The Logical Analysis of Metaphor Understanding in Context

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Abstract. The research of metaphor understanding is a significant field of cognitive science. Metaphor plays an important role in natural language discourse. There is a close relationship between logic and metaphor. This article, we attempt to describe the process of metaphor understanding in context with the theory of possible world semantics. First, the process of metaphor understanding in dynamic context is described. Then, the relationship among possible worlds, context, and metaphor understanding is explored. Finally, a dynamic context updating mode for metaphor is presented.

Keywords: Metaphor, Context, Logical Analysis.

1 Introduction

In the process of language communication, context and understanding are actually dynamic. So they cannot merely be regarded as a static process. As the language communication is processed, context set will be continuously extended or modified, understanding will be changed. For these which one is misunderstood before maybe understood now. The earlier understanding conclusion may be overturned, but a new understanding conclusion is produced. Therefore, we should consider the process of metaphor understanding in the dynamic context. Hope that we can restore the understanding process with integrity from the perspective of dynamic epistemic logic.

2 The Process Description of Metaphor Understanding in Context

Language understanding is a process of accumulation, fusion, transformation and digestion for the language content and meaning. Because of its own characteristics, metaphor understanding is a complex language understanding. Context is the most important participant in the process of metaphor understanding, and context is dynamically changing, which increases the complexity of metaphor understanding. Therefore,

it is necessary to objectively describe the process of metaphor understanding in dynamic context.

The traditional describing theory of the process of metaphor understanding has established some representative description theories from emphasizing the analogy of literal meaning to the transformation of literal meaning. These descriptive theories can be divided into two categories: one is purely speculative theoretical explanation, such as Steinhart, Searle and Eco's theory; one is the brain mechanism model theory of metaphor understanding based on brain science, such as "attribute matching method" and "conceptual metaphor view".

According to these theories and the relationship between cognitive context and metaphor understanding in relevance theory, the process of metaphor understanding can be described in figure 1. On the one hand, the literal meaning of metaphor in a given discourse situation is analyzed, so we can obtain the corresponding meaning of the tenor and the vehicle. And cognitive subject based on the situation factors in current discourse and the cognitive context, encyclopedic knowledge which have been internalized in their mind, consider the influence of objective factors such as the context and the discourse situation; combine with the content of conceptual attribute; dynamically select the similar properties between the tenor and the vehicle; exclude attributes that do not correspond to the current context state, so as to find similarities between the tenor and the vehicle. Then the metaphorical analogy reasoning is carried out to obtain the metaphorical base, which is the real meaning and intention that the metaphor wants to express.
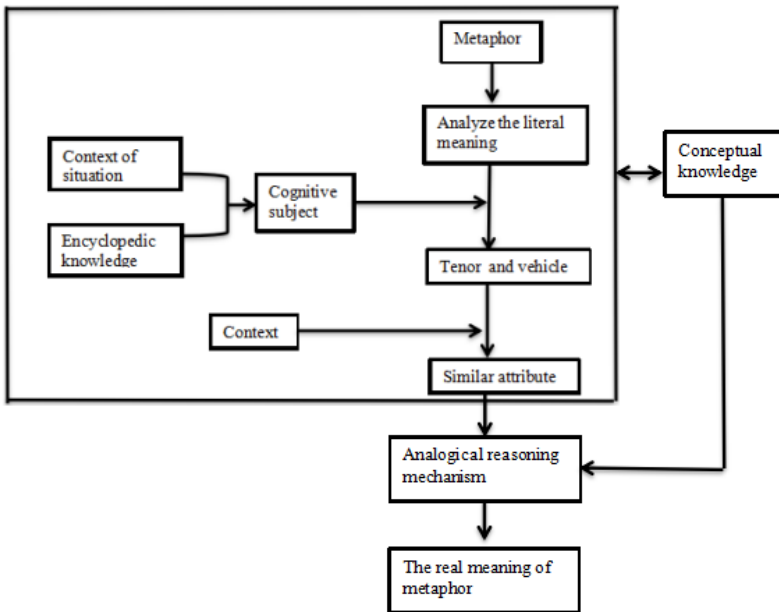

