# EMPATHICA: A Computer Support System with Visual Representations for Cognitive-Affective Mapping

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#### Abstract

EMPATHICA is a computer program under development to facilitate cognitive-affective mapping using visual representations. A cognitive-affective map is a concept graph that includes information about the positive and negative emotional values of what is represented. Potential applications include conflict resolution, literary analysis, cross-cultural understanding, ethical assessment, authoring systems, and cognitive modeling.

## **Cognitive-Affective Mapping**

Researchers in psychology, computer science, and political science have used the technique of *cognitive maps* (also known as conceptual graphs, concept maps, and mind maps) to represent the conceptual structures that people use to represent important aspects of the world (e.g. Axelrod 1976, Novak 1998, Sowa 1999). But such maps fail to indicate the values attached to concepts and other representations such as goals, and therefore are inadequate to capture the underlying psychology of conflicts and other important domains. They lack an appreciation of *affect*, which is the complex of emotions, moods, and motivations that are crucial in human thinking. (Note: there is also a quite different use of the term "cognitive map" referring to mental representations of spatial knowledge.)

A cognitive-affective map is a visual representation of the emotional values of a group of interconnected concepts. Such maps can be produced using any drawing program, but my colleagues and I are developing a computer program written in Java to further their production and application. It is called EMPATHICA, reflecting the hope that the program can be used to increase mutual understanding between people in conflict situations.

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## **Graph Semantics**

- 1. A cognitive-affective map is a labeled graph in which the vertices (nodes) represent concepts along with their affective (emotional) values. The edges in the graph represent the links between the concepts.
- 2. A concept is a representation of an important cognitive element, such as a goal, action, event, person, organization, or general idea. Each concept has an associated emotional value, which can be favorable, unfavorable, or neutral. Values can vary in intensity, i. e. be more or less favorable or unfavorable.
- 3. The links between concepts represent whether the concepts are supportive or conflictive. The kind of support or conflict depends on the nature of the two concepts involved. Examples:

An action and goal are supportive if performing the action helps to accomplish the goal.

Two goals are supportive if accomplishing one helps to accomplish the other, i.e. one is a subgoal of the other.

Two actions are conflictive if it is difficult or impossible to perform both.

Two goals are conflictive if it is difficult or impossible to satisfy both.

Two concepts are supportive if feeling good about one makes you feel good about the other.

Two concepts are conflictive if feeling good about one makes you feel bad about the other.

#### **Visual Representation**

The graph semantics are conveyed visually in accord with the following conventions:

Each concept is represented by a node (vertex).
 Favorable nodes are represented by green circles.
 Unfavorable nodes are represented by red hexagons.

Neutral nodes are represented by yellow rectangles. Degree of favoring and disfavoring is represented by thickness of lines and darkness of color. Color coding is optional to be used when available.

Each link is represented by an edge.
 Supportive links are represented by solid lines.
 Conflictive links are represented by dotted lines.
 Strength of support of conflict is represented by thickness of lines.

Figure 1 schematizes this kind of representation. The use of green for positive and red for negative is modeled after traffic lights, following Giaccardi and Fogli (2008).

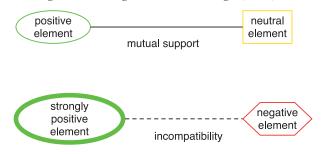


Figure 1. Schema for a cognitive-affective map.

# **Applications**

#### **Conflict Resolution**

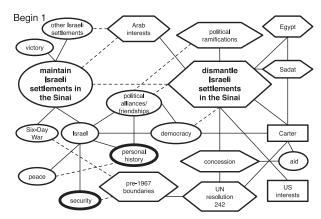
The primary intended application of cognitive-affective mapping is conflict resolution. It has already been used in a detailed analysis of the emotional changes that led to the breakthrough peace agreement between Egypt and Israel in the 1978 Camp David accords (Findlay and Thagard, forthcoming). This analysis was done manually using the OmniGraffle drawing program, but EMPATHICA already provides a prototype of how cognitive-affective mapping could be facilitated by a computer support system.

More ambitiously, we want to use EMPATHICA as a tool that disputants could use to clarify and help resolve their disagreements. It will work as follows, assuming a conflict between persons, e.g. Alice and Bob.

- 1. Alice prepares a cognitive-affective map of the conflict, and also prepares a cognitive-affective map of what she thinks is Bob's view of the conflict.
- 2. Bob does the same for him and Alice.
- 3. An algorithm to be developed compares the 4 resulting graphs and notices similarities and differences. Computationally, this is non-trivial, because subgraph isomorphism is an NP-complete problem.
- 4. Based on similarities and differences, EMPATHICA suggests to Bob and Alice what they might focus on to resolve their conflict.

Figure 2 shows a cognitive-affective map representing the mental state of Menachem Begin at the beginning of the 1978 deliberations at Camp David. This system of

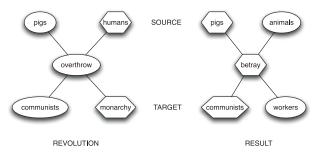
concepts and their emotional valences has been simulated using the HOTCO program (Thagard, 2006).



**Figure 2.** Cognitive-affective map of Menachem Begin in 1978, from Findlay and Thagard (forthcoming). Color was not used in this map.

## **Literary Analysis**

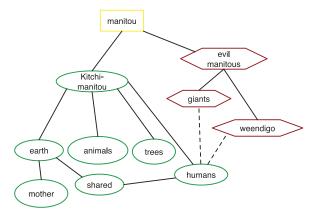
Thagard (forthcoming-a) uses cognitive-affective mapping to display the emotional structure of the political analogies used by George Orwell in his powerful allegory, *Animal Farm*. Figure 3 shows the implicit analogy between the novel and the Russian revolution.



**Figure 3.** Cognitive-affective map showing the emotional correspondences between the novel *Animal Farm* and the Russian revolution. From Thagard (forthcoming-a). Color was not used in this map.

## **Cross-Cultural Understanding**

Thagard (forthcoming-b) uses cognitive-affective mapping to display the major differences in values that occur in different cultures, for example between mainstream and aboriginal peoples. Similarly, the technique may be useful for characterizing deep ethical disagreements on issues such as abortion. Figure 4 displays some of the emotional concepts of the Anishinabe indigenous people of North American before the arrival of Europeans.



**Figure 4.** Cognitive-affective map of Anishinabe view of the world. From Thagard (forthcoming-b).

#### **Authoring**

We owe to Ashwin Ram the suggestion that EMPATHICA might be useful for developing interesting characters in novels, plays, and films. One possible application is the construction of believable agents in computer games, which requires emotional understanding (Poznanski and Thagard, 2005),

## **Cognitive Modeling**

We hope EMPATHICA will prove useful as a tool for producing and depicting cognitive-affective maps. But it should also be possible to adapt it for computational modeling of emotional states, because the conventions used in cognitive-affective maps are based directly on the HOTCO model of emotional coherence that has been used to simulate numerous kinds of inference (Thagard, 2006, 2010). Our model here is the Convince Me system of Schank and Ranney (1992), which is an educational tool for drawing explanatory coherence networks that incorporates the ECHO computational model of inference to explanatory hypotheses (Thagard, 1989).

#### Acknowledgments

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