Utilizing OWL for Wittgenstein's *Tractatus*

Amélie Zöllner-Weber, Bielefeld, Germany / Alois Pichler, Bergen, Norway

This article presents experience gained from an attempt to develop an ontology for Wittgenstein's *Tractatus*. The term "ontology" is here used as in computer science (Artificial Intelligence). A computational ontology structures information hierarchically and supports semantic retrieval and reasoning. In this article, we outline the mentioned ontology, its development as well as possible applications. Several projects in the field of humanities have already utilized or developed ontologies for different topics. But modeling topics using ontologies represents just a starting point for more advanced (computational) applications in the humanities. In philosophy, the development and application of ontologies seems still at an early stage. With this article, we wish to help catalyse and develop this process further.

1. Introduction

Ontologies as they are used in Computer science[1] include taxonomies of our conceptualization of a part of the world. This part of the world is called the *domain*; an ontology structures this domain hierarchically into *classes*; the classes can have *properties* (*slots*) and *restrictions*, and *instances*, individual objects, which can be attached to a class. Although the structure of an ontology is rather static, the information included in the ontology can be queried and manipulated in several ways. Ontologies are used today in a wide range of fields, including research, industry and the public sector, primarily to help organize and retrieve semantic information, or more generally, to express structured information. In the last years, such ontology work has also entered the field of humanities and linguistics. Several applications of ontologies have already been developed in linguistics,[2] library science[3] and literature studies.[4] Even though one would expect that formats already developed to express and utilize ontologies are just as useful for storing, retrieving and processing data in the humanities as they are in other areas, using ontologies in the humanities is not yet very common.

For this paper, a Wittgenstein scholar on the one hand and a scholar on ontologies on the other (and both with a heavy interest in Digital Humanities), have come together in order to explore the possibilities for fruitfully applying the method of ontology to a piece of philosophical writing, Wittgenstein's *Tractatus logico-philosophicus*. The idea behind this endeavor was to investigate to what extent it is possible to model the content of a philosophical text such as Wittgenstein's *Tractatus* using a formal ontology language, as well as to test subsequent computational applications. This is not a task which is far removed from either the humanities or philosophy. In fact, in 2006 the EU decided to finance, through its *e*Content+ program, a project in philosophy which has semantic enrichment and ontology based machine extraction of philosophical information on its primary agenda.[5]

For our purpose of building an ontology for the *Tractatus*, we have chosen a popular and widely used ontology language: OWL.[6] The fact that OWL works strictly hierarchically and is focused on instances, seemed an advantageous feature, since the *Tractatus*, at least at first glance, appears to be a work which is hierarchically structured and has a conception of (a part of) reality which can easily be categorized into *classes*, *subclasses* and *properties.* Also, the *Tractatus* – with its discussion of *Gegenstände* and *Namen* - seemed to provide the *referents* required in any ontology making which is oriented towards *instances*, much more than most philosophy texts. In the course of applying OWL to the *Tractatus* we discovered, however, that things were more tricky than it at first seemed. In particular, the ontology's hierarchical demand and class-subclass (*genus-species*) focus posed challenges which may show yet unresolved problems for its applicability in the humanities more generally. At the same time, applying such a strict language as OWL to relatively un-strict philosophy texts, or even literary texts, will nevertheless always help to illuminate one's understanding of these texts and to explicate, communicate and document this understanding. The limitations which we encountered in our small project have therefore not discouraged us from continuing to build and utilize ontologies for philosophy texts, since the advantages remain substantial.

In the following, we first present OWL in more detail. An outline of a part of the ontology is then given and possible applications are sketched. Finally, problems and limitations as well as advantages of our ontology approach are discussed.

2. Applying OWL to Wittgenstein's *Tractatus*

OWL was introduced to enable machine-processing of semantic information on the internet, including logical reasoning: "The OWL Web Ontology Language is designed for use by applications that need to process the content of information instead of just presenting information to humans."[7] There are different versions of OWL, which involve different degrees of rigorousness: In *OWL Full*, every object of the ontology can take on all ontology categories, i.e. *class*, *instance*, etc.[8] By contrast, in *OWL DL* (*D*escription *L*ogic) objects have to be defined uniquely. This prevents certain problems in applications of the ontology. Especially for logic-based applications, OWL DL is most adequate. Users who have already specific applications in mind can create limited and small ontologies with *OWL Lite*. OWL DL seemed for our purpose the most apt version since the developed ontology should eventually be applicable also to other philosophical texts, while at same time also permitting applications which are as rigorous and controlled as possible.

