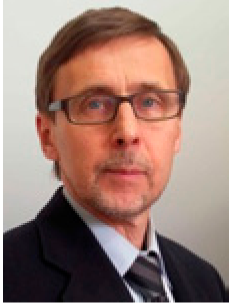
Epistemic Pluralism and Multi-Perspective Knowledge Organization: Explorative Conceptualization of Topical Content Domains†

Mauri Kaipainen* and Antti Hautamäki**

*School of Communication, Media and Information Technology, Södertörn University, Alfred Nobels allé 7, S-141 89 Huddinge, Sweden, <mauri.kaipainen@sh.se>
**Agora Center, University of Jyväskylä, Mattilanniemi 2, P.O. Box 35 (Agora), FI-40014, <antti.e.hautamaki@jyu.fi>

Mauri Kaipainen, PhD, professor of media technology at Södertörn University (Sweden), has a background in education, musicology, and cognitive science. His research agenda focuses on processes of mediation in which knowledge emerges from local or individual activities. His current theory construction aims to clarify the idea of ontospaces, dynamically evolving multi-faceted ontologies that constitute a model of knowledge organization, and concept emergence. In addition to interactive narrative, the model has a range of applications in media art, community and collaborative media applications, as well as learning environments with collaborative knowledge building, bottom-up e-democracy.



Antti Hautamäki is a research professor, director of the Agora Center at the University of Jyväskylä, and an adjunct professor of theoretical philosophy at the University of Helsinki. He holds a PhD in philosophy. Hautamäki has published and edited over 30 books and published over 100 articles about philosophy, cognitive science, innovation, and information society. His books include *Points of View and Their Logical Analysis* (1987) and *Sustainable Innovation: A New Age of Innovation and Finland's Innovation Policy* (2010). His current research focus is on innovation processes and service innovation.

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ABSTRACT: Based on strong philosophical traditions, cognitive science results, and recent discourses within the discipline of knowledge organization, the authors argue for a perspectivist approach to concepts in information systems. In their approach, ontology is dissociated from concept, and instead conceptualization is left up to the epistemic activity of the information system user. A new spatial ontology model is explicated that supports multiple perspective-relative conceptual projections of the same domain. With an example domain and a demo application, they provide a preliminary proof of concept of how different perspectives yield alternative classifications, categorizations and hierarchies, all the way to a different ways of narrating the domain. The results suggest the potential of multi-perspective knowledge organization systems that not only support search and retrieval of information but even the articulation and conceptual disposition of information.

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1.0 Introduction

Every corpus of information can obviously be classified, categorized, and conceptualized from multiple alternative perspectives. Despite this, most information systems, including library classification systems, database architectures, as well as indexing and search engines of the Internet, still today customarily assume a single conceptual structure, typically a hierarchical taxonomy that constrains the metadata of the domain in question. From the philosophical point of view, such a structure represents the ontological assumptions underlying an information system in the sense of setting the constraints of what can retrieved and materialized from there. This term of ontologies has therefore been widely adopted by information technology.

It is obvious that an ontology can serve as a means to promote a particular scientific, ideological, pedagogical, or aesthetical paradigm with its particular set of values and prioritizations. Ontologies are never neutral, but reflect special interests or power positions regardless of whether the power use is deliberate or merely due to the lack of alternatives. However, at least public information systems should avoid biases inherent in predetermined conceptualizations and fixed ways of organizing information. Citing Hjørland and Pedersen (2005, 586), "a specific interest (say that of Scandinavian public libraries) should lead to the design of systems, which are optimal given the interest or purpose and which do not just lead to the acceptance of implicit values inherent in systems that are designed, for example, for commercial purposes." Therefore we suggest that there is demand for information systems that do not depend on a single ontology. In order to find alternative ways to handle concepts in information systems, we will reconsider the roles of epistemology and ontology in a way in which concept is not fixed to predetermined ontological assumptions, but instead becomes relative to perspectives taken.

After the review of concepts and concept theories in 1.1, in 1.2, we relate them to the philosophical discourse of perspectivism. Then we will establish a particular sense of talking about ontologies in 1.3, instrumental to a perspectivist theory of concepts, and lay the ground for a dynamical approach to conceptualization by means of spatially modeled similarity in 1.4.

1.1 Concept theories

Concept theories aim to define and describe concepts, the core of elements of cognition, that structure the understanding of information. Therefore they are of interest not only to philosophy, linguistics, informatics, and cognitive sciences, but absolutely crucial to any discussion relating to knowledge organization, that is, activities such as document description, indexing, and classification performed in libraries, databases, archives, etc. (Hjørland 2008). Due to this multifacetedness, there is no concensual account of concepts, but rather a number of parallel and often competing discussion threads, which may sometimes—but not always—cross disciplinary borderlines.

In information science, theories of concepts have not until recently been considered systematically. Hjørland (2009) covers a range of concept theories starting from Plato to what he describes as post-Kuhnian, the trend following Thomas Kuhn's (1962) suggestion that concepts—like scientific paradigms—evolve culturally and historically and should be interpreted in such contexts. Further, he relates concept theories to epistemologies, which he divides into four groups: empiricism, rationalism, historicism, and pragmatism. Empiricism bases knowledge on observations (and on inductions from a pool of observations); rationalism relies on logics, principles, rules, and idealized models; while in the case of historicism, knowledge builds on social contexts, on historical developments and on the explication of researchers' preunderstanding. Finally, in pragmaticism, knowledge is based on the analysis of goals, purposes, values, and consequences.

