Interpretation of Metaphors with Perceptual Features Using WordNet

Rini Bhatt, Amitash Ojha, and Bipin Indurkhya

Cognitive Science lab, International Institute of Information,
Technology Hyderabad- 500 032, India
rini_bhatt@students.iiit.ac.in, {amitash.ojha,bipin}@iiit.ac.in

Abstract. Metaphors based on perceptual similarity play a key role in stimulating creativity. Here, we present a metaphor interpretation tool using features of source and target to generate perceptual metaphors which might be conceptually very different, thereby generating new interpretations from familiar concepts.

Keywords: Perceptual metaphors, conceptual combination, creative cognition, juxtaposition, conceptual association, metaphorical interpretation.

1 Introduction

"What is creativity?" This question has no universally agreed answer. [1] For our purpose, however we define creativity as the ability to generate ideas or artifacts that are novel, surprising and valuable, interesting, useful, funny, beautiful, etc. According to Perkins "Creativity is not a special 'faculty', nor a psychological property confined to a tiny elite. Rather, it is a feature of human intelligence in general". [2] It rests on everyday capacities such as the association of ideas, analogical thinking, searching a structured problem-space, and reflective self-criticism. Various kinds of creativity have been mentioned in the literature. But broadly there are three ways in which processes can generate new ideas: *Combinational, exploratory* and *transformational*. [3]

We are concerned with combinational creativity, which is the production of novel (unfamiliar, improbable) combinations of familiar ideas. It has been studied in AI by the many models of analogy and by the occasional joke generating programs or database metaphor generation tools. One such system is JAPE, which models the associative processes required to generate punning jokes. Such processes are far from random, and depend on several types of knowledge such as lexical, semantic, phonetic, orthographic, and syntactic [4]. For analogy, most AI models generate and evaluate analogies by exploiting the programmer's careful pre-structuring of the relevant concepts. This guarantees that their similarity is represented, and makes it likely that the similarity will be found by the program [5].

In this paper we present a metaphor interpretation tool using perceptual features of Source concept and Target concept. The tool can help users to generate perceptual metaphors by evoking their ability to make free associations. The tool, in other words, assists users to create unfamiliar association from familiar concepts.

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1.1 Pictorial Metaphors

Metaphorical thinking is known to play a key role in stimulating creativity. In a metaphor, one kind of object or idea is used in place of another to suggest some kind of likeness between them. They serve in making connections between things that are not usually seen as connected in any conventional way. For example, computer science instructors often explain the function of the Control Unit in a computer's Central Processing Unit by saying it is 'the traffic policeman of the computer'. The general use of the term 'memory' to denote computer storage is metaphoric. Thus, metaphors are instruments of divergent processes because they synthesize disparate ideas.

Similarly, in pictorial metaphors two concepts are juxtaposed or replaced to create a unified figure suggesting one concept being described in terms of another. The perceived incongruity in the image invites the viewer to interpret the image metaphorically. Though metaphors have mostly been studied as a literary device, but research on pictorial metaphor has over the past 25 years yielded a few theoretical studies [6], [7], [8], [9].

1.2 Perceptual Similarities in Pictorial Metaphors

We have hypothesized that perceptual similarity between two images at the level of color, shape, texture, etc. helps to create metaphorical associations [10]. Elsewhere we have shown that participants have preference for perceptually similar images in generating metaphorical interpretations. Also they help in creating more conceptual associations between Source and Target [11].

1.3 Computers and Creativity

For creativity a cognitive agent needs to break conventional conceptual associations and this task is difficult for human beings because we inherit and learn, in our lifetime, to see the world through associations of our concepts. It requires a significant amount of cognitive effort to break away from these associations. Computers, on the other hand, do not have such conceptual associations. Therefore it must be easier for the computers to break away from these conceptual association simply because they do not have them to begin with. It follows that computers are naturally predisposed towards incorporating creativity [12].

2 Using WordNet for Generating Metaphorical Interpretation

2.1 Idea and Aim

The present system aims to extract perceptual features of Source concept and Target concept and uses it to anchor conceptual associations between them for a metaphorical interpretation. The larger goal of the system is to be able to generate metaphorical interpretations for an image by extracting perceptual features (for visual: color, shape, texture, orientation, etc, for touch: Hot, cold, rough, smooth, etc.). With the availability of these features, various concepts can be evoked (which are usually

not evoked just by the conceptual description of the object) and as a result distant associations can be generated which may or may not be creative. But as a matter of fact the perception of the creativity lies in the interaction between cognitive agent and stimuli. So, the system can suggest some combinations (that are guided by the perceptual features of concepts and are not arbitrary) using WordNet, which may be seen creative by users.