[1] It is only in this sense we use the term here. Computational ontologies were first introduced in *Artificial Intelligence* (AI) where they focus on the modelling of concepts and their relations in computer systems. See Gruber 1992, p.199: "An ontology is a formal, explicit specification of a shared conceptualisation."

[2] This includes *GOLD*, an ontology for descriptive linguistic (http://www.linguistics-ontology.org/gold.html) and *WordNet*, a lexical reference system (http://wordnet.princeton.edu/).

[3] See the *FRBR ontology* for bibliographic records (Renear 2006).

[4] See Zöllner-Weber 2005.

[5] DISCOVERY - Digital Semantic Corpora for Virtual Research in Philosophy; see http://www.discovery-project.eu/.

[6] OWL - W*eb* O*ntology* L*anguage*; see http://www.w3.org/TR/owl-features/.

[7] Web Ontology Working Group 2004, see http://www.w3.org/TR/owl-features/.

[8] See Antoniou and Harmelen 2003.

To build our ontology, we identified first central concepts of the text and then modeled their relations in a hierarchy.[9] After several revisions, we settled on making *Wirklichkeit* and *Bild* superclasses of the ontology, while other concepts, including *Sachverhalt* and *Element*, were defined as subclasses. Our going back and forth was caused by the difficulty met identifying which *classes* would allow the most smooth and consistent inheriting of *properties* throughout the level of *instances*. It quickly became clear to us that the hierarchy and inheritance character of the ontology as also its intended *genus-species* structure met serious obstacles in the text. At the same time, it is through these filters that one very effectively detects that the conceptuality of the *Tractatus*, at least partly, opposes the hierarchy and inheritance characteristics of, for example, zoological taxonomies. Fig 1 shows a part of the class structure of our *Tractatus* ontology.

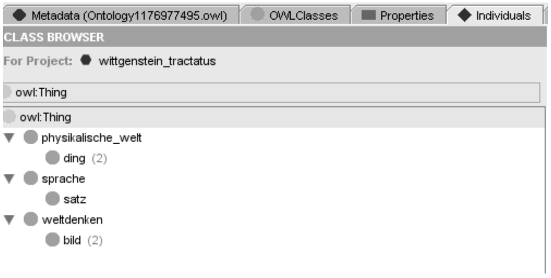

Fig 1: Extract of the ontology in the Protégé editor. Every point represents a class; the class hierarchy is represented by indentation.

For building ontologies, the identification of *instances* or *example realizations* is crucial. But the *Tractatus* is very sparse in giving concrete examples. Nevertheless, we identified at least a few instances, including *roter Fleck im Gesichtsfeld* and *hoher Ton*. Features of the instances were expressed by attributing different *properties*, e.g. *Färbigkeit*. To enrich the informational content of the ontology, the properties were also hierarchically ordered as is shown in Fig.2.

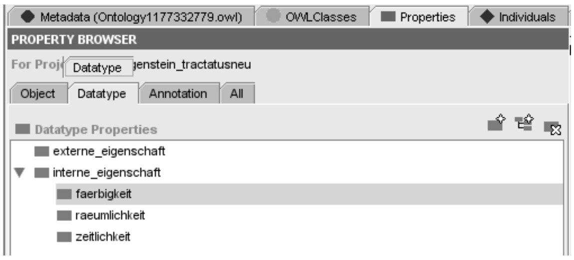

Fig. 2: Properties *externe Eigenschaft*, *interne Eigenschaft*, *Färbigkeit*, *Räumlichkeit*, *Zeitlichkeit*, hierarchically ordered in the Protégé editor.

We are aware that the structure of our ontology can be debated and questioned on the basis of a different understanding of the *Tractatus*. This is, however, not the place to discuss adequate interpretations of the *Tractatus* and arrangements of its conceptuality as such. It is, however, the place to point out that through such ontology arrangements we not only are better enabled to explicate disagreements in our understanding of the text and to revise our views, but also can have the machine's assistance for it.[10] At the same time, it should not go unnoticed that our ontology endeavor was not straightforward, not without significant uncertainties, and not without unsatisfactory solutions to the problems we met, to which we will return to in the last section of our paper.