Hjørland's consequent (2009, 1523) definition of concepts is formulated as "dynamically constructed and collectively negotiated meanings that classify the world according to interests and theories." Further, he stipulates that "concepts and their development cannot be understood in isolation from the interests and theories that motivated their construction, and, in general, we should expect competing conceptions and concepts to be at play in all domains at all times."

To plot our approach onto the map of Hjørland's four epistemological theories, we can fully accept that concepts reflect accumulated observations, rather than that they originate from some logical or rational inference. We likewise adopt the empiricist interpretation and therewith justify the rejection of the rationalist approach in this context. However, from the point of view of our model, both historicism and pragmatism can be regarded as instances of a perspectivist epistemology. Our model is all about perspectives that determine how observations are classified, regardless if they are historical or pragmatical by nature.

To understand what is meant by the concept of 'concept' itself, it's useful to clarify some related historical notions. In medieval logic, semantics was based on a threefold system consisting of a) an entity, such as a horse; b) a general noun such as "horse"; and c) an idea in mind, in this case the idea of horses (see Lyons 1977) that closest corresponds to what we mean by concept. Charles Peirce rearticulated these distinctions respectively as a) sign, b) object, and c) interpret. Gottlob Frege, in turn, made an important distinction between sense (Sinn), corresponding to concept in this discussion, and reference (Bedeutung) of expressions. For example, the phrases "The Morning Star" and "the Evening Star" are different concepts, but have same reference (the same planet).

Modern mainstream philosophy follows the related two-part distinction between extension and intension. There, "extension" refers to the class of things to which it is applied, while "intension" points at the the set of essential properties that determine the applicability of the term (see Lyons 1977, 158-159), respectively. This distinction, in turn, allows telling apart extensional and intensional logics. What could be described as extensionalist blindness apparently characterizes today's mainstream information systems that are uncapable of recognizing intensions and cannot thereby deal with conditions that modify meaning, such as beliefs or points of view. At the same time, they are ignorant of a massive body of psychological evidence for the context-and attention-dependency in perception and cognition (e.g., Gärdenfors 2000, 112-114; Schwartz 2007; Smith and Vela 2000).

In the field of knowledge organization, Hjørland is not alone in suggesting that the categorizations are dynamical. Even Andersen (2002) suggests that classification may be explained systematically from a family resemblance point of view and, furthermore, argues that this approach allows for taxonomies being dynamic entities, which may undergo change. But we take the intensionalization of information systems further than a mere explanatory model. We propose information systems that assume dynamically evolving conceptualization on the level of user interaction with the ontological level of system, that is, perspective-relative epistemic exploration. Before elaborating this further, however, it is good to take a closer look to the implied perspectivism.

1.2 Perspectivism

The recognition of the perspectival nature of cognition can be called perspectivism (see Giere 2006). This approach has long historical roots, at least going back to Friedrich Nietzsche, who stressed that one always knows, or perceives, or thinks from a particular perspective. There can be more than one correct account of how things are in any given domain (Baghramian 2004, Chapter 10). The issue is not to state which perspective is correct or true, but how to explore and mutually relate multiple perspectives. There is no need to assume any convergence of different perspectives to any final form. In this framework, perspectives are contexts of surrounding and constantly changing perceptions, impressions, influences, and ideas, conceived of through one's language and social upbringing. (See also Magnus and Higgins 1996). Correspondingly, in philosophy of science, interpretations of observations are said to be theory-laden; that is, they depend on the theory adopted (e.g., Hanson 1958; Kuhn 1962; Feyerabend 1981).

As another view to the multiplicity of perspectives, Quine (1980, 65) talks about "the totality of our so-called knowledge or beliefs" that is "a man-made fabric which impinges on experience only along the edges." According to him, different theories, or as we may interpret them, conceptualizations, are underdetermined by experience and can be empirically equivalent. That is, same facts can support different, even inconsistent conceptualizations, each of which only partially matches the experienced reality. A logical treatment of perspectivism has been elaborated by Antti Hautamäki (1986), based on the concept of determinables presented originally by Johnson (1964) in 1921. According to the latter, determinables are adjectives, although grammatically they are substantival (colour). Determinates or determinate values, like different colours, in turn, produce logical divisions of the space of determinables. In this setting, determinates of a determinable must be exclusive and exhaustive. These terms are among the foundations of the approach to ontology, to be elaborated in the following.