Fig. 1. The process model of metaphor understanding

It should also be noted that metaphors can generally be divided into two categories: dead metaphors (conventional metaphors) and living metaphors. Dead metaphors refer to those that enter into language unconsciously through long-term established regular relationships. The meaning of conventional metaphors has become part of the meaning of words and may have been included in dictionaries. Through numerous repeated uses and associations, these meanings have become established literal meanings, such as the use of words "mountainside", "header" and so on. Dead metaphors enrich our language, expand our knowledge base of concepts, simplify the use of language, and link different categories of things together. However, the understanding of metaphor in the sentence we are concerned about is still living metaphor, and because of the existence of living metaphor that our conceptual knowledge base can be constantly updated. Therefore, the interaction between conceptual knowledge and metaphorical understanding is also involved in the model of describing the process of metaphor understanding. Metaphorical concepts formed in the process of metaphor understanding can be accumulated through learning. Conceptual knowledge accumulates along with each link in the process of metaphor understanding. When it is necessary to invoke the previously reserved conceptual knowledge in the process of metaphor understanding, it can act on the process of metaphor understanding in turn. The relationship between them reflects the human ability to acquire and apply language knowledge.

Through the above description of the process model of metaphor understanding, we can know that context plays a central role in the process of metaphor understanding which runs through the process of metaphor understanding. "How to make use of the interaction of contextual information to effectively obtain the correct and reasonable interpretation of the metaphorical meaning" is a dynamic choice of metaphorical similarity attributes, and a key problem to be solved in the reasoning process of metaphorical meaning. Generally speaking, context consists of two parts: objective factors and subjective factors. The objective factors are the contexts of the discourse; the subjective factors are the situation factors, and the cognitive contexts, encyclopedic knowledge which are internalized in cognitive subject at that time. The integration of objective and subjective factors constitutes all the background knowledge needed in the process of metaphor understanding. Of course, what we invoke and activate in the process of metaphor understanding is not all the knowledge of context, discourse situation and cognitive subject, but the part related to the current discourse that needs to be selected and extracted according to the current situation.

In conclusion, the process of metaphor understanding depends on the interaction of the following three parts: (1) Knowledge of language system; (2) Objective contextual information (situation and context); (3) Subjective situation (cognitive context and encyclopedic knowledge of the subject). These three interactions can be: "(1) Determine the metaphorical meaning of language; (2) May supplement and omit the implied content; (3) Give a specific emotional color; (4) Remove the ambiguity of metaphor; (5) Provide preconditions to correctly infer and express the meaning; (6) Enrich the meaning of metaphor; (7) Reveal the hidden meaning of metaphor. This is the ultimate goal of metaphor understanding."[1]

3   The Relation Among Possible World, Context and Metaphor

It was Leibniz who first put forward the theory of "possible world". In his view, "The world is a combination of possible things, and the real world is a combination of all possible things (a most abundant combination). Maybe there are different combinations of possible things, and some combinations are better than others. So there are many possible worlds, and every combination of possible things is a possible world."[2]

According to Loux, if someone want to understand the possible world, "one must first ask the understanding person to identify what kind of things the real world is, and then explain to him that the other possible worlds are additions and subtractions of that kind, and that they are not different from the real world in kind, but only in their internal differences."[3] From this, as an assigned set, the possible world set also contains the actual world. This actual world refers to all actual beings in the entire universe, in terms of time which including the past, the present and the future. In this sense, the actual world is also a possible world, while other non-actual possible worlds cannot determine its physical space at any place, it only has logical space. In other words, a state of affair A is possible, if and only if, A does not contain logical contradiction. The group which is combined by state affair A_1, A_2, A_3... is possible, if and only if, A_1, A_2, A_3... cannot deduce the logical contradiction. The combination of possible things formed by an infinite number of things of various properties is a possible world. Thus, the possible world includes not only what is physically possible, but also what is logically possible. In fact, when we construct the semantic model of a modal system, we do not need to discuss what the possible world is, but only give a set of non-empty possible worlds. Each possible world is a relatively independent system, but there are various relations among them. In these the most important is: accessible relation, isomorphism relation and similarity relation. The relationship of accessibility means that two worlds can realize an event at least in terms of features, functions, structures, etc. Isomorphism is a mathematical concept. "Two worlds are isomorphism, which means that the factors (elements) of the two worlds correspond to each other in spatial distribution, and are constructed in similar ways. This suggests a one-to-one correspondence between the two worlds in the order of space and time." [4] Two worlds are similar in that the two worlds are in constant proportion to each other in their properties (characters or relationships).