3. Possible Applications using the Ontology

On the basis of ontologies, especially OWL ontologies, different kinds of applications are possible. Because of its specification, OWL DL inherits concepts of a logic formalism called *Description Logic* (DL). Thus, it is reasonable to apply mechanisms of logic formalism like reasoning or drawing inferences to an ontology built with OWL DL. In logic-based languages, e.g. *Prolog*, or in inference machines like *Racer,* inferences can be drawn and implicit information can be made explicit. These programs use a *knowledge base*, e.g. an ontology, *facts* and *rules*. By querying on the knowledge base, the facts and rules are interpreted so that a result can be found. A scheme of drawing inferences is shown in Fig. 3.

On the basis of our *Tractatus* ontology, it is possible to draw inferences which provide information about the relations between different concepts of the *Tractatus*. Queries using *backtrack* methods[11] can be applied to draw inferences on the hierarchy of the ontology. A scheme of backtracking is shown in Fig. 4. Further inference types can be querying special properties or instances included in the ontology. In addition, there might be alternative applications – apart from logic-based approaches - in order to represent information. For example, OWL ontologies can be stored in database systems that can handle their structures. By storing these ontologies in for example *eXist*, a special database system, indexing and text-search are supported.[12] One can also imagine developing web interfaces that allow editing and searching within an ontology.[13]

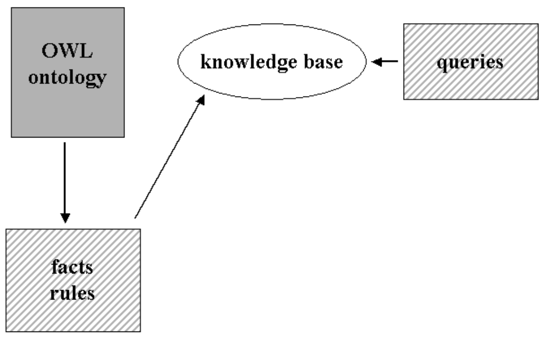

Fig. 3: Scheme of the organization of logic reasoning

All these applications are reasonable approaches toward utilizing ontologies in philosophy. In conclusion,

[9] For creating the ontology, we have used Protégé ((see http://protege.stanford.edu/). Protégé is a general editor for ontologies, but includes plug-in support for the syntax of OWL and offers a graphical interface. In addition, more plug-ins have been developed for Protégé for support of logical reasoning. Other free available editors are SWOOP (http://code.google.com/p/swoop/) as well as SWeDE (http://owl-eclipse.projects.semwebcentral.org/).

[10] This has been observed on a more general level with regard to text encoding (see Pichler 1995).

[11] See Charniak and McDermott 1985, Brassard and Bratley 1995.

[12] See http://exist.sourceforge.net/.

[13] A client-server based system to enable access to an ontology for literature studies is introduced by Zöllner-Weber 2007.

one should check which kind of result is required and should choose the techniques with regard to the demands. In the case of the *Tractatus* ontology, *backtracking* proves to be a valuable tool as is exemplified in Fig. 4.

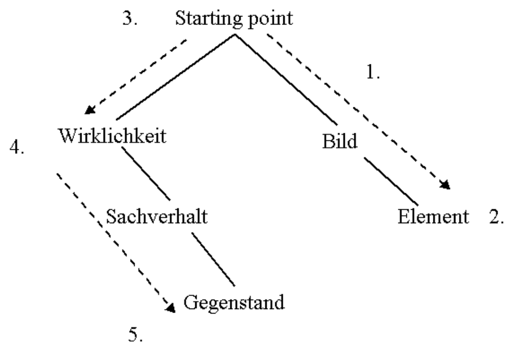

Fig. 4: Scheme of backtracking in the *Tractatus* ontology. Exemplarily, it is queried for *Gegenstand*: (1.) Traversing search space, (2.) Search condition no longer valid and solution (*Gegenstand*) not found, (3.) Backtracking to starting point, (4.) New search of remaining part of the tree, (5.) Solution found, stop of search.