1.3 Reconsidering ontology in information systems

In the present context, the concept of ontology is discussed in the practical sense of information systems, not in any metaphysical sense. Here ontology is related to the topics within an information system. In the standard practice, such ontologies, specifications of conceptualization (Gruber 1993), represent an analytical view of an expert, which may yield a consensus of some particular community of practice. This kind of ontology constitutes a fixation to a particular conceptualization, and thereby constitutes an obstacle for the perspectivist epistemology. In contrast, we consider another approach to ontology based on collaborative annotation, such as applied in recent social media like Facebook, Twitter, or YouTube. In this practice, participants mark and classify the content, popularly referred to as 'tagging.' The resulting annotations, or 'folksonomies' (Mathes 2004, see also Quintarelli 2005), are non-hierarchical, or 'flat,' and do not directly translate to expert-controlled classification systems (e.g., Gruber 2005). However, the potential of collaborative tagging even for systems of knowledge organization has been recognized (e.g., Macgregor and McCullogh 2006). As the preliminary disposition, it has been suggested that collaborative annotations can be translated to formal ontologies (e.g., Zhang and Wu 2006; Laniado et al. 2007; Eda et al. 2008). In our view, however, such an approach misses the point that collaborative annotations, as such, are manifestations of the multiplicity of conceptual points of view to the domain. It is equally justified to put the convention of formal ontologies into question on the grounds that they appear not to be capable of accounting for common conceptualizations. We propose a reconsideration of ontology by decoupling 'concept' from ontology and leaving it up to the participant's epistemic activity to conceptualize the domain. As a distinction to the canonical convention, we refer to ontologies as specifications for conceptualization, rather than of conceptualization (referring to Gruber 1993). Thus, ontology is not to be understood as a specification that in itself provides an unambiguous conceptualization, but rather as the coordinate system instrumental for the dynamical conceptualization of the topical domains.

We will elaborate the idea of conceptualization as epistemic activity, which can take place as interaction with an information system, a kind of interaction that goes deeper than search and retrieval and relates and amounts to active knowledge-construction. It is to be appreciated that the idea that the mind actively constructs the conceived world can be tracked back to Kant. In psychology this view has been prominent since Piaget, and has been further elaborated, for example, by Kelly's (1955) Personal Construct Theory.

1.4 Similarity as the principle of dynamical conceptualization

The assumption of similarity relations as the foundation of conceptualization is a tradition leading through the history of philosophical epistemology via Hume, Hegel, Popper to Carnap, as well as through psychology since William James. It is justified by vast evidence (e.g., Krumhansl 1978; Goldstone 1994 Tversky 1991). The key point is that similarity is not absolute but depends on the perspective of the observer. This has been pointed out in empirical settings: similarity judgments are highly attention and context-dependent (for an overview, see Gärdenfors 2000, 113).

We assume similarity relations to underlie perspective-relative classification and categorization, hierarchic mereological organization (part-of and belongs-to relations), and narration. In the following (section 2), we will elaborate a spatial model of information organization that models similarity in terms of proximity and allows a spatial model of perspectivism. Here we assume—in the Nietzschean spirit—that concepts are being continuously constructed in terms of epistemic exploration of alternative similarity-based groupings, instead of being fixed by a static ontology. In section 3, we sketch how such a model can be applied to elaborate multi-perspective information systems. In section 4, we aim to demonstrate how multiple alternative conceptualizations can be drawn from a single content in response to interactively explored perspectives. The conclusions follow in section 5.

2.0 Ontospace

As a directly intensional and thereby instrumental point of departure to a perspectivist model of conceptualization, we adopt Gärdenfors' (2000) theory of conceptual spaces augmented with Hautamäki's (1986) theory of viewpoints. For Gärdenfors, a concept is "an idea that characterizes a set, or category of objects" (60). In his model, such a set occupies a convex region of a conceptual space, which is determined by quality dimensions that describe the entities of a topic domain. Thus, if a description of an object is inside a concept, one can say that the concept applies to that entity. Gärdenfors' approach allows quite naturally a dynamical extension that does not directly deal with the fixed conceptual space. Our approach deals with perspective-relative projections of object distributions in that space that will be called representational spaces. Distances in the representational space, in turn, can be related as similarity relations, which, in turn, contribute to dynamical perspective-relative conceptualization.

2.1. Ontodimensions and ontocoordinates

In order to elaborate ontology with regard to intensional logic and perspectivism, we apply the spatial metaphor of Gärdenfors and define ontology as a state space, consequently termed ontological space (ontospace), a coordinate system that specifies the dimensions with respect to which items of the topical domain vary, however without implying any universal ontological assumptions.

Let I be a set of determinables, also referred to as attributes, properties, or qualities, for example, I = {redness, roundness, weight, length,…}. Associated with each determinable, there is a set of determinate values D_i. Then an ontospace for a topic domain is n-dimensional space $A=D_1xD_2x\ldots xD_n {}^{=}X_iD_i$. Elements of A are n-tuples of the form $a = [a_1,a_2,\ldots,a_n]$, where a_i belongs to D_i. Each entity x of the topic domain can be represented as state $s(x) = a_x$ in ontospace A, where $a_x = [a_1,a_2,\ldots,a_n]$, of which the elements are also conceivable as the ontocoordinates of x. It's quite natural to suppose that there is a distance measure m_i for all determinables i, expressing the degree of mutual similarity elements in terms of set D_i of determinate values. Here m_i is a function from A_ixA_i to the set of non-negative real numbers R^+ where $m_i(a_i,a_i') =$ the distance of values a_i and a_i' in set A_i. Consequently, larger distance means less similarity.

