

Knowledge of places: an ontological analysis of the social level in the city

Maria Rosaria Stufano Melone*, Dino Borri*, Domenico Camarda*, Stefano Borgo**

Abstract

In this paper we develop an investigation about geographical places as complex spatial environments. The approach we explore is based on ontological analysis. We aim to integrate a cognitive stand within the traditional analytical and organizational views of complex spatial environments. Our focus is about facilitating decision-making processes.

The introduction of ontological levels is rather useful for organizing the modelling of complex systems. The levels we elicited are informative, anyway our understanding of space cannot lack the contextual perspective of every single place and of any single individual. Our research is still ongoing, and following researches are needed to develop a formal framework that can completely integrate standard and ontological methodologies for a general contextual knowledge.

Keywords

Spatial cognition, Ontological analysis, Cognitive modelling, Spatial planning

* DICATECh, Politecnico di Bari, Italy

**Laboratory for Applied Ontology ISTC CNR, Trento, Italy

Introduction about place: the space we live in

Place is an interpreted space and a reasoned space, and the concept of place is typically the result of an aesthetic fruition. The essence of a place lies in the quality of its being somewhere specific, it concerns the knowing that one is "here" rather than "there" (Rapoport, 1977). In this perspective the concept of being enclosed becomes a very important aspect of the making of a place.

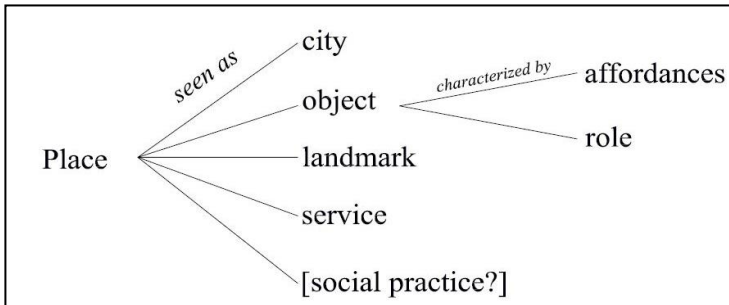


Figure 1 - About the place

Places are understood primarily through cognitive contexts. We *read* places we live in. Thanks to geometrical rules/indications we can interpret our being in a space in an objective proposition but at the same time our being in a place is defined only with richer descriptions that are not objective but subjective. Every single person in a place has a subjective point of view and that point of view characterizes lived places. Our knowledge of places can derive from experiences, from stories that structure ideas and feelings about them. ‘Subjective knowledge’ is a kind of representation of places, and a representation vary from subject to subject and even across one’s life (Orr, 1992). “Knowledge of a place — where you are and where you come from — is intertwined with knowledge of who you are.

Landscape, in other words, shapes mindscape.” (Orr, 1992, p.130).

Scientific research has tried to get a definition of representation of space/place in various interested domains. Research in applied ontology (Borgo, Masolo 2010) has developed methodologies and tools to move forward in this direction. A prerogative of the ontological approach is that ontologies are typically an abstract construct, away from data structures and implementation strategies and the ambiguities of the natural language. Here we are writing about ontology as a technical term denoting a conceptual artifact that is designed for a purpose, which is to enable the modelling of knowledge about some domain, either real or imagined (Gruber, 1993).

The languages for ontology have formal semantics aimed to improve understanding and interoperability across systems and users.

A case for urban planning

Planning activities are often oriented to manage complexity as the result of a recurrent interaction between collective knowledge and the desired results, trying to envision desired futures. Because of this occurrence, it is necessary that planning aims at matching the aspects of urban design with its inherent political dimension (Formato, Russo, 2014). An urban project or a plan or a strategy needs to evolve over time, it can't be frozen like a snapshot (Gregotti, 2004). It needs to be continuously updated and steadily shared by all the interested people.