4. Discussion and conclusion

One aim of our undertaking was to explore the possibilities as well as identify the problems of developing a formal ontology representation for a text of philosophy. We picked Wittgenstein's *Tractatus* which seemed as promising a candidate as a philosophy text can be. In the process of creating the ontology, we soon faced problems and limitations. Wittgenstein's terms cannot always be organized hierarchically, as the OWL specification demands. Sometimes, it was difficult to decide whether a term was completely subsumed by another one, or where a term was used as a synonym, belonging to the same hierarchical level rather than to a sublevel. Hierarchy poses a problem also on another level: Information which lies outside the hierarchical relationships cannot easily be included by using OWL. But, at least with regard to synonymy, we could use cross-links or use an OWL construct which defines objects as synonyms.

A second problem was the inheritance feature of OWL. This means that *properties* referring to features of *Tractatus* concepts defined as *classes*, are inherited by their *subclasses*. But surely, even if a term is the *superclass* of another *term*, the subsumed term has not all the features of the superordinated term. This led to problems regarding e.g. classifying *Tatsache*, which on the one hand naturally belongs under *Sachverhalt*, but in other respects does not have all the properties of *Sachverhalt*. Here, a solution could be to use an anonym ancestor which only contains features that subclasses have in common. Then, different features can be attached to the subclasses. The same problem arose on a higher level, since *Sachverhalt* belongs to both superclasses *Wirklichkeit* and *Bild*, but should not inherit all their features.

Modeling theories is often difficult and challenging, and this may in particular be the case with regard to philosophical theories. But we have seen several advantages of using ontologies. If parts of Wittgenstein's thought are modeled in an ontology, a structured formal overview can be produced. This overview or taxonomy of one's understanding can be easily shared and used as a foundation for discussing Wittgenstein's thought. Furthermore, on the basis of the ontology, machine-based applications can be carried out. Summarizing, we consider developing ontologies for philosophy texts an interesting and challenging enterprise which will stimulate and improve the application of formal methods for qualitative text analysis, the interpretation of philosophical texts and their validation.[14]

Literature

Baader, Franz, and Nutt, Werner 2003. Basic Description Logics, in: Franz Baader, Diego Calvanese, Deborah L. McGuinness, Daniele Nardi, and Peter F. Patel-Schneider (eds.), *The Description Logic Handbook*. Cambridge: Cambridge University Press, 43-95.

Brassard Gilles, and Bratley, Paul 1995. *Fundamentals of Algorithmics*. Prentice-Hall.

Charniak, Eugene and McDermott, Drew 1985. *Introduction to Artificial Intelligence*, Addison-Wesley.

Gruber, Thomas R. 1993. *A translation approach to portable ontology specifications*. Knowledge Acquisition, 5(2), 199–221.

Nardi, Daniele, and Brachman, Ron J. 2003. An Introduction to Description Logics, in: Franz Baader, Diego Calvanese, Deborah L. McGuinness, Daniele Nardi and Peter F. Patel-Schneider (eds.), *The Description Logic Handbook*. Cambridge: Cambridge University Press. 1-40.

Pichler, Alois 1995. "Transcriptions, Texts and Interpretation", in: Kjell S. Johannessen and Tore Nordenstam *Culture and Value. Beiträge des 18. Internationalen Wittgenstein Symposiums*. 13.-20. August 1995 Kirchberg am Wechsel, 690-695.

Puppe, Frank, Stoyan, Herbert, and Studer, Rudi 2000. Chapter 15: Knowledge Engineering, in: Günther Görz, Claus-Rainer Rollinger and Josef Schneeberger (eds.), *Handbuch der Künstlichen Intelligenz*. München: Oldenbourg Verlag, 599–641.

Web Ontology Working Group 2004. *Web Ontology Language (OWL)*. http://www.w3.org/2004/OWL/.

Zöllner-Weber, Amélie 2006. Formale Repräsentation und Beschreibung von literarischen Figuren, in: Georg Braungart, Peter Gendolla, Peter and Fotis Jannidis (eds.), *Jahrbuch für Computerphilologie* (7). Paderborn: mentis Verlag, 187-203.

Zöllner-Weber, Amélie 2007. Noctua literaria - A System for a Formal Description of Literary Characters, in: Georg Rehm, Andreas Witt and Lothar Lemnitzer (eds.). *Data Structures for Linguistic Resources and Applications*. Tübingen: Gunter Narr Verlag, 113-121.