The determinables can be qualitative or quantitative, both expressed by means of quantitative ontocoordinate values in order to refer to positions of entities in the ontospace. In fact, all qualitative variables can be transformed into quantitative variables. To occupy the whole ontospace, not just its origo and outer edges, we allow graded values. This can be done with the state function whose values include real numbers in the interval [0,1] for all determinables. These real numbers can be interpreted as expressions of the degree of membership in fuzzy sets (Zadeh 1965).

In terms of visualization, an ontospace is a multidimensional matrix that allows numerous dimension-reducing algorithms to be applied, such as multidimensional scaling MDS (e.g., Kruskal et al. 1978), Kohonen's self-organizing map SOM (e.g., 1982), principal component analysis PCA, or Eigentaste (Goldberg et al. 2001). The ontospatial approach we build on assumes positions of observers concerned on prioritizations of the dimensions, that is, which dimensions of the ontospace to take into account, which is not to be confused with direct preferences on ontocoordinates of elements themselves.

In summary, we have proposed an ontology model that accommodates varying perspectives as its inherent property, such that constitutes extraspatially observed perspective-relative similarity among entities of the topic domain. In the following, this is further developed to explain the epistemic activity of multi-perspective explorative concept-construction.

2.2. Perspectives to ontospace and explorative conceptualization

We have adopted the view that a perspective is always present and accordingly there is no such thing as a concept without a perspective. A tacit perspective may the form of the choice and prioritization of determinables, positions of each in hierarchy, the applied metric, means of measurement or scaling. We infer that no ontology, neither in the philosophical nor technical sense, should be interpreted in an absolute way, but rather as a construct that already in itself includes some implicit interpretation and choice. Our contribution is to suggest making perspectives explicit and interactively explorable.

We assume that perception and cognition, ultimately the brain, cannot effectively deal with a world of unlimited dimensionality since evolution has mainly adapted it to the constraints of the directly perceivable two and three-dimensional aspects of the environment. The prerequisite of cognitive-perceptual sense-making is to reduce the high (or endless) dimensionality of the environment, defined by a large number of attributes, properties, and relations, to something lower-dimensional. Our model addresses this reduction in two ways. First, based on Gärdenfors's conceptual space theory, conceptualization can be seen as such a reduction. Secondly, it allows a perspective-relative information organization that can be explored dynamically, reminiscent of the ways in which movement in space allows making sense of complex physical environment.

The key is that projecting data elements in ontospace A to a lower dimensionality of B allows relating objects to each other in terms of similarity relations, and their derivative classifications, mereologies and hierarchies. It is difficult, however, to determine the optimal level of the reduced dimensionality, beyond the heuristic that it should not exceed cognitive manageability, which may be placed n=7, as discussed in terms of Miller's (1956) magical number of seven, or some measure of the capacity of comprehension or working memory (e.g., Just and Carpenter 1992), or visual perceivability (e.g., Dastani 2002). In terms of visualization, more than 3-dimensional spaces cannot be easily made intelligible, perhaps due to the evolutionary adaptation to the physical environment. As a practical solution without categorical commitment to any particular dimensionality, it is simplest to think of dimensionality of B being two when it comes to interactive visualizations, and one when the spatial dispositions on B are to be conceptualized as narratives.

For Hautamäki (1986), points of view are defined as selections of determinables. Intuitively, a point of view is a set of relevant or notified determinables. Following Kaipainen et al. (2008) we generalize this to perspective, an array $P = [p_1,p_2,\ldots,p_n]$ of weights, expressed as real numbers ranging within interval [0,1] associated to all determinables. The weights pi express the interest or attention of a speaker towards each ontological dimension i. Perspective P is in control of transformation R_P from high-dimensional ontospace A to lower-dimensional representational space B. We suppose that a distance measure M in B is defined in some way (among several options). The core of our method is that function R_P respects the distance measures m_i of determinables in the following way:

a) If $p_i=1$, then the distance m_i contribute fully to the distance measure M.
b) If $p_i=0$ then the distance m_i is ignored by M.
c) Intermediate values $0< p_i <1$ refer to partial contributions to the distance measure.

By means of function R_P, objects of the domain can be categorized in a manner that reflects the adopted perspective. The result of transformation R_P is a perspective-relative spatial organization of the entities on B, constituted by distance measure M_P for the objects within the domain B. This can be based, for example, on Euclidean distance.

As discussed earlier, we generally assume that dimensionality-reduced mapping R_P facilitates the cognitive manageability of A, on grounds discussed earlier. In this context, we interpret ontological space A to in terms of representational space B where a relation of similarity is defined. Then the transformation R_P from A to B generates similarity relation to A: a and b in A are similar if their representations $R_P(a)$ and $R_P(b)$ are close to each other in B. This observed similarity results of a categorization rule in Gärdenfors's terms, modelled as perspective P in our model, resulting in a perspective-relative partitioning of the space. Representational space B can be then thought of as a visually apparent two-dimensional map of similarity relations that forms the basis of gradually more elaborate conceptual structures, perhaps following the following sequence of inferences:

1) Prototypes, categories, and tessellations have been topics of a vast literature. For the present treatment, it suffices to assume that concepts are centered around a prototypical representative entity, as proposed by Eleanor Rosch's prototype theory (e.g., 1973, 1975, 1983). Correspondingly, in Gärdenfors's conceptual space model, concepts will correspond to convex regions of the space (Gärdenfors 2000, 60, 71). Supposing the betweenness relation is defined, a region C in a conceptual space is "convex if, for all points x and y in C, all points between them are also in C" (ibid. 69). A similarity relation can be defined by unbroken betweenness (Gärdenfors and Williams, 2001).