The planner, as well as the urban designer, has always to look at changes of the territory and to read the different relational aspects occurring between built space and the complex urban and social organization that inhabits it. Architecture,

social sciences or anthropology play active roles in devising and developing urban projects. As in an anticipation game, a city needs to be thought as a relational system made of a whole, not merely a composition of districts (Ingallina, 2007). Therefore, for planners as well as for decision makers, it is important to model enriched, reliable and shared future places.

Urban spaces often have anonymous creators: the social collective agent that does not have well-defined and limited times/goals/consciousness. Today there is an evident trend toward an integrated conception about the designing process of a plan. During the last years, an awareness about the complexity and the dynamics of a spatial-organization structure has been growing over time.

During the making of a planning process (for an example made of dialogues, analysis, individuation of needs and goals), it is important not to forget that sophistication and ingenuity do coexist. Otherwise, the risk is to build an ineffective communication, full of ambiguities and consequently to achieve inadequate and ineffective (if not damaging) decisions.

Dealing with geographical places

Ontological analysis is the study of what is at the core of our view on reality. It can give an important contribution to recognize the essential elements and features of places, to clarify and discriminate their properties and attributes and of course to organize them. In fact, it is crucial for humans (and non-human systems) to be able to distinguish and share meanings about objects, properties and processes. In searching for a general framework where to discover and organize this kind of information, we can list a few levels that seem quite relevant. We propose to subdivide these

levels as follows: spatial, artifactual, cognitive, social, cultural and processual. These levels, in turn, can be subdivided in finer levels as we can see from these cases: in fact, the chain of granularity could be long and with a complex path.

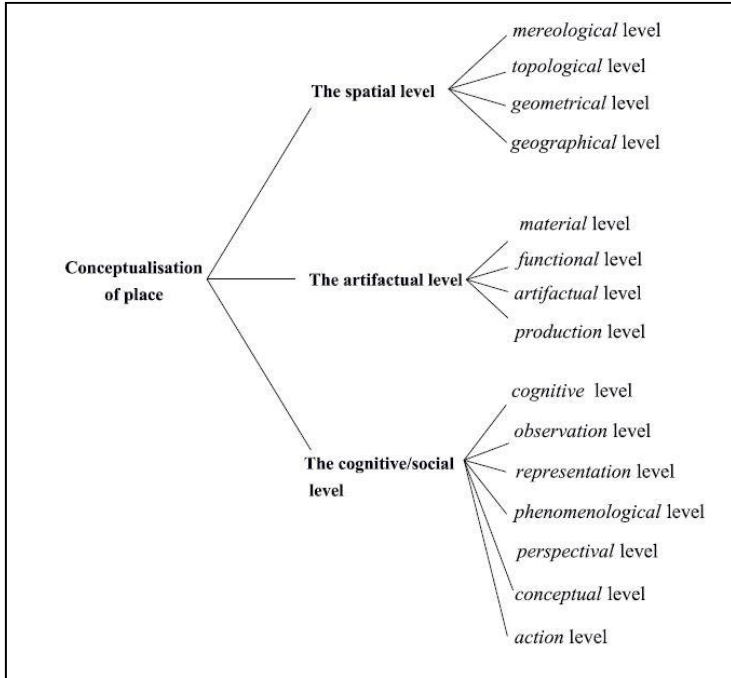


Figure 2 – Levels for the conceptualization of place

The spatial level

The spatial level is of course the most studied level because it is in large part independent on the subjective perspective and it easily leads to ontological analysis and formal representation (Bateman *et al.*, 2007; Borgo, 2007). Under this level we can point out some sub-levels, i.e.: (i) the *mereological* level within which one understands space in terms

of parts, e.g., recognizing the distinction between an area and its neighbourhood; (ii) the *topological* level within which one understands space in terms of contact and unity, e.g., recognizing the contiguity between neighbourhoods and the unity of a city; (iii) the *geometrical* level where one understands space in terms of shapes, e.g., recognizing that the shape of a city is constrained by that of the valley where it is located; (iv) the *geographical* level in which one understands space in terms of locations and descriptions, e.g., distinguishing between being along a river or having a radial disposition in space.

