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Social psychology insights into ontology engineering

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HIGHLIGHTS

- An ontology is a shared conceptualization establishing what must be the "truth".
- There is a conformism to and of the ontologist and to the choice of formalism.
- The expert, by its special position recognized, has an influence on the individuals.
- Can we use texts as the correct transposition of the domain knowledge?
- The ontologist role is to translate a social representation into a formal language.

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ABSTRACT

The Social Psychology perspective provides a new look into the ontology engineering processes. In this paper, we analyze in particular how ontologies, as formal psycho-social entities, are the outcome of influences. The types of influence range from the sources (originating from the experts and the corpus authors) to the ontologists. As it is impossible to design an ontology without any influence, the ontologist should develop his awareness and has to minimize the influence through the process by taking precisely into account the ecosystem considered.

1. Introduction

Most articles, and other work regarding computational ontologies, provide in their preamble the definition proposed by Gruber [1]: "explicit specification of a shared conceptualization" (or by Borst [2] referring to formalization instead of explicit specification). Behind this definition, Guarino et al. [3] distinguish three notions that these authors are trying to explain. First, it is a *conceptualization*, *i.e.* "an abstract, a simplified view of the world[1] that we wish to represent for some purpose" (in reference to the work of Genesereth and Nilsson [4]). Secondly, a computational ontology is a formal entity. It is an explicit specification using a language – typically from the family of description logics – referring to the different elements (i.e. concepts/classes, instances, terms, properties and relationships). Thirdly, a computational ontology is a shared conceptualization. It is a consensual expression of a representation that one or more individuals have of their world. It is "a structure of domain where subjects understand its primitive terms in the appropriate points of view". Nevertheless, for these authors, a formal conceptualization could be unshared in the case – for example – where it models the conceptual level of an individual. For these authors, a formal conceptualization may not be shared when it is modeled at the individual level. According to Uschold [5], "every person, organization or system has an [often tacit] ontology on the things presumed to exist in the world and how they behave…These ontologies pervade and underpin our deliberations, inform our decisions and guide our actions". And a shared

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[1] Guarino et al. [3] define this conceptualized world as "a totally ordered set of world states, corresponding to the system's evolution in time".

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conceptualization may not be formal when a set of specific knowledge is considered by a given group of persons "to be clear about what things mean and in doing so, gets everyone on the same page" [5]. In this paper, we propose to focus on this last point from the social psychology perspective.

Doise and Mapstone [6] define social influence as a "set of processes that modify perceptions, judgments, attitudes or behavior of an individual based on his knowledge of perceptions, judgments and attitudes of others". Taking into account the cognitive component of these elements as well as the point of view of Fischer [7] who considers the influence as both cause and effect, then an ontology could be viewed as a social object. This social object would be both the result of social influences in its construction phase and the object of social influence in its use. In this paper, we aim at highlighting the critical points of the conceptualization phase. These critical points are well-known problems that are addressed by the social psychology and the cognitive psychology. These approaches have been applied to the ontology engineering.

Although the ontologies development begins to democratize and is gradually getting out of the research laboratories, the creation process of large ontologies remains an open question. Gandon [8] offers five successive steps to develop an ontology: (1) ontology specification, (2) resources definition, (3) data analysis, (4) conceptualization and (5) ontologization/formalization. Bachimont et al. [9] bring together the first four phases in a first level called "semantic engagement", and the formalization phase in a second level called "ontological commitment". Our work, presented in this paper, only focuses on semantic engagement and does not affect the conceptualization formalization.

Based on the perspective of the various fields of psychology, the aim of this paper is to make an inventory of the different leverages that influence the process (and related resulting bias). From the inter-individual point of view, an ontology is the result of all group members influences (normalistic approach) or of the influence of part of the group over other group members (conformist approach). From the intra-individual point of view, personal conceptualizations are subject to many influences such as culture, emotions or standards. These inter and intra-individual variations are observable not only in terms of categorization but also in terms of typicality. We try to consider the ontology in its wholeness and complexity by taking the most ecological approach. Specifically, the ontology has a greater chance of appropriation by its users when it integrates the ecosystem in which it has been developed. This appropriation may be (1) direct, as a form of internalization of the modeled conceptualization, or (2) indirect, with a good recall and high precision in semantic query extension as part of an information extraction process.

