judgement of MRC. Figure 4 gives some examples,among with the numbers are the degree of each word in MRC.

3.2   The Reliability of Adjectives Expansion

We take a online visual thesaurus dictionary-*Thinkmap*[11] to test and verify the reliability of adjectives expansion in our knowledge net.*Thinkmap* is an interactive tool that allows users to discover the connections between words in a visually captivating display and works with more than 145,000 words and 115,000 meanings organized in an innovative and intuitive design. Figure 5 and Figure 6 show the expansion of "smooth" to "fine" and "slick" and then from "fine" and "slick" to "delicate" and "cunning"(which is marked by red dash).That is , the expansion of the adjectives in our net is rational and meaningful.
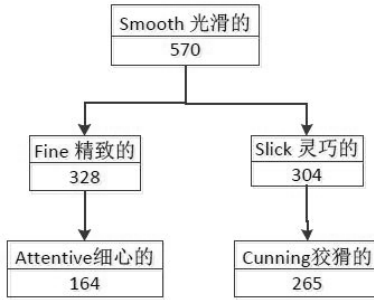
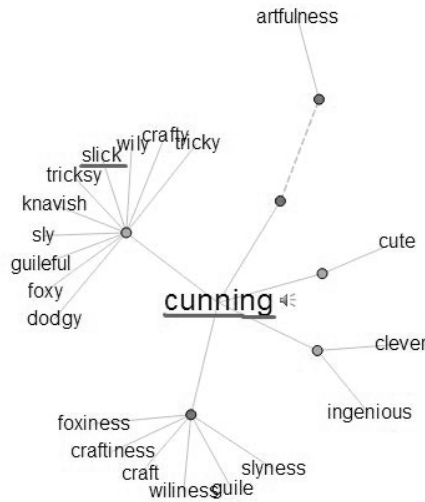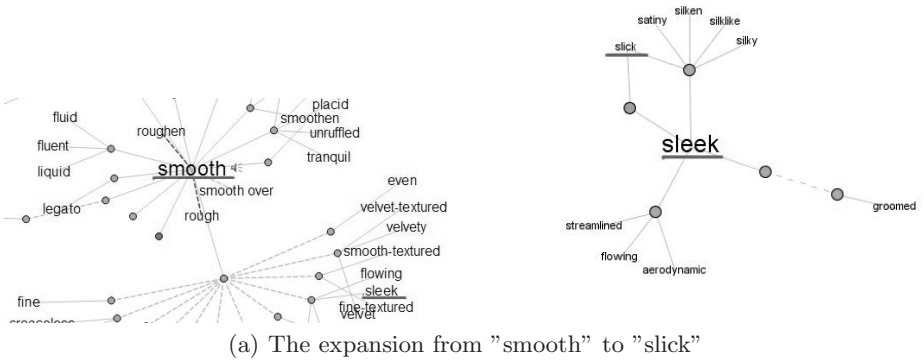**Fig. 4.** Examples of the words in our net tested with the degrees in MRC

(a) The expansion from "smooth" to "slick"

(b) The expansion from "slick" to "cunning"

Fig. 5. An expansion from "smooth" to "slick" to "cunning" in the visual online thesaurus dictionary-*Thinkmap*
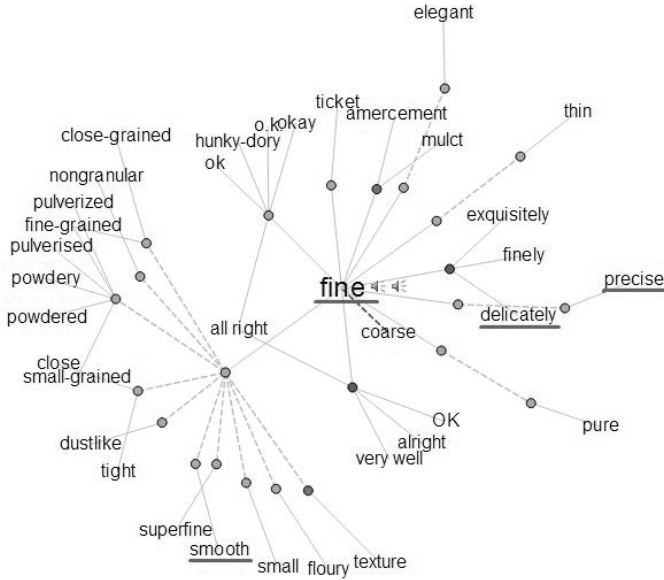
Fig. 6. An expansion from "smooth" to "fine" to "delicate" in the visual online thesaurus dictionary-*Thinkmap*

4 Conclusion and Future Work

We present an adjective-based knowledge net to face the metaphor comprehension ,textual emotion analysis and emotion inference in this paper in a view of cognitive embodiment. Its application on metaphor comprehension does not employ any statistics method or hand-craft knowledge resource, but the embodied cognition to the new things of human beings. This kind of net is not a static knowledge net like WordNet or FrameNet, but a dynamic one which can be expanded with any different culture, emotion or any different context. In the part of emotion inference, we describe the emergent and development of emotions. Within inference, we realize the emotion analysis in text. What's more, we don't employ the existing method to divide the emotion into simply negative, positive or neutral , but qualify emotions with fuzzy values. Thus, emotions will be clearer and easier for us to analyze in the large text. In the future work , it is devoted to construct a metaphor evaluation system with this knowledge net and realize the emotion inference with deep excavation. Also, how to connect nouns with this net more closely is one of our future work.

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