Further, the Region Connection Calculus of Cohn et al. (1997), together with the classical Voronyi (1907) tessellation, can be applied to determine C by means of thresholds of similarity that forms its category boundaries (Gärdenfors and Williams 2001). To interpret these spatial means of conceptualization in the present framework, let us assume prototypes q_k for certain concepts selected by some cognitive or perceptual processes. Each prototype is an element of ontospace A: $q_k = [a_{k1},a_{k2},\ldots a_{kn}]$. By using the available distance measure M_P , we can form new concepts $C(q_k,t_k)$ based on prototypes q_k and a threshold t_k, which is a positive real number. Object x belongs to the extension of the concept $C(q_k,t_k)$ if and only if $M_P(s(x),q_k) < t_k$ The interpretation of this definition is that an entity belongs to concept $c(q_k,t_k)$ if its distance from the prototype q_k is smaller than the given threshold t_k. A Voronyi tessallation in conceptual space C is given by the triple (P,d,C) where P is a set of generator points $\{p_1,p_2,\ldots, p_m\}$, and d is a distace measure on C. The tessallation regions $c(p_i)$ is $\{x|d(p_i,x) <= d(p_j,x)$ for $j=1,2,\ldots,m\}$. $c(p_i)$ is the category generated by p_i.

2) We propose that perspective-relative spatial dispositions in B define not only distinctions between comparable (same-level) categories, but even a multi-level hierarchy of mereological is-a and is-part relations. Let K and L be subsets (concepts) of a conceptual space A. If K is a subset of L, then K is a subconcept of L. This kind of mereology may have any number of levels.

3) As a preliminary notion, we also suggest that narrative disposition can be inferred from mereological hierarchies, interpreted as dispositions of the entities. This will be sketched in the examples below.

3.0 Multi-perspective knowledge organization

We envision multi-perspective knowledge organization, interactive means of conceptualization that allow the observer to explore the topical domain from multiple perspectives in order to construct their individual conceptualization of the domain consisting of information elements. From each perspective opens an ontospatial disposition in which information elements link to each other in terms of similarity relations, allowing inference of concepts as exemplified below with an example domain.

3.1 Example: Economy stimulation policies

For a preliminary proof-of-concept, assume an on-demand compilation of articles on economical recovery stimulation policies. Since the challenge of designing and implementing multi-perspective information systems with actual content is way beyond the resources available, our example is based on an imaginary content database on policies adopted by governments to fight economical recession, a topic to which there is surely a range of perspectives.

Ontospatially described metadata for the content was generated manually to simulate stereotypical stances of 'Keynesians,' 'Neoliberalists,' 'Interventionalists,' and 'State-Capitalists,' four examples of each, referring to terms commonly used in the literature of economics, e.g., Jessop (2002). Each article is annotated in terms of ontodimensions, each referring to the degree of acceptance of a particular policy proposition. The metadata could potentially originate from some collaborative annotation practice ('tagging'), or they could be drawn from descriptive statistics collected by some automated text analysis, for example by means of deriving so-called subject access points from the documents themselves (see Hjørland 2003). Further, as our example shows, nothing excludes the possibility that they are authored by an expert either. Consider also an interface for interactive multi-perspective exploration of the content ontospace. In this example, a drag-and-drop interface allows ontodimensions to be taken into account by dragging them from the list of Ontodimensions into the Perspective column (middle), or vice versa, and to be mutually prioritized by dragging them up or down within the Perspective column. In the demo application[3] weight $p_i = 1/q$ is assigned to dimension i, where q denotes the priority order position—a function among many alternatives to implement a priority ranking among the dimensions. In response to each choice of perspective, the application generates a MDS representation of the topic domain on which proximity corresponds to similarity from that perspective, and displays it on the right column (Figure 1).