Email: amelie.zoellner-weber@uni-bielefeld.de /
alois.pichler@aksis.uib.no

[14] We are aware of other possibilities for modelling semantics than ontologies, e.g. *Topic Maps* which focus on the relation between objects rather than on elaborated hierarchy. – Thanks to Deirdre Smith for improving our English. We would like to thank Stefano David for comments on an earlier version of this paper.

Spontaneous Orders in Social Capital Architecture

Gloria L. Zuniga, Allendale, Michigan, United States

The impetus for this investigation is the relation that I believe exists between information flows and social capital formation. Social capital is a relatively new term popularized by Robert Putnam, most notable for his book *Bowling Alone*. According to Putnam, social capital is constituted by "features of social life—networks, norms, and trust—that enable participants to act together more effectively to pursue shared objectives." (Putnam 1995b) How does social capital develop in the first place? The inquiry into the conditions that lead to social capital formation has even more currency in light of the globalization phenomenon that seems to permeate all areas of human experience today. The important concern is whether the phenomenon of globalization will foster or hinder social capital formation. My interest in addressing this concern is to examine technology and, more specifically, the role that information flows have in the rise of technologically-driven social networks.

We cannot deny that many view technology as heralding a new era of individualism and moral decadence. They perceive the Internet as the ground for a modern-day Hobbesian state of nature in which life is solitary and interactions with others brutish and nasty. In response, we must concede that because the Internet presents an alternative to direct interactions with people, life for some may be solitary. And we must also admit that communication via email and text messaging has had the effect of eroding the aesthetics of correct and artful language and social etiquette, so some may experience life as brutish and nasty. Nonetheless, it is important to point out that today's technological advancements encourage more personal interaction than any other mode of communication in the history of mankind.

I shall argue here that technology-driven social networks are not only the result of spontaneous orders of information flows but, in addition, they are the best means for social capital formation today. And I will show that the architecture of the social networks that is emerging on the Internet can be best described as having a morally-relevant character.

1. Social Capital

Let us first revisit the notion of social capital in more detail now. Social capital is the psychic income that individuals find in social networks by means of shared objectives. We can understand psychic income as any gain in the mental disposition of a worker to act in ways that can be described as optimistic, hopeful, self-confident, or that at least display a positive outlook generally. Arguably, such attitudinal gains will positively serve all realms of experience, including work. Accordingly, an investment of psychic income at work means that one brings a positive disposition to one's tasks. This mental disposition that one brings to the job (combined with other investments such as education and experience) is positively correlated to work performance and, thereby, to gains in pecuniary income. But work performance is not dependent solely on the human capital that a worker brings because the social network at the work environment will indeed affect psychic income. All social networks seem to have a common denominator: information flows. Bowling leagues—Putnam's driving metaphor—presents the prototypical example of a social network. Consider that the central purpose of bowling may not be competition. Rather, it may be a means for exchanging useful or amusing information that we want. These information flows serve as the glue of camaraderie, which boosts psychic income. This exemplifies how information flows can be positively correlated to social capital gains. If we now consider technology-driven social networks, then information flows are even more obvious.

2. The Web 2.0

While it is true that there are newer application technologies today, these are only the effect of what characterizes what we now commonly call the Web 2.0. The causal factor is the new *way* in which the web platform is employed. What merits the name Web 2.0, then, is demarcated by the web-based communities and hosted services, such as social networking applications, that did not exist in the 1.0 period. We have all witnessed in the last few years an increase in web-based communities such as YouTube.com and del.icio.us. But these are only two of the myriad of successful examples of social networking applications.

But take notice of the following contrast. In Web 1.0 applications, there are sellers that provide information about what they offer for sale. This is a one directional information flow. And there are buyers who provide sellers with their financial information to execute the purchase. This is also a one directional information flow. It seems to me that the principal feature of all 1.0 applications is that they are an advertising vehicle. What I call the 1.0 perspective is the narrow view that web applications serve only commerce. What the 1.0 perspective lacked is actual information exchange. Users only gave information in order to complete a transaction. Consequently, there was no adaptation of the content or functionality based on user input. As a result, the content remains static, meaning that it only changes if the web site owner decides to change the web site. By contrast, Web 2.0 sites allow users to choose the type, amount, and nature of some or all of the content they see.