To solve the problem of semantic interpretation of modal logic, in the 1950s and 1960s, based on Leibniz's theory of possible worlds, S. Kanger, J. Hintikka, S. A. Kripke and R. Montague established "Possible World Semantics". The meaning of this theory is that by the non-empty set of the possible world and accessible on its relations semantics, we may be build the model, and based on this model to denote and assignment, then determine the true condition of modal proposition, define logical truth (generally valid), logical deduce, so as to prove the reliability and completeness of the system. Perhaps possible world semantics holds that reality fills the logical space in its least restrictive form. Logical space is composed of all logically possible worlds, in which the object exists in conceptual form. Situation is part of the logical space, and each situation contains some individuals with certain properties and related to each other. According to Leibniz, necessarily true propositions are true in all possible

worlds, and possibly true propositions are true in at least one possible world. Since the actual world is included in the set of possible worlds, a necessarily true proposition must also be true in the actual world, and a proposition that is true in the actual world must also be a possibly true proposition. This is a simple semantic view of the possible world. But the conditions in each world are different. It is not possible that the conditions in each world are the same, so we should place a proper limit on "what is true in the possible world". In this way, a sentence (in this world) is necessarily true, if and only if, the sentence is true in all worlds accessible to this world; a sentence (in this world) is possible true, if and only if, there exists at least one world accessible to this world in which the sentence is true.

We can extend possible world semantics to the treatment of metaphor. In natural language, sentences have the property of uncertainty and ambiguity. It can be said that each meaning is a function from possible world to truth value, and the metaphorical function is not necessarily true or necessarily false. Steinhart believes that most metaphors are based on analogy, so "a metaphor is true at a world if and only if certain parts of that world are relatively structurally indiscernible (they are analogous)."[5] "Possible world semantics provides some good resources to deal with metaphors: logical space, situations, worlds, accessibility, counterparts. It is useful for other reasons. For example: some metaphors (as well as similes) involve comparisons with things that don't actually exist: 'Tornadoes are vacuum cleaners from the sky' compares tornadoes with things that don't actually exist; so, possible worlds are needed to avoid vacuous reference."[5]

A sentence often has multiple meanings, and only relative to a certain context can we judge whether a certain meaning of the utterance is true or false. There are far more additions involved in the context of metaphorical meaning being true than literal meaning being true. "These additional items are inferred from the discourse context in which the metaphor is uttered or from some larger text in which the metaphor occurs. The discourse context itself can be described by some larger text in which the metaphor occurs. The unit of metaphorical discourse is almost always some large text that describes some situation about which the metaphor is uttered. Metaphors are almost never isolated sentences."[5] Every sentence in natural language is usually related to a certain discourse context, which is the description of the situation in which the sentence is used. Context plays an important role in the understanding of discourse. On the one hand, we can judge the true meaning of sentences in the discourse in the context; on the other hand, context restricts the understanding of sentences in the discourse, and the meaning of sentences can be deduced from the context premise. Context is the description of the situation in which a sentence is used, and the situation is a part of the possible world. Therefore, the context of sentence interpretation can be collectively referred to as the set of possible worlds or one subset of them.

4   The Updating Model of the Dynamic Context

In order to deal with metaphor understanding by combining context with possible worlds, we need to explain the updating model of context first. We can think of context

as a group of propositions or a set of propositions that the speaker and listener both know, believes or accepts. The correct understanding of the context of the discourse and its changes is a necessary and important condition for correct expression, communication and understanding, as well as for successful communication.

C^* represents a set of contexts, W represents a set of possible worlds, so $C^* \subseteq W$. In fact, the process of understanding metaphor is a process of constantly revise their beliefs, in which the respective context sets are constantly expanded and modified. A sentence is a function of a context set to another context set. The context change function is called $|S|$. This function maps the context set C^* in which the sentence S is said to a new context set $|S|C^*$. There are two main changes in the context set: expansion and revision.

