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Representational Transformation: A Facilitative Process of Understanding

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Abstract Representational transformation is a process through which one representation of a domain is understood in terms of another representation. This is a prevalent strategy that is used by comprehenders to obtain a better understanding of various domains. Metaphoric language is one of the areas in which representational transformation of domains is used. Perhaps one of the most complex areas of representational transformation is mathematics. Mathematicians transform the abstract representation of problems into concrete imageable representations in order to facilitate the process of solving these problems. It is the creative mind that decides which representation is easier to solve and how a difficult-to-process representation can be transformed into an easy-to-process representation. After discussing these subjects, three-dimensional space and motion events, as two domains through which a large number of abstract domains can be understood, are discussed.

Keywords Representational transformation, Metaphoric language, Mathematics, Imageable representation

1. Introduction

Understanding one thing in terms of another one is a subject that has been discussed under the rubric of a variety of terms, such as cross-domain understanding, mapping, similarity, etc. The essence of understanding one thing in terms of another one is the existence of a deep similarity between these two things. The ways through which deep or underlying similarity between two things is discovered by comprehenders is a subject that has raised many questions. Deep similarity between two things or two domains may be based on a variety of factors, among which the relational similarity is perhaps the most-discussed one. The relational similarity is a type of homogeneity that relies on the nature of relations among elements in two parallel domains. However, there are some other factors that may be involved in the deep similarity between two domains. In fact, a combination of factors can be involved in the deep similarity between two parallel domains. In such cases, it can be said that the degree of similarity or homogeneity is dependent on the number of factors that could be considered as the base of similarity. In discussing similarity between two domains, we need to distinguish between those factors which are superficial or easily-observable and those which are deep and hardly-perceivable by our senses. The degree of similarity between two domains is reliant on the extent to which they share superficial and deep features. In the following sections, these subjects are discussed under the title of "representational transformation." The focus will be on metaphors and some examples from the field of mathematics. Then, the three-dimensional space and motion events, as two systems for representational transformation, are discussed.

2. Change of Representation in Metaphor

Metaphor is seen as understanding one domain in terms of another domain [1]. The nature of domains and the ways that the two domains interact with each other have been the subject of a large body of research over the past decades. The meaning of every metaphor is the product of a two-way interaction between the two domains. In fact, the base domain functions as a framework within which the target domain is understood. The starting point of this process is the mapping of the base domain into the target domain. After this initial stage, target domain is described and understood through the base domain. The metaphor is usually used to describe an abstract unfamiliar domain in terms of a familiar domain [2]. It has been suggested that any metaphor is comprehended through a one-to-one correspondence between relations in the base and target domains [3]. That is, relations among elements in the base are mapped into relations among elements in the target. Looking at metaphor comprehension from the mentioned perspectives, one may suggest that the process of metaphor comprehension can be considered as a kind of representational transformation. In fact, base and target can be considered as two specifically

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different representations of a single domain. In other words, the domains can be seen as two isomorphic elements belonging to a superordinate general category. From this perspective, base and target of a metaphor are seen as two homogenous members of a common class. The essence of this homogeneity is a fundamental question that has been widely discussed in the literature of the field. In some cases, it seems that physical similarity is the main base of a metaphor. The metaphor *That bird is an airplane* is one of such cases. In some cases, it seems that relations among elements in the two domains are the main base for a metaphor [3]. However, in some cases, it is very difficult to imagine any physical or relational similarity between the two domains. It has been argued that metaphors are understood through the inclusion of base and target into a common category [4]. For example, the metaphor *My lawyer is a shark* is comprehended by including *my lawyer* and *shark* into a common category of entities that are vicious, aggressive, and tenacious [5-10]. Therefore, it can be said that *my lawyer* and *shark* are two homogenous members of a superordinate general category. In this case, homogeneity of members is based on certain common features. These common features are defining criteria of the general category. Although this category is considered as a general metaphorical class, it is not essentially dissimilar to literal categories. In literal categories, a large number of entities can be included in one class on the basis of some defining criteria. For example, in the literal category of animals, an endless list of differences exists among various animals. However, all of them belong to the general category of animals, no matter how much they can be different in other respects. Here, what is important is the existence of fundamental criteria that defines the category of animals. The number of these common criteria is much smaller than the number of uncommon features of animals. However, this does not create any problem for defining this category. The important point is that the common defining features are essentially more fundamental than uncommon and non-defining features of the category.