Free participation and dynamic collaboration have led to new markets of information that could have never been imagined. Who would have designed a source for information on the lowest gas prices in one's vicinity? GasBuddy.com provides participant-driven gas price data that is continuously updated. Who would have thought that the quest for shared intelligence would override what we had previously accepted as the fundamental right of property? From the pioneering effort of Linus Torvald's open code operating system, Linux, open source platforms are now commonplace. We can also find web-based regions of shared intelligence known as wikis. Who could have thought that the latest scientific discovery on any given subject matter could be accessible even to the layperson without any formal education? Wikipedia, for example, offers accessible and up to date specialized knowledge obtained from the collaboration of all willing experts in the world on any subject. It is not a perfect medium of shared intelligence, of course, for we know that open source communities are not immune to human frailties: from the selfish use of the medium for airing a favored political position to the deliberate posting of incorrect information for no defensible reason. But as a result of these inevitable snags, open source communities have learned to be self-regulating without neglecting incoming information flows. It is the efficient use of information flows in Web 2.0 applications that permits the evolution of shared intelligence that crosses national boundaries and languages.

Everything seems to suggest that the success, in the sense of user participation, of 2.0 applications can be explained in the following way: users are motivated by a sense of social belonging, one that can be only obtained from taking part in the creation of something with other people. This *is* social capital formation. It is at least conceivable, then, that the Internet's contribution to the globalization phenomenon may not be as gloomy as many fear. Perhaps it would be more accurate to describe the Web 2.0 perspective as the pursuit of expanding social capital globally.

Similarly to markets, social networking sites have been a spontaneous development. In the case of markets, Friedrich Hayek observed that only by far-reaching decentralization, it would be possible to make full use of the knowledge and information dispersed among all individuals in society. (1945) Today's technological advancements confirm Hayek's observation in the new social frontier: the Internet. The knowledge collaboration that occurs via the Internet is possible because participants enter freely, and the unfettered nature of their interactions maximizes efficiency by directing information to their most wanted uses.

3. The Information Architecture of Social Networks

Let us now consider the infrastructure of social networking sites more closely. From a technical perspective, an information architecture is the blueprint of a web site's content, and it includes function, language, navigation, interface, interaction, and visual design.

The taxonomy of information architectures in Web 1.0 applications can be summed as follows: (1) information flows from sellers to consumers, (2) information flows from consumers to sellers. What it lacked is an interactive dynamic. An awareness of the topology of information flows would have helped, but this would have not been sufficient. Even with all the financial resources available to hire the best ontologists, programmers, and information engineers, the end result might still be a less than adequate information architecture because the perspective is one-sided and the information flows are not interactive.

The remarkable thing is that 2.0 web site developers do not seem to dedicate many resources to the planning of the information architecture, yet it is exponentially more efficient. Opening the door to multi-directional information flows permitted the emergence of new programming technologies that supported such multi-directional information flows. In the taxonomy of a 2.0 information architecture there are no web owners, on the one hand, and clients, on the other. There are only participants and as a result there is no micromanagement at work. In fact, it is necessary for the web site owner or webmaster to relinquish of control of the web site and to place trust on the users to create the content. Since the information flows are not only multi-directional but also unpredicted, these carve the path for new web technologies rather than the other way around. Web 2.0 information architectures are thus orchestrated spontaneously. How did this happen? It is tempting to call this phenomenon a natural social phenomenon because it seems a characteristic of human nature to discover new social orders.

4. Human Nature, Morality, and Social Networks

Some biologists have discovered a link between behaviors of reciprocity and moral goodness. Moreover, we appear to value morally relevant behavior even more highly if there is no kin selection incentive. We expect people, for example, to be emotionally supportive of friends. Consequently, although we approve of those who behave in this way, we do not find the fulfillment of this expectation particularly praiseworthy. We would find it unusual only if the expectation is *not* fulfilled because we understand emotional support as an obligation among friends. Accordingly, we would judge the failure to fulfill this obligation to be morally wrong. But when someone is willing to provide such an effort toward a stranger, then we judge this to be morally meritorious behavior because we do not feel morally obligated to strangers. Any such deeds that are made for the benefit of others without the motivation of kinship are indeed socially beneficent and thereby good. In this light, we can see more clearly the moral significance of the phenomenon that has resulted from the 2.0 perspective. The social interaction among participants is morally relevant insofar as it is reciprocal, but it is also morally meritorious because the beneficiaries are strangers.