2.2 WordNet

WordNet is a large lexical database of English, developed under the direction of George A. Miller (Emeritus). Nouns, verbs, adjectives and adverbs are grouped into sets of cognitive synonyms (synsets), each expressing a distinct concept. Synsets are Interlinked by means of conceptual-semantic and lexical relations.

It can be visualized as a graph with edges between words with some relationship (synonym, antonym, part-of, etc.) between them. Such words will, henceforth, be referred to as neighbors bearing the graph analogy in mind. WordNet 2.0 for Linux allows us to feed a word and the relationship (synonym - noun/adjective,etc.) on the commandline and outputs the words which satisfy this relationship - the 'neighbors' of that word. This is exploited while generating metaphors of multi-word sets of perceptual and conceptual features.

2.3 WordNet and Metaphor Generation

There have been various attempts to use WordNet for generating metaphors. [13],[14]. [15]. We take a different approach and try to use perceptual features of concepts to anchor the metaphorical interpretation. The creativity assistance tool generates metaphors for any arbitrary combination of words divided into 2 categories "Perceptual" and "Conceptual". The generated 'metaphors' depend upon certain parameters, for instance, it takes into account, a certain threshold within which to look for neighbors of a word. It also allows for semantic constraint on the metaphors generated. As mentioned, with WordNet, we can find synonyms, antonyms, hypernyms, etc. of a given word. In our tool, we have considered the three mentioned here and any one type or a combination of these in any order can be used to generate interpretations by taking that particular path.

2.4 Threshold

It is important to define this threshold as WordNet is organized as a connected graphand the search will go on infinitely unless a certain threshold value for the number of levels which can be visited for finding relevant words, is specified. Moreover, a word which is related to the given word but is, say, thirty levels away will likely be semantically and relationally dissimilar and therefore, will not satisfy our primary objective of finding different interpretations for the given set of features.

2.5 Anchoring

Since various features are to be considered in the perceptual set as well as the conceptual set, this entire set of features must be taken as a whole to identify

interpretations which are relevant to the entire picture instead of treating the features separately. In order to do this, there is a need to identify ‘an anchor’ word which is closest to the set of all features and serves as the link between them.

This anchoring was done by finding the words up till the mentioned threshold for all the input features and then finding the words common to all the input features,i.e. if the input words (perceptual features) are ‘big’ and ‘red’ then the tool discovers the neighbors till the specified threshold and now from those two lists finds the closest common word.

Once the common word or the ‘anchor’ has been found for both the perceptual features and the conceptual features, these anchor words are used to generate word-pairs. Neighbors of the anchor words are discovered till the specified threshold and these separate interpretations of the perceptual and conceptual anchor are then combined to give P*C two-word phrases as metaphors, where

P = number of interpretations of the perceptual anchor word
C = number of interpretations of the conceptual anchor word.

The user could specify search till 2 levels for relation hypernym and then 3 levels for relation synonym. So here, first hypernyms would be generated till 2 levels and for the words derived, synonyms would be generated till 3 levels.The levels of semantic relations and their order bears significance on the results generated, i.e. whether five levels of hypernym are explored followed by two levels of synonyms or vice versa.

"The heuristic of choosing the first listed sense in a dictionary is often hard to beat, especially by systems that do not exploit hand-tagged training data." [16]. Instead of following a particular method of disambiguation, we have chosen to consider both noun and adjective for perceptual features while only nouns have been considered for conceptual features. This is to allow generation of metaphors from both senses of the word - choosing to limit it to one might detract from the creativity of metaphor generation. Choosing to include nouns while discovering neighbors in case of perceptual features includes a trade-off - we get a wider range of interpretations now which include some that would be have been absent if the word was considered as only noun or only adjective, however, the list would also include some interpretations with a bad similarity measure.

3 Testing and Results

We present an example which illustrates one of the results. In this example, 'red' and 'hot' are entered as the perceptual features. Now the tool seeks to find an 'anchor' for the given perceptual features within the specified threshold (in this example it is 2 levels). Bearing the graph structure in mind, first all the immediate neighbors (of the form synonym-noun and synonym-adjective) of the ‘red’ and the word 'hot' are discovered. This is level one i.e. these words are at distance '1' from the original words entered. From these words, a further level of words is discovered, i.e. the immediate neighbors of level 1 words. From the two lists - one for 'red' and the other for 'hot', the common words are determined. For these words, a common measure of distance from both words is computed. This is calculated as the vector distance between the words 'red' and 'hot' from the common word.

The one with the least such distance qualifies as the anchor word. This graph is a partial representation of the discovery mechanism followed to find the anchor word for perceptual features. After computing the two lists, 'wild' is found as the common word at minimum distance - 2 - as it is a layer 2 word for both 'red' and 'hot'. The words encircled in red color trace the path from 'red' and 'hot' to 'wild'. Thus, 'violent' is a synonym of 'red' and 'wild' is a synonym of 'violent' thereby giving a path from 'red' to 'wild'. Similarly for 'hot', 'raging' and 'wild'. Thus, 'wild' becomes the anchor word for this set of perceptual features. A similar mechanism is followed for conceptual set and a common word is found at the similar level (or at user defined level). Now, once the system has one common word for perceptual features and one common word for given conceptual features, same procedure is followed and list of neighboring words are generated as result for a certain level.

