From Ontology to Structured Applied Epistemology

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1 Introduction

We have proposed the development of highly-structured scientific research reports (e.g., [1]) as well as highly-structured descriptions of historical events on which historical analyses can be based [3]. Because structured revisions to knowledge are integral to scientific research and analytical histories, such reports and descriptions should support the ability to describe, justify, and ultimately to implement changes to knowledge models. Thus, we propose that representations of such materials need structures for both semantics and applied epistemology.

We base the semantics of rich knowledge models on the Basic Formal Ontology (BFO). BFO is a rigorous upper ontology [4]. While it is widely used to organize relationships among biological entities, some considerations for how it might be applied beyond ontologies to the description of full research reports and richly structured histories are not yet specified. Similarly, while BFO distinguishes between Universals and Particulars (instances) there has been little investigation into how rich descriptions of instances might be modeled. We have suggested that BFO might be extended to incorporate features like those in object-oriented programming languages [2]. A programming-language implementation could show Transitions in the network of Dependent Continuants and Processes associated with an Independent Continuant. We believe that all Processes should create at least one Transition and that all Transitions should be based on at least one Process. Higher-level Processes may be decomposed into lower-level Processes and each of those lower level Processes should implement at least one Transition. Further, we believe that all Processes should include both a Range and a Domain. In addition, BFO elements could be used to construct high-level structures such as Scenarios that would help to describe complex interactions of several Independent Continuants.

2 Discourse Systems and Structured Applied Epistemology

Epistemology is concerned with how knowledge is acquired. We apply a relatively broad sense of epistemology and describe our work as structured applied epistemology because we are concerned with developing information systems that can support evidence, warrants, claims, and argumentation regarding the acquisition of knowledge. While some of these structures could be considered as information artifacts, we believe that epistemology is more than ontology. Indeed, the publication of a scholarly report and the claims it includes is a type of document act that includes a contingency (i.e., disapproval by colleagues) for failure to be accurate.

There has been considerable work on rhetorical and discourse tags and on composite hypertext systems that support interaction with structured argumentation. However, none of those systems supports the coordination of discourse tags with rich semantics. The SWAN ontology [5] is notable but the links it provides are mostly at the level of entire research reports, or sections of research reports. Ideally, we should be able to browse the details of evidence, warrants, and claims presented in research reports. For instance, for claims based on scientific experiments, we should be able to browse the details of the experiments. That could be as detailed as specific causal pathways that were considered and the way those pathways were explored in a line of research. Potentially, these structured descriptions could be assembled into a traditional IMRD framework for research reports [6] but also accessed via other paths.

For histories, we have proposed the development of a standardized digital library of sources [3]. From that, we envision a structured entity-event fabric or unified temporal map that would present

events. It could also indicate uncertainty or disagreement about events. Argumentation about history and historical analysis could be integrated into that framework. In other words, it could become a structured approach to footnotes [3] for narrative histories and historical analysis.

3 Structures for Applied Epistemology

We propose specific structures for applied epistemology Claims, Evidence, Warrants, and Argumentation. Claims and Evidence map to knowledge models with the details of the mapping to be articulated. Warrants are relationships connecting Claims and Evidence. Argumentation integrates and evaluates the Claims, Evidence, and Warrants, and provides comparisons as well as a conclusion. For example, a scientific research design is a Warrant that is evaluated for internal and external validity. Internal validity refers to whether the research design and procedures were implemented as intended. For instance, a check on manipulations connects the actions implementing the manipulation with the results where the Claim is that the manipulation was successful. External validity refers to whether the research effectively addresses the Research Question. If the research is judged to adequately address the Claims of the structured research question, then Reference Knowledge Models (i.e., models based on accepted claims about Universals) can be revised.

While science is most often associated with making updates to Reference Knowledge Models and history is most often associated with models of Particulars, the distinction is not entirely straightforward. Some areas of science, such as geology, apply broader principles to observed instances. Likewise, it is common for historical accounts to appeal to broader principles. Moreover, argumentation about particulars may result in generalizations, about which causal claims may be made but which do not rise to the level of formal Universals. In addition, there is a range of styles of argumentation and the types of claims that can be supported by each style.

4 Discussion

We propose structures for applied epistemology that build on the rigorous semantics of the BFO. This combination of rich semantics and structured applied epistemology should allow the development of rich knowledge repositories that can support highly-structured research reports as well as unified temporal maps of historical events and evidence.. The development and extension of ontologies of social acts and of tools to manage interaction with large and highly versioned repositories, will further support the benefits from highly-structured repositories.

5 References

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