But, however morally meritorious we find human social cooperation with strangers to be, we have to admit that, typically, it is rare. But I do not believe that this is so because we are not disposed toward socially cooperative behavior toward those with whom we do not have relations of kin or of friendship. Rather, I believe that the reason is that we do not have many opportunities in our modern, survival savvy societies of self-sufficient individuals. When given the chance, however, people have embraced non-self-interested social cooperation. We can find the evidence of this in the many Web 2.0 communities.

It seems to be the case, then, that the architectures of multi-directional information flows that we find on the Internet indeed strengthen social capital formation because they provide the opportunities for social cooperation. Aside from the potential aesthetic and economic benefits that may be obtained in technology-based social networks, the value of their information architectures is fundamentally moral in character because the goal is only social contact in exchange for mere reciprocity. I find it much like a game of tugging with my cat, in which the goal is the tugging, not possessing my sock.

Literature

Arrow, Kenneth "Observations on Social Capital," *Collected Papers of Kenneth J. Arrow*, Volume 5, Production and Capital, Harvard

Axelrod, Robert, 1984. *The Evolution of Cooperation*, Basic Books

Axelrod, Robert "The Evolution of Cooperation," *Science* 211(4489):1390-6

Robert J. Barro and Rachel M. McCleary 2003. *Religion and Economic Growth*, NBER Working Paper No. W9682

Becker, Gary 1975. *Human Capital*, Chicago: University of Chicago Press

Bourdieu, Pierre "Ökonomisches Kapital, kulturelles Kapital, soziales Kapital" in *Soziale Ungleichheiten* (Soziale Welt, Sonderheft 2), Reinhard Kreckel (ed), Goettingen: Otto Schartz & Co., 183-198

Bourdieu, Pierre "The Forms of Capital" In: Richardson JG (ed). *The Handbook of Theory: Research for the Sociology of Education*, J. G. Richardson (ed). New York: Greenwood Press, (1986) 241-258

James Coleman, "Social Capital in the Creation of Human Capital," *American Journal of Sociology*, 94 Supplement (1988) S95-S120

Ferguson, Adam 1767. *An Essay on the History of Civil Society*, London: T. Cadell, et al.

Foley, Michael W. "Is it Time to Disinvest in Social Capital?" *Journal of Public Policy*, 19 (2) 141-173

Forguson, Lynd 1990. *Common Sense*, Routledge

Hobbes, Thomas 1651. *Leviathan*, Andrew Crook

Hume, David 1748. *An Enquiry Concerning Human Understanding* and *Dialogues Concerning Natural Religion*, Edinburgh

Hayek, Friedrich A. 1973. *Law, Legislation, and Liberty*, Chicago: University of Chicago Press

Hayek, Friedrich A. "The Use of Knowledge in Society," *American Economic Review*, XXXV (1945) 519-530

Mandeville, Bernard 1714. *The Fable of the Bees*, London: J. Tonson

Menger, Carl 1871. *Principles of Economics*, 1976 James Dingwall and Bert F. Hoselitz (trans.) New York University Press

Putnam, Robert D. 2001. *Bowling Alone*, New York: Simon & Shuster

Putnam, Robert D. "Bowling Alone: America's Declining Social Capital," *Journal of Democracy*, 6:1 (1995) 65-78

Putnam, Robert D. "Tuning In, Tuning Out: the Strange Disappearance of Social Capital in America," *Political Science and Politics*, 28:4 (1995) 661-683

Smidt, Corwin (ed) 2003. *Religion as Social Capital*, Waco, Texas: Baylor University Press

Smith, Barry "Formal Ontology, Common Sense, and Cognitive Science," *International Journal of Human-Computer Studies*, 43 (1995) 641-667

Sobel, J. "Can We Trust Social Capital?" *Journal of Economic Literature*, 40 (1): 139-154

Solow, R. M. 2000 "Notes on Social Capital and Economic Performance," in Social Capital: A Multifaceted Perspective, Ismail Serageldin and Partha Dasgupta (eds) Washington, DC: World Bank

Wilson, Edward O. "The Biological Basis of Morality," 1998 *The Atlantic Monthly* 53-70

Email: ontogloria@gmail.com