Expansion refers to adding the context change function $|S|$ directly to its context set basic on both parties without giving up the old context set. The new context set is in fact the union of the propositions in the S_i and the original context set C^*, and can be expressed as $|S|C^* = C^* \cap S_i$, or $C^* + S = C^* \cap S_i$, these two expressions are equivalent.It should be noted that in the new context set $|S|C^*$, S_i and $\neg S_i$ cannot be true at the same time, so as to conform to the cognitive rules of people. It is impossible for people to deny one thing and affirm it at the same time. We can also construct some postulates to overcome inconsistencies:

$$type: C^* + S \text{ is a context set} \tag{1}$$

$$success: S \in C^* + S \tag{2}$$

$$expansion: C^* \in C^* + S \tag{3}$$

$$minimal\ action: \text{If } |S| \in C^*, \text{so } C^* = C^* + S \tag{4}$$

$$monotony: \text{For all } \mathcal{H}, \text{if } C^* \subseteq \mathcal{H}, \text{so } C^* + S \subseteq |S|\mathcal{H} \tag{5}$$

$$minimal\ change: C^* + S \text{ is the smallest set that satisfies}(1) - (5) \tag{6}$$

The postulate (1) can guarantee any results of the extension to be a context set. The postulate (2) indicates that once we decide to accept S as a function of context change, it will be included in our context set. The postulate (3) means that when a subject decides to add information to its context set, he/she does not need to discard the previous context, but directly expands on the old context set. The postulates (1), (2), and (3) ensure that any old contextual information cannot be given up as extended. Postulate (4) minimizes the degree of context change. The postulate (6) is about the principle of the information economy. Once we accept an extension equivalent to adding a postulate (3), there is no need to add anything else to the absolute necessity. The postulate (5), like postulate (4), can be derived from other postulates.

Revision refers to the abandonment of some information that the subject originally believed in the context set, such as the proposition S_i in the context change function $|S|$. Because, in the process of updating, the context will voluntarily give up some information that we previously knew was wrong. And often, in order to give up S_i, we

should have to give up more information, such as the information that is logically implied S_i. $C^* - S$ is used to represent the state of the context set after the subject abandons the proposition S_i on the basis of the original context set C^*. Its postulates mainly include the following:

$$type: C^* - S \text{ is a context set} \tag{7}$$

$$revision: C^* - S \subseteq C^* \tag{8}$$

$$minimal\ change: \text{If } S_i \notin C^*, \text{so } C^* = C^* - S \tag{9}$$

$$success: \text{If } \nvdash S_i, \text{so } S_i \notin C^* - S \tag{10}$$

$$recovery: \text{If } S_i \in C^*, \text{so } C^* \subseteq |S|(C^* - S) \tag{11}$$

$$extensionality: \text{If } \vdash S_i \leftrightarrow S_j, \text{so } C^* - S_i = C^* - S_j \tag{12}$$

$$min - conjunction: \left((C^* - S_i) \cap (C^* - S_j)\right) \subseteq C^* - (S_i \wedge S_j) \tag{13}$$

$$max - conjunction: \text{If } S_i \notin C^* - (S_i \wedge S_j), \text{so } C^* - (S_i \wedge S_j) \subseteq C^* - S_i \tag{14}$$

The postulate (7) determines that the revision result is still the context set, rather than the empty and incorrect set. The postulate (8) indicates that no other irrelevant information should be added to the context set during the revision. The postulates (9) and (10) are similar in some ways; they both stipulate that nothing must be done if the intended goal remains to be achieved. The postulate (11) states that the result of a revision should not depend on the syntactic representation of the sentence we want to revise. The postulate (12) ties expansion and revision together: assuming that S_i and S_j are trusted, when S_i is abandoned, S_j may also be forced to be abandoned, but according to the principle of information economy, S_j is abandoned only when it is needed to. The postulates (13) and (14) give the constraint on the behaviour of "-" when the revision is a conjunction case.

From the above analysis, it can be seen that the expansion and revision of the context set can be carried out simultaneously. In communication, context is in the process of dynamic change. When new context information appears, if it is the first time or can be combined with the old context without contradiction, the set of the old context will be expanded to further analyze the metaphor. If the new context combines with the old context with contradiction, context collection inconsistent would happen that we cannot extend the old context simply. It has to be revised first. We should get rid of the information that don't consist with the actual context information, and other information which has logical entailment relationship with the context. So as to get a new context set, and then base on it metaphor can be analyzed.

5   Conclusions

The understanding of metaphor can help people and machines to reconstruct or restore the omitted information in the text, then can better help people to extract the omitted metaphorical information from the whole text. However, we have to be able to express it logically before we can implement it on a machine. There are closely relation among logic, context and metaphor. In this paper, we describe the process of metaphor understanding in dynamic context, and then discuss the relationship among the possible world, the context and the metaphor understanding, finally give a logical updating model of dynamic context.

Acknowledgment

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