Our paper is structured as follows. The conformist approach is defined in Section 2. The importance of the expert choice and the possible ontologist influence are shown in Section 3. In Section 4, we present the problems related to the use of a corpus in the ontology design process. Finally, in Section 5, we conclude this paper with several questions on the difficulty to engineer an objective ontology.

2. Conformist approach of ontologies

In 1785, Nicolas Condorcet showed in his work on the application of the analysis to the probability of the decisions using the plurality electoral formula that: "the democratic system delivers balanced decisions on condition that each voter ignores the decisions taken by the other group members". This fact is also considered in Games-Theoric [10] and used in work like [11].

There are several forms of conformity. There is the *complacency*—or conformism utilitarian purpose. By adhering to the positions of the group, the individual does not wish to enter into conflict with it. There is the *identification*—or conformity by attraction. In a mutual interest objective, the individual complies with the group's positions in the desire to establish and maintain positive relationships. And finally, there is the *internalization*—or conformity by confidence. This is the biggest influence of the group on the individual who is fully committed to his values and endorsed it.

In the context of ontologies, it is possible to recognize the conformism influence type in the engineering phase and the use phase (which is even a condition *sine qua non* to ensure that the ontology is used/appropriate). Currently, if an ontology is not built (neither validated) in a collaborative process, it is based on (1) pre-established nomenclatures, (2) a representative domain-related corpus of texts and whose authors have the status of experts, and (3) knowledge expressed by these experts (during the phases of conceptualization and validation). We are witnessing here conformism on several levels:

- ontologists compliance (and later the ontology users compliance) with: (i) the pre-existing norms incorporated into the ontology, (ii) the experts (cf. Section 3) and (iii) the authors of the texts selected to design the ontology (cf. Section 4);
- compliance with the ontologists selecting the sources. It can affect the experts in the knowledge gathering phase;
- compliance with the choice of formalism and standards (choice of top-ontology, for example).

In order to reduce this influence point, it could be interesting to adopt a collaborative methodology. This idea of collaborative construction is also defended by Kotis and Vouros [12], offering the HCOME methodology (a Human-Centered Ontology Engineering Methodology). The HCOME project authors also make the following observation: "existing ontology engineering methodologies emphasize on the role of knowledge engineers (or of a central structure governed by a control board, whose tasks is to collect and analyze change requests to a single shared ontology) in the ontology life-cycle". Their methodology involves all users at all stages including the design phase, the ontology validation or the update. It is based on the concept of *Knowing* [13], a set of individual knowledge (acquired through experience, among others) and collective knowledge (as a result of the interaction among the various group members). This transdisciplinary project establishes a link between cognition, ergonomics, psychology, sociology and computer science.

The ontologist using expert inputs should be able to assess the authority of such experts. It is essential to evaluate the status of the knowledge to be delivered to ensure a satisfactory and relevant ontology knowledge appropriation.

3. From experts influence to ontologists influence

The experts can be likened to leaders in the sense that they have a significant influence on the group by the knowledge they have in a given domain (i.e. their expertise). The *influence style of the expert* depends on several parameters. The Tannenbaum and Schmitt model [14] identifies three parameters: (1) the leader characteristics, (2) the group characteristics (autonomy, competence, acceptance of change, etc.) and (3) the context (type of problems, type of the interest domain, etc.) Lippit and White [15] distinguish three different aspects of the leader's impact: (1) socio-emotional climate, (2) performance, and (3) the cohesion. According to Antonin Gaunand, lecturer in leadership and management, there would be a new kind of leader: the Manager of collective intelligence. This is the portrait-type of the useful and efficient expert in ontology engineering. According to this author, it is an individual who "does not keep his knowledge for himself. Within his company, he shares