The artifactual level

The artifactual level is about recognizing the physical realm and how human activities can change it. The artifactual level adds an intentional aspect to the environment (Borgo *et al.*, 2011). We propose that this level is organized in sub-levels too, e.g.: (i) the *material* level where one understands space in terms of materiality, e.g., seeing the presence of wood, concrete, water; (ii) the *structural* level that allows to understand space in terms of qualified components, e.g., distinguishing natural vs. man-made and a residential vs. a production area; (iii) the *functional* level where one understands space in terms of functionality, e.g., recognizing a building as a shelter; (iv) the *production* level, which looks at entities as manipulation sites, e.g., seeing a farm as production site.

The cognitive level

The specific abilities of humans are at the core of this level. Here we can distinguish: (i) the basic *cognitive* level that allows to understand space in terms of experience, e.g., perceiving how to move across objects in space; (ii) the *representation*

level that leads to understand space in abstract terms, e.g., perceiving the relationships among areas in an airport; (iii) the *observation* level that lets one understand space in terms of how things in it may change, e.g., perceiving the change in the transportation system; (iv) the *phenomenological* level, where one understands space as a moving entity, e.g. perceiving a city as evolving; (v) the *perspectival* level that allows to understand space from a perspectival viewpoint, e.g., differentiating a square depending from where one is looking at it; (vi) the *conceptual* level, where space is seen as a collection of realized concepts, e.g., perceiving space as the manifestation of natural and artificial objects; (vii) the *action* level, where one understands space as an entity in which to act, e.g. perceiving the changes that one can enforce on things.

The case study

The aim of our research and of the method we are proposing is about planning process. Our core point is trying to make communication and knowledge exchanges disambiguated: this would make the contexts at hand clarified to all participants to the process itself.

Participatory mechanisms of knowledge about and for spatial organizations rely on facilitation agents (as knowledge engineers), who are also in charge of preparing essential knowledge basis about the issue to be dealt with. The whole process is a complex path, and it is subject to possible biases (as inconsistencies, inadequacies, misunderstandings, etc.) towards to the paradoxical Babel effect for the development of plural knowledge.

In previous works (Stufano Melone *et al.*, 2017) we reasoned toward applying the ontological analysis of places. In the present case, as a pilot project for testing our frame, we have

worked on data collected for the making of Taranto strategic plan toward 2065. Data were collected via a series of nine community-based, interactive processes of knowledge exchange, aimed at building future scenarios for the new plan by using the *future workshop* approach (Khakee *et al.*, 2002). The interactive processes of knowledge exchange were carried out in Taranto, a city in southern Italy, during spring and summer 2014.

Analyzing the social level

The application of our research approach and method can be set up through the following steps:

- Building the theoretical framework
- Incorporating task's data or elements
- Analyzing the levels of the framework in relation to the data, one at a time

This analysis is useful to test if every level is well structured or if it is necessary to model additional information to characterize the specific sub-levels.

With the aim of testing our proposed framework, it was useful to start from some given data for a first delineation of 'objects', 'attributes' and 'relations' populating the different levels. We started from the social ontological level since the material collected in the Taranto case study was rich from this perspective. As previously written, the material collected in Taranto was not built under the present research perspective. This involves its unsuitability for an analysis of the remaining levels, e.g., cognitive and spatial ones.

Because of its broad connotation, we have to limit the boundary of the meaning of 'social' in this first analysis. The data we worked on focused primarily on social reference points, i.e., the elements that people use to identify an area or to navigate across the city. We observed that at the social level it can be difficult to elicit the distinction between

formal and informal knowledge, because social knowledge is primarily informal, tacit and implicit. The first analysis singled out references to places and landmarks, because of the relevance they have in social practices, listing relevant entities and some relationships. Once collected, entities can be classified in ontological terms following a foundational ontology like DOLCE (Borgo, Masolo, 2010).