3. Change of Representation in Mathematics

Representational transformation is a strategy that is widely employed by mathematicians to solve very complex mathematical problems. In Abstract Algebra, a very complex abstract problem can be transformed into a geometric representation. The aim of such representational transformation is to change an abstract algebraic problem into an imageable geometrical problem. In many cases, solving the geometrical representation is much easier than solving the algebraic one. Since geometric representations of mathematical problems can be processed by the support of visual sense, the solution of abstract problems can significantly be facilitated by such transformations. However, depending on the nature of the problem, it may be better to transform a geometrical representation of a problem into an algebraic representation. This can widely be seen in Analytical Geometry. In this branch of mathematics, very complex geometric shapes can be represented by much simpler algebraic equations. For example, a complex curve can be represented and analyzed through its equation. In such cases, it is much easier to use algebraic methods to solve the problems. As was mentioned, the selection of representation is heavily dependent on the nature of the problem. It is the creative mind of mathematician that decides how to transform one representation into another one and how to find the most suitable representation of a problem. In fact, when a mathematician transforms the representation of a problem, s/he creates a new model of the same problem. The two representations of the problem are isomorphic at a deep level, although they may be very different at a surface level [11]. The superficial differences between the two representations does not create any problem. The answer of one representation is the answer of the other one because both of them are isomorphic; that is, both of them are inherently a single problem. The surface differences between the two problems do not mean that they have different answers. Even, the surface differences between their answers do not mean that they have different answers. In fact, the two superficially different answers are two representations of the same answer. This answer can be called deep or underlying answer of a large number of mathematical problems that are isomorphic at a deep level. All of these problems share an underlying representation at a conceptual level.

4. Three-dimensional Space for Representing Various Phenomena

One of the widely-used systems for understanding various phenomena is the three-dimensional space. Because of its imageability, three-dimensional space is a very good option in terms of which many complex phenomena can be understood and analyzed. In fact, the three-dimensional space is an excellent system for the modeling of a large number of abstract systems. When we look at our language, we see that many world's phenomena are described and understood in terms of the three-dimensional space. The sentence *We are far away* describes the relationship between two persons in terms of distance between two points in the three-dimensional space. Similarly, the sentence *It is a subject close to my heart* describes the interest in a subject in terms of physical distance in the three-dimensional space. When we talk about a huge distance between the richest people and the poorest people, we describe the economic conditions of people in terms of the three-dimensional space. Such cases are abundant in our language. They show that we widely use the three-dimensional space as a basic system for understanding many phenomena. This is particularly the case with abstract systems. Because of their non-imageability, abstract systems are difficult for us to understand. Therefore, we use them through the mediation of imageable systems, among which the three-dimensional space is one of the best ones.

5. Motion Events for Representing Various Phenomena

Motion events are another system that can be used to describe a lot of phenomena. This is particularly the case with metaphorical descriptions of abstract non-motion events in terms of motion events. In English, the metaphorical sentence *He went through the roof* is used to describe angriness. In this case, the feeling of *angriness* is understood as an upward movement. The metaphorical sentence *We have passed through a lot of difficulties* describes *people* as moving observers along the road of life. In this description, life is described as a road, and people are described as travelers moving along the road. Similarly, the sentence *Time passes rapidly* describes the abstract concept of *time* as a moving object. In contrast to the previous metaphorical sentence, this sentence describes *people* as non-moving objects, and it is the *time* that is understood as a moving entity.

6. Summary

Representational transformation is one of the most effective strategies that can be used to obtain a better understanding of various domains, particularly abstract ones. Representational transformation is a kind of mapping through which highly abstract domains can be mapped into easily-perceivable domains, the result of which is the easier understanding of the abstract domains. The abundant use of metaphor in our language clearly shows that representational transformation is widely used by our conceptual system. Compared to mathematical transformation, representational transformation in the metaphorical use of language cannot be considered very complex. In mathematics, complex representational transformation can be employed to facilitate the process of solving highly abstract problems. The job of a creative mind is to find a way for transforming a difficult-to-process representation of a problem into an easy-to-process representation of that problem. A clear description through which the best representation of a problem can be found is a question that remains to be answered.

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