Abstract

Causation is shrouded in mystery. Notwithstanding much work on causation in a number of different domains, it remains a challenge to build an adequate theory of causation for ontology engineering. This dissertation aims to offer a functional perspective on causation, thereby enabling domain experts to have a fairly expressive representation of multifarious causal phenomena. As for its theoretical basis, causation is modeled upon the device ontology view of reality, assuming an intimate connection between causation and context. Combined in order with the device-ontological understanding of change, the systemic-functional notion of lawhood, and the systemic conception of function as goal achievement, this fundamental idea finally leads to the conceptual mapping of causation onto function and the **achieves** causal relation (as well as the **prevents** causal relation). Underpinned by the idea of 'causally efficacious occurrents', the **achieves** causal relation can hold between a specific pair of three subtypes of occurrents: events, processes, and states.

In addition, an expressive causal representation is practically developed based on the observation that an ontological modeling of causation would be particularly useful for expressing causal chains of various phenomena. This contributes to the precondition-for relations and the development of indirect causal relation (**allows** and **disallows**) that are based on direct causal relations and that are diagrammatically conceptualized as the Configuration of State-mediated Causation (CSC). These four kinds of causal relations are conceptually organized in the form of the functional square of causal relations. Those accomplishments are supported by the idea of a state-centered approach to causation. The explanatory force of the proposal is shown by its ability to accommodate a wide variety of examples extracted from the relevant literature. The dissertation also provides a preliminary formalization of these four causal relations and takes the first step towards a full-fledged functional theory of causation in ontology engineering.

To illustrate the application of the functional view of causation, the causal evolution of the River Flow Model (RFM) of diseases is attempted so that careful consideration of the relationship between disease and causation can be given. In biomedical ontology research, a disease ontology is built to meet a high demand for a common semantic framework in which an increasing amount of medical information and data are shareable among different information systems. An accurate conceptualization of disease is thus helpful for the robust construction of disease ontologies; but disease nevertheless remains an elusive notion from an ontological viewpoint. Against this background, the RFM was proposed around 2010 to explain the disease notion that has a close affinity with medical practitioners' typical understanding of disease. The core idea of the RFM is that a disease is a dependent continuant constituted of causal chains of abnormal states. For instance, diabetes is a dependent continuant whose causal chains have as part the causal relation between the state of the deficiency of insulin and the state of the elevated level of glucose in the blood. The practical utility of the RFM is indicated by its active domain-level implementation for the last decade. One remaining theoretical problem with the RFM is its explicit reference to the notoriously difficult concept of causation. The application of the functional perspective on causation to the RFM leads to the improved RFM conception of disease: a disease is constituted of abnormal states to which events, processes, and states bear either the **achieves**, **prevents**, **allows**, or **disallows** causal relation.

With knowledge as its key concept, knowledge science aims to offer a systematic understanding and facilitation of the creation, exploitation, and the accumulation of knowledge involved in individuals as well as in society. The dissertation contributes to knowledge science by building a common ground for representing different causal phenomena in different domains and facilitating an integration of and an interdisciplinary collaboration across research fields dealing with the concept of causation. It also furthers the causal underpinning of the RFM, thereby not only enhancing the interoperability and flexibility of an increasing amount of disease-related data and information but also showing the practical potential for creating of medical knowledge in the long run.

Keywords: causation, function, the River Flow Model (RFM) of diseases, biomedical ontology, ontology engineering