

The Issue of Perspectivity in Formal Theories of Spatial Representation

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Aims and Objectives of the Research

The aim of my research is to develop a formal theory of spatial representation able to account for perspective-dependent spatial concepts. In my current project I develop a formal ontological theory for reasoning about perspective-dependent locations and I show how perspective-dependent spatial concepts relate to the framework of detached locational concepts. Thus, my aim is to investigate both the philosophical nature of perspective-dependent locational concepts and the way in which they fit into formal ontological theories of spatial representation. While interested in a computationally efficient theory, my main focus is on the conceptual adequacy of the framework I shall propose.

Justification for the Research Topic

Ever since Hayes' *Naïve Physics Manifesto* [4], Qualitative Spatial Reasoning has been a flourishing branch of a common-sense approach to modelling human behaviour in autonomous machines. The question of perspectivity in spatial orientation and of perspective-dependent spatial relations has again and again been in the focus of qualitative calculi of spatial representation (see e.g., [5]). Moreover, perspective-dependent locational concepts are widespread in human discourse and appear in the language practices of a variety of disciplines (ranging from geographic navigation to the bio-medical practice). However, the question of perspective-dependent spatial concepts and their relation to the framework of absolute locational concepts has not been examined so far from a philosophical perspective on formal ontology. As a result, important parts of the relevant literature ignore issues that are related to the question of embedding perspectivity into existent location theories in a conceptually and ontologically adequate manner. In my research, I try to develop a framework for both computationally adequate theories of perspective-dependent spatial representation and philosophically intriguing questions as to the precise nature of perspective-dependent location. I build this framework on mereotopological background structures (often found in bio-medical ontologies) that are able to support entities of different metaphysical kinds.

Research Questions

- 1 Definition of perspectival spatial representations:
 - What kind of spatial representations count as *perspective-dependent* representations?
 - What is the formal structure of perspective-dependent spatial expressions?

2 Formal account of perspectivity

- How should perspective-dependency be formally captured? What is a “point of view” and what is its role in a formal account of perspective-dependency?
- How should the dependency between a point of view and the corresponding entity be expressed?
- What principles rule perspective-dependent spatial expressions?

3 Perspectivity within a theory of spatial representation

- What is the conceptually correct account of the relationship between detached, absolute concepts of spatial location and their perspective-dependent counterparts?
- What kind of mereo-topological background theory is best suited to support an extension towards location theories that account for perspective-dependent locations?

Research Methodology

The aim of developing a framework for perspectival spatial concepts translates into two different, though related subtasks. First of all, my concern is to determine a theory of spatial representation that provides an adequate background theory for a formalism able to account for perspectival spatial concepts. In this respect I am focusing on mereotopological theories in the spirit of Achille Varzi's and Roberto Casati's theory of spatial representation [1], [2], able to support complex extended formalisms that distinguish between a variety of metaphysical categories (e.g., spatial regions and tenants, material objects and events, abstracta and concrete, etc., see [3]). I shall propose new axiomatic principles for the mereotopological background theory to make it even more suitable as a unified formal-ontological framework for entities of different metaphysical kinds.

Second, I shall propose a first-order extension of the adequate mereotopological background theory with the aim to include perspective-dependent locational concepts. I am concerned with both an adequate semantics and the relevant corresponding axiomatic principles that rule my first-order formalism for perspective-dependent locations.

Research Results to Date

- Clarification of the nature and definition of perspectival locational concepts.
- Development of a first-order formalism for expressing perspective-dependent spatial concepts on the basis of Achille Varzi's Kuratowski Extension of General Extensional Mereology (KGEMT) and his theory of location [2].
- Development of a semantic model for my theory.
- New mereo-topological axioms for KGEMT
- Some first axiomatic principles for my formalism.

References

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4. Hayes P (1979), *The Naive Physics Manifesto*, in: D Michie (ed.), *Expert Systems*, Edinburgh: Edinburgh University Press.
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