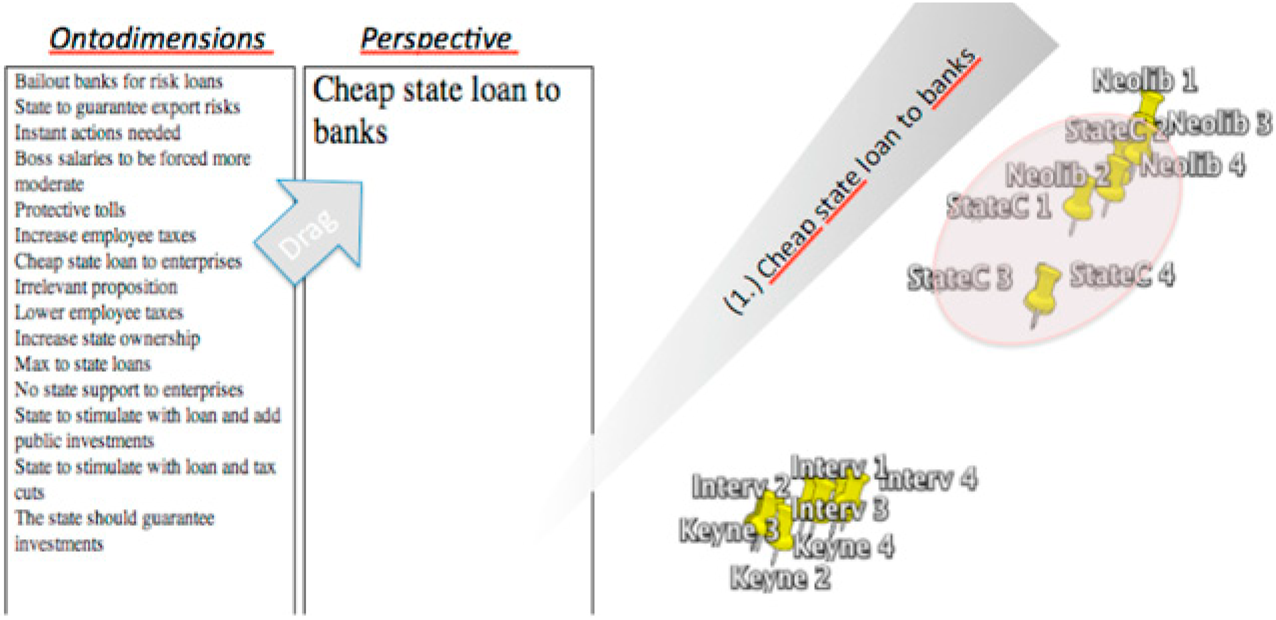

Figure 1. Ontospace of the domain of stimulation policies as it appears from the perspective of the single ontodimension corresponding to proposition "Cheap state loan to banks." By means of the proposed interface a perspective is taken by dragging chosen Ontodimensions from the left column to the Perspective (second left column) in order to have the spatial distribution of the content entities visualized correspondingly. The gray cone opens to the direction of increasing support for the proposition.

In order to demonstrate the emergence and consistency of concepts based on proximity-qua-similarity cross a sequence of perspectives, imagine the following exploratory sequence. Note that in computing the visualizations, labels are not taken into account, but they are provided only for the purposes of interpreting the results.

3.1.1 Perspective 1

As the initial perspective, draw proposition "Cheap state loan to banks" to the Perspective column, corresponding to weight $p_{\text{Cheap state loan to banks}} = 1.0$. This results in a one-dimensional sorting of the content, dividing the policies to two groups with the proponents on the upright.

In this case, the visualization suggests a polarization of the policies with respect to the chosen dimension between those standing for the proposal and those against it. It is to be appreciated that, even in everyday life, the initial understanding of a novel domain is often equally simple. The additional benefit of the spatial representation with respect to a regular list of search results is that it allows estimating the relative distance between the clusters and reveals variation between individual items. For example, it appears that the degree of agreement among the 'proponents' varies significantly more than that of the 'opponents.' This may give a hint of the need for further exploration of whether this setting is a flat oversimplification, or whether it holds also from some other perspective.

3.1.2 Perspective 2

To explore this further, drag dimension "Cheap loan to enterprises" to the second priority position in the Perspective column (Figure 2).

In terms of the spatial metaphor, the additional dimension reveals significant ontospatial depth of the conceptualization, revealing a three-component concept, projected on a two-dimensional map. Even so, it remains epistemically uncertain whether this conceptualization has continuity or higher-dimensional volume.

3.1.3 Perspective 3

Taking into account the additional dimension of "Increase state ownership" as the 3[rd] strongest proposition with $p_{\text{Cheap state loan to banks}} = 0.33$ still confirms the three-class conceptualization, but splits the "Keynes-