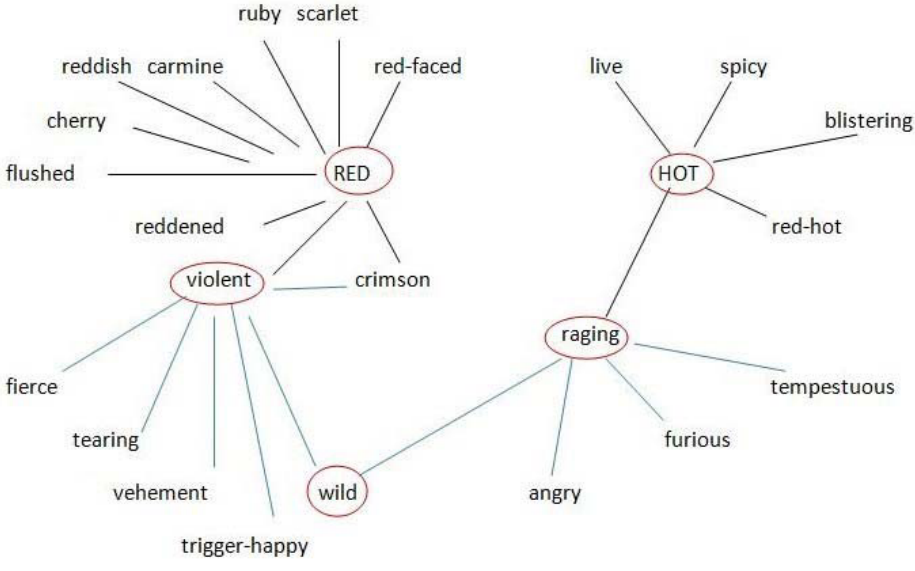

Fig. 1. Graphic representation of an example to find a common word for perceptual features

Further, A user testing was done with some of the results. 10 sets of word-pairs (each containing 50 word-pairs generated by system) were taken as test stimuli. These pairs were produced with 2 levels of synonym and 1 level of hypernym. To generate stimuli two perceptual features and one conceptual feature was used. 7 participants were asked to categories these pairs as 1. Metaphor, 2. Anomaly and 3. Literal. We found that 63 percent of word-pairs were categorized as “metaphor”, 32 percent of pairs were categorized as “anomaly” and 5 percent of word-pairs were categorized as “literal”. The difference between them was statistically significant. $F(2, 12) = 4.14$ $p < .05$. (Figure 2)

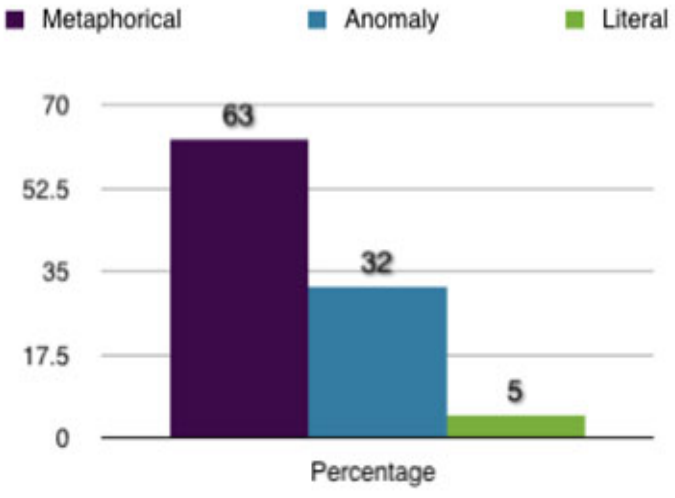

Fig. 2. Categorization of generated word-pairs

4 Limitations and Future Work

The system is in its preliminary stage and has to be developed and tested further. At present it has various limitations: In the system, selection of levels is completely arbitrary and there is no fixed threshold to decide the metaphoricity of word-pairs. Some of the results at the very lower level can be interpreted metaphorically and some can not be interpreted metaphorically at higher level. We plan to solve this problem by measuring the distance between source and target in some conventional metaphors. An average distance can guide us to suggest that at what level chances are high for two concepts to be related metaphorically.

The system aims to extract perceptual features automatically by a given picture using image search engines [17]. But for this users will be asked to tag the object depicted in the image. Image search engine will identify the color of the background, shape of the object, etc and then provide set of perceptual features. These perceptual features combined with conceptual feature/s can be used for further interpretation task.

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