From the data we had about the social level, it clearly emerged that the objects of the city are not mere building, locations and landmarks. These terms are used to indicate complex cognitive objects enriched with a set of different meanings/signifiers that can be contextual. A building can acquire different meanings depending on the time and even on the person that mentions it. This analysis has shown that at some point it will be necessary to elaborate complex definitions for such entities.

Analysing Taranto's social level data, the different way of looking at the city among technicians and inhabitants appeared. There is a distinction from objects which are taken at their face value like buildings of low interest, the cruise ships and, from some aspects, the sea itself and objects that mean something else. Indeed, the same term can occur during the discussions with different meanings, e.g., as a landmark and as a generic building. Many entities have special social roles -like the city itself which is historically intended as the capital of Magna Graecia. Another layer of meanings is introduced by reference to the service level that includes public services like restaurants, cafes and shops, bathing establishments (this time the term denotes the service, not the physical entity nor the landmark), the university and the pedestrian network across the city (mainly identified in special areas like the waterfront). From available data desired features emerged, which can be understood in different ways, i.e., as functional objects, as reassessment of existing objects, as services, as norms or generic topics. Here

we found out: the work to be done, areas to be closed to traffic, primary and secondary infrastructures, regulation of public spaces.

The networked layout of meanings highlighted by the ontological analysis can be shown by looking at a single object (for instance, the San Cataldo cathedral) and then generalizing it. We applied an ontological analysis to this object from the perspective of the social level: San Cataldo cathedral is a building with a relationship to space in terms of occupancy of an area, separation of inside vs. outside, shape and location. The church itself is a material object that affects the surrounding elements in terms of size and occlusion, and even its colour affects the perception of the area. It has a particular internal subdivision and its functional classification determines the intended as well as the unintended uses. These are all distinct meanings that the church building brings up when one refers to it. This network of meanings is enriched by the roles San Cataldo plays, e.g., in the hierarchical ordering (not just a church but a cathedral) and in the social habits (a safe place, a place where to talk, a place where to hide) with all the interconnection across these roles. All these meanings have a position in the ontology and by collecting and classifying these meanings, we build an explicit representation of this implicit network. Via the ontological system, we can then explain which meanings are triggered in a discussion and even identify those that form bundles for the inhabitants.

Through this kind of analytical effort, we elicit the local “culture” of the inhabitants, the way they tend to understand their own place, and even what they (perhaps unconsciously) consider to be the primary relationships between the elements in it.

Discussion and conclusion

In this paper, we tried to highlight how complex and rich are planning processes, and how more complex are the participated ones.

The participatory knowledge of (urban) architectural spaces is full of qualitative and narrative descriptions. In general terms, we can say that participatory knowledge is oriented to three identifying dimensions (by name, by function, by localization) among which apparently there are no hierarchies. An exception could be the dominance of the name (which is function and also localization). Nevertheless, there are relationships and redundancies, in the sense that name is function. The outcomes of participatory conversations in both architectural and non-architectural space organizations can quickly provide site and agent positioning knowledge (for varied situations: transformative, emotional, evaluative, orienting, etc.) whose level of structuring in relational terms is usually low. It is so low that it cannot be a basis for behavioural performance in material (operational cognition: design-realization) and immaterial (cultural cognition: case comparison, structural critique) manipulation of spaces characterized by a sufficient degree of integrated social acceptance (which is obviously the only type of valuation possible within knowledge systems integrated between expertise and common sense).

The complex cognitive dialectics between expert knowledges and non-expert knowledges is characterized by 'cognitive balances' between the different cognitive subsystem involved. This is framed in the anthropology of an even more complex cognitive milieu whose structures are formed by distinguished relations between the different agents (human and not-human, biotic and abiotic in the socio-technical systems). Those relations are developed dynamically and in contingent situations that could be

analyzed via a theory and a method based on ontological analysis.

There is a strong perspectival aspect in the way we live in places, a kind of description (mostly implicit) of the place that includes what are for us the relevant elements in it and their relationships. We can elicit a general position from that. In the perspective of analyzing place, the deriving information entity contains: a (typically partial) description of the place, what is in it and how the place is evolving (e.g. things moving, leaving or arriving, agents acting and transforming them etc.) and possibly the potential interactions between us and what is in the place. A place is grounded, as opposed to a generic location, is a context that refers to one or more actual/existing entities.