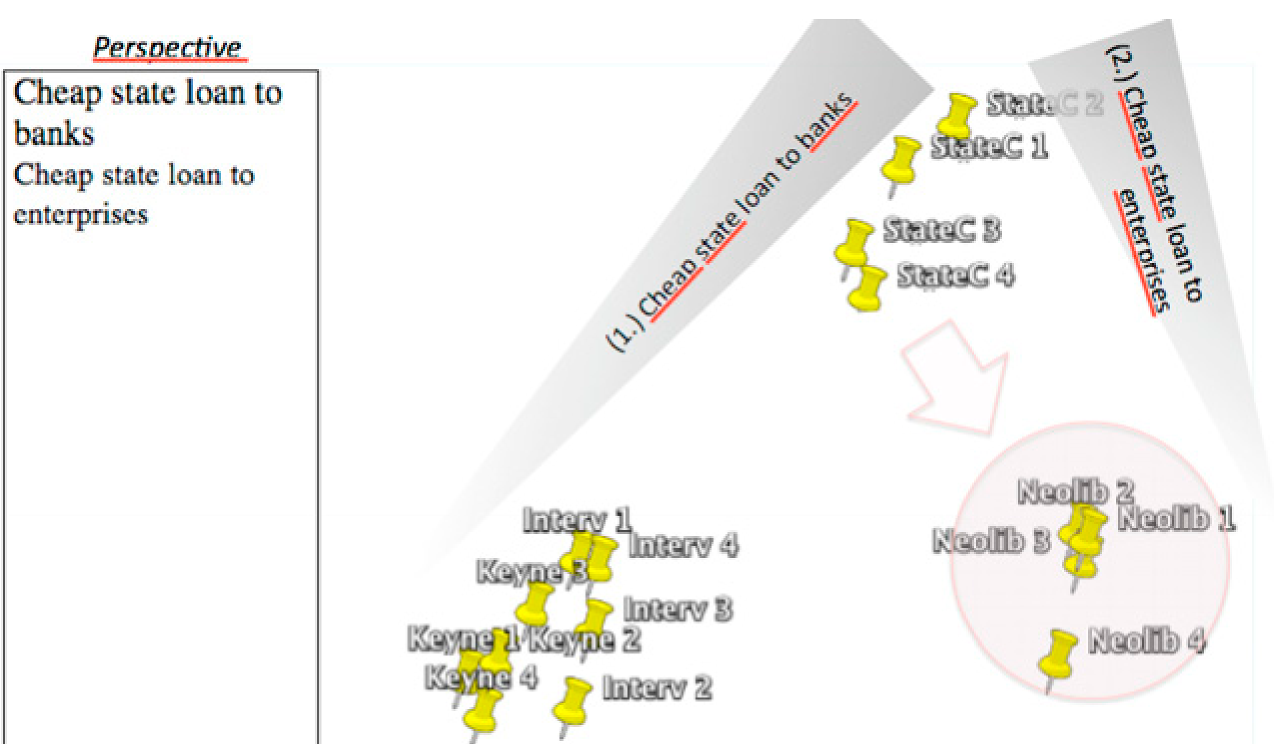

Figure 2. A three-part concept achieved by taking ontodimension "Cheap loan to enterprises" into account in addition to "Cheap loan to banks." The reader may imagine spatially 'peeking around' axis (1) to reveal the "Neolib" (oval-marked) cluster that was initially superimposed by the "StateC" cluster in Image 1. The first position in the Perspective column corresponds to $p_{\text{'Cheap\_loan\_to\_banks'}} = 1/1 = 1$, the second to $p_{\text{'Cheap\_loan\_to\_enterprises'}} = 1/2$, and so on.

ian-Interventionalist" class into two subclasses, thus revealing another dimension of the conceptual volume .

3.2 Conclusions

Our model suggests that conceptualization is like exploration of abstract entities in space, comparable to observing artifacts in physical space. Knowledge is constructed by means of integrating subsequent exploratory movements in the memory and considering similarity relations that constitute conceptual dispositions. At a given moment of the assumedly continuous exploratory process, the observer may infer the following.

3.2.1 Prototypes, categories and classes

Prototypes, categories, and classes may be founded on Gestalt-type perceptual interpretation of the visualization, but may also be additionally supported by algorithmic division, e.g., by means of prototype selection and subsequent Voronyi tessellation. These, in turn, may provide the basis of identification and naming categorizations, assuming that names are not given a priori. Our point is that, provided spatially constituted similarities, a range of means can be harnessed to serve explorative multi-perspective knowledge organization, which not only allows conceptualization-supporting visualization, but may even be applied for perspective-relative content montage.

3.2.2 Mereological hierarchies

Mereological hierarchies, as depicted by Figure 3, that support hierarchical navigation within multidimensional content, where each title links to the underlying content element, for example as below.

Economical recovery stimulation policies:
1. State Capitalist
2. Neoliberalist
3. Keynesian-Interventionalist
    3.1. Keynesian
    3.2. Interventionalist
        3.2.2 Narratives

Mereological hierarchy can be interpreted as a disposition for sequential narrative. Assuming that the ontodimensions reflect meaningful aspects of the con-

