Causality and Conceptual Coherence in Assessments of Similarity

Abstract
Conceptual coherence, which refers to concepts whose contents make sense to the perceiver, has been associated traditionally with the notion of similarity, that is, objects, events, or entities form a concept because they are similar to one another. An examination of traditional similarity-based concept theories suggests that they do not provide an adequate account for conceptual coherence. Library and Information Science needs to explore knowledge-based approaches to concept formation, which suggest that one’s knowledge of a concept includes not just a representation of its features, but also an explicit representation of the causal mechanisms that people believe link those features to form a coherent whole.

Introduction
“Concepts are the glue that holds our mental world together [...]. Our concepts embody much of our knowledge of the world, telling us what things there are and what properties they have” (Murphy, 2002, p. 1). The standard psychological usage of concept is that of a mental representation individuated or defined by its contents or features (Laurence & Margolis, 1999). Concepts are tied closely to categories: Categorization involves characterizing something by means of concepts so, for example, my concept of dog allows me to pick out a category of entities that I would call dogs. Conceptual coherence refers to concepts whose contents “seem to hang together, a grouping of objects that makes sense to the perceiver” (Murphy & Medin, 1999, p. 427). Conceptual coherence has been associated traditionally with the notion of similarity, that is, objects, events, or entities form a concept because they are similar to one another. Objects fall into natural clusters of similar kinds (e.g., dogs) that are, at the same time, dissimilar to other kinds (e.g., cats).

The notion of similarity, or likeness, underlies many approaches used in Library and Information Science (LIS) in the design of bibliographic classification systems: The reliance upon similarity assumes a shared or common understanding of the attributes or features that give a concept its identity. Does similarity explain, however why a concept was formed or why it makes sense to the perceiver? Will the same concept have the same degree of coherence amongst different people, even within the same domain? Prior theoretical knowledge may contribute to representations of categories; for example, people not only know that birds have wings and that they can fly and build nests in trees, but also that birds build nests in trees because they can fly, and fly because they have wings (Rehder, 2003). In comparison, however, with the development of models that account for the effects of similarity and empirical observations, there has been relatively little development of formal models to account for the effects of such prior knowledge on the formation of concepts.

This paper will examine how conceptual coherence is defined and explored in existing concept theories. It will be argued that traditional similarity-based theories do not provide an adequate account for conceptual coherence, and that LIS needs to explore newer, knowledge-based approaches to concept formation, which suggest that one’s knowledge of many concepts includes not just a representation of a concept’s features, but also an explicit representation of the causal mechanisms that people believe link those features to form a coherent whole.
In the cognitive sciences, similarity is thought to play an essential role in how people acquire and categorize information: Once knowledge is acquired, similarity serves as an organizing principle by which individuals classify objects, form concepts, and make generalizations (Tversky, 1977). Similarity is the foundation of inductive thinking, since categories whose members share similar properties have stronger inductive power than categories whose members are less similar (Heit, 1997; Murphy, 2002).

The concept of similarity, normally referred to as likeness in the LIS literature, is often stated as being an important underlying principle of bibliographic classification. Shera (1965) posits four basic assumptions of bibliographic classification: universal order of knowledge; hierarchical (genus-species) division; differentiation; and permanence. Maltby defines classification as “not only the grouping of things which resemble one another and the separation of those which do not, but the arrangement within each group of its components according to their degree of resemblance” (Maltby, 1975, p. 16). Broadfield (1946), however, suggests that likeness indicates merely a relationship between things; it is not a characteristic of things.

**Similarity-based theories of concept formation**

The Classical Theory posits that concepts contain necessary and sufficient conditions by which they can be defined. Categorization is a process of checking to see if the features that are part of a concept are satisfied by the item being categorized: Entities that are considered similar are members of the same category by virtue of the fact that they share the same properties. All members of the same category are equally similar to each other because they possess the same properties; similarity is thus symmetrical, because what is true for one entity in the category is true also for another.

The Prototype Theory argues that all concepts show gradient degrees of membership; for example, a sparrow is a better example of bird than is an emu, because a sparrow is associated more readily with the features that one attributes to birds (Rosch, 1999). Items can be considered extremely typical, moderately typical, atypical, and borderline concept members; typicality is thus a graded phenomenon. The judged similarity of any two items is measured by comparing the sets of shared and distinctive features that are associated with them. Prototype Theory is sensitive also to context; for example, dogs or cats might be cited as prototypical pet animals, while elephants and lions prototypical circus animals.

The Classical and Prototype theories both focus upon unitary descriptions that capture the central tendency of any given concept; the difference lies in the acceptance or rejection of a set of necessary and sufficient features to create that description. The Exemplar Theory suggests that people do not have a unitary definition of the concept dog, for example, nor is this concept composed of a list of features that is found to varying degrees amongst dogs. Rather, one’s concept of dog is composed only of the set of dogs that one has actually encountered and remembered (Smith & Medin, 1999). This means that my definition of dog would be based not on a unitary description that would necessarily apply to a majority of dogs, but to my exemplar of dog.

In his seminal study of similarity, Goodman (1972) concluded that saying that two things are similar does not say very much about them, since any two things can be regarded as similar or dissimilar, depending on which features one selects for the purposes of comparison. A coherent concept is one that makes sense to the perceiver: The reason that bird is a useful concept is that birds are relatively similar to each other; most birds
have wings, lay eggs, and fly, for instance. Items are said to belong to the same concept if they share common properties; the problem is that we may often see things as being similar because they belong to the same concept, rather than categorize them because of their similarity. Any two entities can be deemed similar or dissimilar depending on how many features one uses, and the relevance or salience that one attributes to these features (Murphy & Medin, 1999, p. 428). How well can I define what constitutes my coherent concept of dog? More importantly, is my understanding of the essence of dogness the same as other people’s? My definition of a dog may rely upon a combination of physical attributes (e.g., the ability to bark) and certain behavioural attributes (e.g., fetching, herding, or retrieving). If I place a higher value on herding behaviour, I am likely to associate this attribute more closely with barking, than a person who places a higher value on fetching behaviour, since barking is often an important component of herding. Similarity-based theories do not explain sufficiently how our underlying knowledge or understanding of the essence of a concept affects which properties we choose as well as which we combine in causal relationships to affect our understanding of a concept’s coherence.

