UC Merced

Proceedings of the Annual Meeting of the Cognitive Science Society

Title

Structure-Mapping vs. High-level Perception: Why the Fight is Not Mistaken

Permalink

https://escholarship.org/uc/item/20503001

Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 19(0)

Author

Desai, Rutvik

Publication Date

1997

Peer reviewed

Structure-Mapping vs. High-level Perception: Why the Fight is Not Mistaken

Rutvik Desai (RUDESAI@CS.INDIANA.EDU)
Department of Computer Science
Indiana University, Bloomington, IN 47405, USA

Introduction

High-level Perception (HLP) (Chalmers, French & Hofstadter, 1992) and Structure-Mapping Theory (SMT) (Gentner, 1983; Falkenhainer, Forbus, & Gentner, 1989) are two theories of analogy which differ in significant aspects. Recently, there has been a claim (Morrison & Dietrich, 1995) that the competition between these two theories is ill-founded, and that they deal with different aspects of analogy. SMT seeks a "horizontal" view of analogy where a mapping is constructed between existing representations, while HLP seeks a "vertical" view of analogy, where the process of construction of representations is explained. Here, we argue that HLP and SMT do not merely deal with "different aspects" of analogy, but differ in a fundamental way.

HLP vs. SMT

A basic assumption behind SMT is that the processes of situation-perception and mapping are temporally separable. One could have a "representation-construction module" which would provide the input for the "mapping module". HLP maintains that these two are inextricably intertwined: the representations we build are influenced by the mapping we make, and vice versa. SMT and its implementation, SME, as well as programs such as ACME (Holyoak & Thagard, 1989) have been criticized (Chalmers *et al.*, 1992; Hofstadter *et al.*, 1995) for starting out with hand-coded representations. If a system is provided with representations that contain *just the right information* in *just the right form*, then the difficult part of analogy-making is accomplished. The analogy has to made in the first place to construct such a representation.

Morrison and Dietrich (1995) claim that SMT is a theory of how given analogies are *comprehended*, not a theory of how analogies are *discovered*, and thus the above criticisms do not apply. They say that, "... as SME is a model of analogy understanding, it is immune to [Chalmers *et al.*'s] criticisms based on creating an analogy because in understanding, the hand-codings they look for ... may be legitimate." (p. 680). However, if the analogy is "given" in the form of representations which contain the right information in the right form, then the problem of understanding is simplified to a great extent, if not trivialized. To understand "Life is a journey", one must decide just what characteristics of the extremely rich concepts of "life" and "journey" to consider. The representation of "life" that will enable SME to make this analogy is unlikely to be successful in the case of "Life is a bed of roses" or "Life is like a box of chocolates." The main task in analogical thinking is to extract the "essence" of the situation, and the essence changes drastically depending on how the situation is perceived. When the gist of a situation (in the context of a particular analogy) is provided in the form of a "correct" representation, the major task is accomplished, whether one is understanding a given analogy or discovering a new analogy.

It may seem that SMT in fact accounts for the problem of selecting relevant information. According to SMT, *relations* between *objects* are preserved, while *attributes* of objects are mostly ignored in an analogy. However, it is not clear *a priori* how the labels of "object", "attribute", and "relation" should be applied to various parts of the domain. In the heat-flow/water-flow analogy, it is essential for SME that "heat" be represented as an object flowing from coffee to ice cube. However, in "Coffee is like a drug", it seems that heat should be an attribute of coffee, and should be ignored. A similar problem arises in deciding the number of arguments to be used for a relation. It is not clear that one will always select the same number of arguments (in the same order) for all the relations to be mapped onto each other, unless one knows beforehand which relations should produce a match.

Thus, it seems that the apparent real-world prowess of programs such as SME is dependent upon hand-coding of representations. It is true that the current implementation of HLP, the Copycat program, does not deal with real-world situations either. However, it does construct representations in a psychologically plausible way in a challenging microdomain, which we believe is genuine progress.

References

Chalmers, D., French, R., & Hofstadter, D. (1992). High-level perception, representation, and analogy: A critique of artificial intelligence methodology. *Journal of Experimental & Theoretical Artificial Intelligence, 4*, 185-211.

Falkenhainer, B., Forbus, K., & Gentner, D. (1989). The Structure-mapping engine: algorithm and examples. *Artificial Intelligence, 41*, 1-63.

Gentner, D. (1983). Structure-mapping: A theoretical framework for analogy. *Cognitive Science , 7*, 155-170.

Hofstadter, D. *et al.* (1995). *Fluid concepts and creative analogies*. New York: Basic Books.

Holyoak, K., & Thagard, P. (1989). Analogical Mapping by Constraint Satisfaction. *Cognitive Science, 13*, 295-355.

Morrison, C. & Dietrich, E. (1995). Structure-mapping vs. High-level perception: The mistaken fight over the explanation of analogy. *Proceedings of the Seventeenth Annual Conference of the Cognitive Science Society* (pp. 678-682). Hillsdale, NJ: Lawrence Erlbaum Associates.