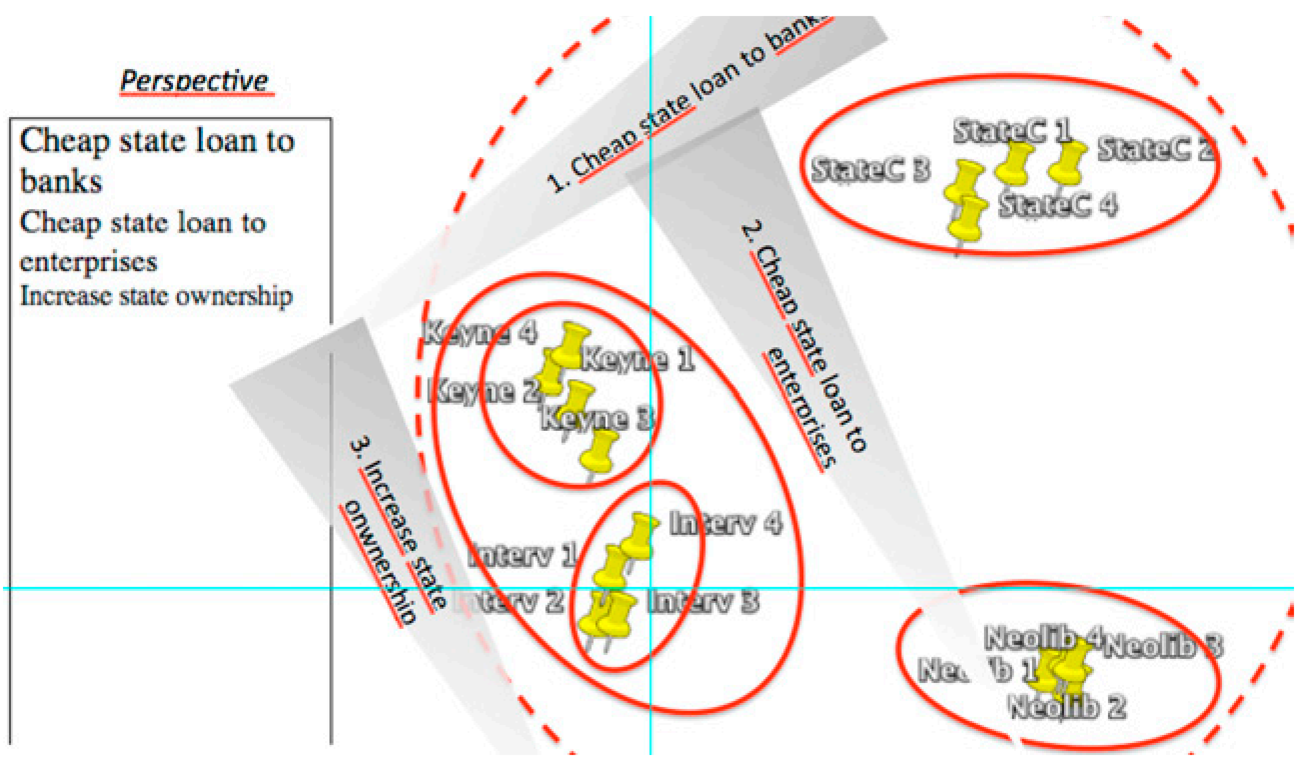

Figure 3. The introduction of third ontodimension "Increase state ownership" splits the leftmost cluster into two separate, yet mutually relatively similar clusters ("Keyne" and "Interv"), to be interpreted as a subdivision of a category. The hand-drawn ovals characterize the implied mereological hierarchy of three levels.

tent, the perspective-relative hierarchy forms a meaningful context for narrating the concept, for example as below:

> There are three kinds of economical recovery stimulation policies: State capitalist, Neoliberalist and Keynesian-Interventionalist. While state capitalists [content from database], neoliberalists [content from database]. Apart from these there are Keynesian-Interventionalist policies, according to which [fill in content from database]. Among the latter, Keynesian policies differ from Interventionalists in that [fill in content from database].

Consequently, knowledge is more than a static view of the relations between the elements. It is the dynamic understanding of the domain that integrates conceptualization from a range of perpectives, something that accommodates the fact that another observer may end up with a totally different, yet equally justified, conceptualization. The readers are invited to perform their own explorations with an online demonstration accessible on the Internet (http://mt.sh.se/ose).

4.0 Discussion

This article has drawn together implications from the discussions of epistemic and ontological pluralism in philosophy for information systems. From this ground, a reconsideration of ontology as a coordinate system serving dynamical conceptualization has been proposed. Further, we have elaborated a spatial model of ontology (ontospace), a system of multiple descriptive dimensions, within which entities of an information domain are described in terms of their respective coordinates. Here the activity of conceptualization can be seen as continuous exploration of perspectival views to the ontospace, based on the psychological and cognitive science models of similarity as spatial density. Each perspective to the ontospace constitutes a unique set of criteria for similarity among the elements. As we have shown, each perspective to the ontospace allows for a particular cognitive-perceptual construction of 1) concepts as regions of the ontospace; 2) their interpretation as prototypes, categories, and tessellations; 3) hierarchies of mutually embedded clusters, and even their translation to 4) sequential narrations.

As a preliminary proof of concept, we have drafted an interactive tool, a perspective-relative means of knowledge organization that supports the participant's mental conceptualization, linkings and narratives to grasp the relations of the artefacts displayed. We apply this tool to an imaginary domain in order to demonstrate how epistemic involvement contributes to conceptualization. Each perspective explored amounts to a particular way of classification, categorization, hierarchization and narrating the topical content, as we claim,

While this study makes the shortcut of assuming an ontospace as given, in practice, the issue of annotation remains open for multiple solutions. Obviously, the method of annotation is crucially related to the amount of labour and cost of multi-perspective knowledge organization—and thereby its viability in general. A path already suggested is that the ontologies result from collaborative annotation or 'tagging,' assuming that the practice is immersed in the context of a social or collaborative practice. In some cases, 'tagging' can take place implicitly by means of behavioral tracking of measurements. Another possibility is that the annotations are collected by means of automated text analysis, although this would also mean inheriting a range of semantic-related issues therewith.

Our version of perspectivism is compatible with pragmatism and historicism, but goes further by providing a formal model for expressing different points of view. We believe that our approach provides not only an instrumental formalization for information retrieval based on an empirical attitude towards classification of documents. It goes even beyond retrieval to what can be considered conceptual articulation of information. In this sense, this can be said to amount to being a medium and to involve mediation. Applications of multi-perspective knowledge organization in interactive media can be envisioned, including websites presenting, say, compilations of daily news flow, whose hierarchical disposition (or 'navigation') is regenerated for each individual perspective chosen, interactive films that adapt their narrative in realtime or on-demand books, of which the disposition is determined by the perspective chosen by the buyer before it is printed out.

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