Knowledge-based models of concept formation

Theory-Theory posits that the process of learning about most concepts involves noticing how often properties or features occur and co-occur; for example, blackness and roundness are both frequently-occurring features of tyres, yet roundness seems to be more central to tyres since it is so closely linked to the function of tyres (Keil, 2003). Concepts are learned as part of our overall understanding of the world around us; they are influenced by what we already know, but may serve also to affect our existing knowledge (Murphy, 2002; Rehder, 2003). So, for example, recent experiments in the creation of self-replicating robots could cause us to question our current understanding of the biological function of reproduction. Theory-Theory believes that we do not rely only on simple observation or feature matching to form concepts: We make inferences based upon our prior knowledge and experience and can add information that we do not observe in the item itself. The essences of concepts are not simply assumed to be defining features, but also the causal reason behind the manifestation of surface features (Prinz, 2002).

Causal-Mode Theory posits that people’s knowledge of many concepts includes not just a representation of a concept’s features, but also an explicit representation of the causal mechanisms that people believe link those features. People use causal models to determine a new object’s category membership (Rehder, 2003). Causal-Mode Theory measures the importance of individual features on concept membership based upon people’s domain theories; for example, straight bananas are rated as better members of the category bananas than straight boomerangs are of the category boomerangs, a result people attribute to the default feature curved occupying a more theoretically-central position in the conceptual representation of boomerang as compared to banana. Causal-Mode Theory posits also that particular combinations of features affect people’s decision as to what makes for a coherent concept (Rehder, 2003).

Prinz (2002) argues that with its reliance upon defining essences, the knowledge approach does not provide a sufficient explanation for conceptual structure: If I cannot identify the essence of a dog, then how can I have a coherent concept of a dog? Saying that what makes a dog is the essence of being a dog is circular at best. People’s theories may be incorrect or could change over time. The knowledge approach does not suggest that my friend and I possess the same understanding of dog, but that we are capable of
forming our own coherent concepts, which reverts to the definition of conceptual coherence, namely, that a concept make sense to the person who forms it. It is possible that my interpretation of doghood may differ from other people’s in details, but does this mean that is impossible to achieve a degree of consensus over what constitutes a dog? Rather than insist upon a unitary definition of doghood, the knowledge approach acknowledges the existence of degrees of doghood that can be agreed upon, especially within a specific domain, and the fact that these areas of consensus may vary across different domains. We must be willing to accept a degree of uncertainty and some fuzzy boundaries in the design of concepts, and that we may still find enough areas of commonalities to make concepts coherent across a domain. The concept of marriage, for example, has recently undergone changes in both societal and legal definitions in Canada, such that it no longer necessarily involves the civil union of a man and a woman. It could be argued that the knowledge approach reflects the normal progression of concepts over time that reflects changes in societal and cultural norms.

The knowledge approach accepts that one’s essence of a concept may be wrong if it is based on erroneous theories of knowledge. Once again, however, the knowledge approach may simply reflect the realities of life. It is possible for one person to accept the tenets of creationism, even if scientific evidence suggests that this theory may be unfounded. It is questionable whether similarity can prevent the formation of “wrong” concepts; a person can be provided with all the correct attributes of a concept and still choose to define the concept incorrectly. The question of consensus, however, may act as a mitigating factor; although not all the members of a domain may agree on the essence of a concept, to the point where some members’ interpretation of this concept may be perceived as “wrong,” the knowledge approach suggests that it is still possible to establish a baseline level of consensus common to the majority of the members.

**Conclusion: The knowledge approach and bibliographic classification**

The knowledge approach to conceptual coherence parallels well recent discussions within LIS about the structure of bibliographic classification systems. Hjørland and Albrechtsen (1999) and Beghtol (2003) argue that classification research must be situated within specific contexts and the domains in which the classification systems are designed to function. Classification is based more upon interpretation and judgment than upon logic, and its ultimate purpose is to suggest a view of the world that makes sense, or is coherent, to its users (Mai, 2004). The socio-cognitive view of domain analysis emphasizes how domains structure culturally-produced signs and symbols and how its members mediate their cognitive processes into coherent concepts that reflect shared cultural, historical, and social meanings (Hjørland, 2004). The knowledge approach’s emphasis upon consensus has parallels also within LIS. Consensus in classification can be traced to Henry Evelyn Bliss (1939), who believed that classification systems should reflect how members of the scientific and educational communities structure knowledge in their respective domains.

The dependence of many LIS bibliographic classification systems upon similarity-based measures of conceptual coherence may result in systems that impose a unitary definition of coherence on any given concept. There is a need within LIS to examine the impact of knowledge and causality upon people’s construction of concepts and to see whether it is possible to achieve a consensus of coherence for these concepts within given domains. The Causal-Model theory is the most developed working model of the knowledge approach in its formal account of how causal knowledge influences the importance
of features and specific configurations of features in judgments of concept membership. This model’s ability to provide a precise, quantitative account of both the differences in feature weights and the importance of feature configurations induced by people’s knowledge thus makes it an attractive candidate for integrating the knowledge approach into the construction of bibliographic classification systems.

References