A place is however also something that goes beyond the single agent. It is the result of many shared links across ontological analysis. The classification of what we use to understand places -in general- and the actual place that we are experiencing -in particular- is then a powerful tool for a more comprehensive representation of places. For this reason, we insist that the analysis should include the physical elements (e.g. location and objects), the material components and layout (e.g. enclosed spaces, object distribution); the agentive figures (e.g. habitants, organizations, social roles) the relationships across them and the objects (e.g. generic dependences and actual goal or habits).

In this perspective, the present paper is a step along the path of a thorough ontological analysis, i.e., the tool that in our research we pose as useful to untangle the complex knowledge lying in the places that form city environments.

References

- Bateman J., Borgo S., Lüttich K., Masolo C., Mossakowski T. (2007), Ontological modularity and spatial diversity, *Spatial Cognition and Computation*, 7(1), pp. 97-128
- Borgo S. (2007), How formal ontology can help civil engineers, *Studies in Computational Intelligence*, 61, pp. 37-45
- Borgo S., Franssen M., Garbacz P., Kitamura Y., Mizoguchi R., Vermaas P.E. (2011), Technical artifact: An integrated perspective, *Frontiers in Artificial Intelligence and Applications*, 229, pp. 3-15
- Borgo S., Masolo C. (2010), Ontological foundations of DOLCE, in Poli R., Healy M., Kameas A. (eds.) *Theory and Applications of Ontology: Computer Applications*. Dordrecht, Springer, pp. 279-295
- Borri D., Scandale L. (2005), Aspetti cognitivi e organizzativi di campagne politiche come strumenti di visioning e pianificazione strategica. Evidenze dal caso dei 'Forum per Bari', in Bruzzo A., Occelli S. (eds.), *Le Relazioni tra Conoscenza e Innovazione nello Sviluppo dei Territori*, Milano, Franco Angeli, pp. 100-121.
- Armiero M. and Barca S. (2004), *Storia dell'Ambiente. Una introduzione [History of the Environment. An Introduction]*, Roma, Carocci.
- Formato E., Russo M. (2014), Re-use/re-cycle territories, *TeMA - Journal of Land Use, Mobility and Environment* [<https://doi.org/10.6092/1970-9870/2496>]
- Freksa C., Nebel B., Hegarty M., Barkowsky T. (eds.) (2014), *Spatial Cognition IX*, Heidelberg, Springer.
- Gregotti V. (2004), *L'Architettura del Realismo Critico*, Roma, Laterza
- Gruber T.R. (1993), A translation approach to portable ontology specifications, *Knowledge Acquisition*, 5(2), pp. 199-220

- Heft H. (2013), Environment, cognition, and culture: Reconsidering the cognitive map, *Journal of Environmental Psychology*, 33(0), pp. 14-25.
- Ingallina P., (2007), L'attractivité des territoires : Regards croisés, *Report PUCA - Plan Urbanisme Construction Architecture* [http://www.urbanisme-puca.gouv.fr/IMG/pdf/actes_attr_territoires.pdf]
- Khakee A., Barbanente A., Camarda D., Puglisi M. (2002), With or without? Comparative study of preparing participatory scenarios using computer-aided and traditional brainstorming, *Journal of Future Research*, 6, pp. 45-64
- Orr D.W. (1992), *Ecological Literacy: Education and the Transition to a Postmodern World*, New York, SUNY Press
- Rapoport A. (1977), *Human Aspects of Urban Form: Towards a Man-Environment Approach to Urban Form and Design*, Oxford, Pergamon.
- Stufano Melone M.R., Borri D., Camarda D., Borgo S. (2017), Role and goals of ontological analysis in understanding space and places, *AESoP Conference on Spaces of Dialog for Places of Dignity*, Lisbon, July 11-14.