

Four Rules for Classifying Social Entities

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1. Introducing Social Entities

Many top-level ontologies like Basic Formal Ontology (BFO) have been developed as a framework for ontologies in the natural sciences.¹ The aim of the present paper is to extend the account of BFO to a very special layer of reality, the world of social entities. While natural entities like bacteria, thunderstorms or temperatures exist independently from human action and thought, social entities like countries, hospitals or money come into being only through human collective intentions and collective actions. Recently, the regional ontology of the social world has attracted considerable research interest in philosophy – witness, e.g., the pioneering work by Gilbert (1989), Tuomela (1995) and Searle (1995). There is a considerable class of phenomena that require the participation of more than one human agent: Nobody can tango alone, or play tennis against oneself, or set up a parliamentary democracy for oneself.

Through co-operation and co-ordination of their wills and actions, agents can act together – they can perform social actions and group actions. An important kind of social action is the establishing of an institution (e.g., a hospital, a research agency, or a marriage) through mutual promise or (social) contract. Another important kind of social action is the imposition of a social status on certain entities. E.g., a society can impose the status of being a 20 Euro note on certain pieces of paper, or the status of being an approved medication on a certain chemical substance. Other social entities come along without a physical ‘bearer entity’, like electronic money (Smith, 2003a; Smith & Searle, 2003): The numbers on my account statement do not count as the money on my bank account, but are only signs for it. Such bearerless social entities are established through the transfer of certain rights or obligations from, say, my employer to my bank, where I, in turn, can claim them. Similarly, a credit card itself does not count as money (for were it to count as such, which value would it have?), nor does it represent any money (for how much would it represent?). Rather, using a credit card transfers the right to claim a certain amount of money from the credit card company, which will, in turn, claim it from me. Analogously, a health insurance card is a sign that a hospital will be licensed to claim treatment costs from the insurance company. In this way, the world is replete with a plethora of social entities, which are highly important for our everyday life, for economics, politics, and culture – and thus also for respective information technologies and their applications in these fields.

In this paper, I will discuss an application from medical information science – more specifically, the NCI Thesaurus. I will first discuss some ontological shortcomings of the representation of social entities in this thesaurus (§ 2) and will then suggest four rules for classifying social entities (§ 3), including the use of standard top-level categories, the characterisation of specific social categories, and the representation of ontological relations

¹ <http://www.ifomis.org/bfo>.

between social entities. Finally, I develop a small fragment of a social ontology to show how these rules can be put to work (§ 4).

2. Real World Examples from a Medical Thesaurus

Though social entities as such are not governed by laws of nature, they are, as I will demonstrate, nevertheless important in areas such as medical information science. To assure this relevance, I will draw on real world examples from the National Cancer Institute Thesaurus (NCIT),² a terminology database designed especially for the needs of the US National Cancer Institute (NCI) (Fragoso et al., 2004; Coronado et al., 2004; Golbeck et al., 2004). One function of the NCIT is “the provision of a well-designed ontology covering cancer science” (NCIBC, 2004, 14). To achieve these goals, the NCIT aims at providing a “true is_a taxonomic structure, polyhierarchy, inferred partonomy, and other features that make it suitable for supporting complex query operations against appropriately coded data repositories” (as the NCIT describes itself in its entry “NCI Thesaurus”). I will show, first, that as far as social entities are concerned, the NCIT is far from meeting these objectives (for other criticisms cf. Jansen, 2008a), and, second, that the currently emerging philosophical (sub-)discipline of social ontology can come to help.

Compared to other areas like genes or cell structures, references to social entities may be somewhat peripheral in the NCIT (cf. the figures given in Fragoso et al., 2004). But they are nevertheless important, because the medical world is not disconnected from the social world. Cancer, the focal topic of the NCIT, has social causes and social effects. As Graham Colditz, the general editor of the *Encyclopedia of Cancer and Society* puts it: “Not only do health care providers and regulatory approaches each have a role, but individual behavior changes can substantially reduce the burden of cancer in our society.” (Colditz, 2007, vii) This is why the NCIT contains items like “Stress and coping” or “Social aspects of cancer”. Patients never come along as isolated individuals. Even lonely patients live in a social world, and the social world may support or inhibit a healing process. This is why the NCIT contains items like “Family”, “Minority”, “Support system”, and so on. Moreover, healing patients is a business, governed by health policies and health administration. This is, why the NCIT contains items like “Business rules”, “Accounting” and similar things, as well as cancer research, a social activity in and of itself. This is why the NCIT contains items like “Cancer study”, “Control group”, “Scientist”, and “Funding”. Historically, the NCIT actually started “with a collection of local terminologies in use for coding documents related to managing science – funded grants, reports, and intramural science projects” (Coronado et al., 2004, 34). These aspects of relevance are reflected in the choice of social items which are contained in the NCIT. I will now review some of the ontological shortcomings in the representation of social entities in the NCIT.

(1) That the social world is not at the core of cancer research is reflected in the eclectic and unsystematic way in which social entities are selected for and ordered within the NCIT. Moreover, the NCIT has a clear national bias: it focuses on topics relevant for the United States of America. Thus for example the only item listed under the heading “Underrepresented Minority” is “American Indian or Alaska Native”. Seen globally, there are presumably many more “minority groups presently underrepresented in biomedical and behavioural research” (which is the NCI-definition of “Underrepresented Minority”). Eclecticism concerns the things that are to be represented. Here, a choice of entities is understandable, because NCIT targets a specific topic only, i.e. cancer research. And it is necessary, if the size of the database

² The NCIT can be freely accessed at <http://bioportal.nci.nih.gov/>. All references in this paper are to the version 08.06d.

is not to exceed a certain limit. It is, however, a clear hindrance to data-integration across national borders or topical domains.

(2) Furthermore, the NCIT is rather parochial in its horizon. E.g., it simply regards “Clinical Study” as being synonymous with “Study”. But, of course, not all studies are clinical, some are e.g. literature surveys. “Underrepresented Minority” is simply defined as a group “underrepresented in cancer research”. But, of course, a group can be underrepresented in many other ways, too. “Funding” is subsumed under the semantic type “Governmental or Regulatory Activity”. But is it essential that funding is done by the government? What about companies, charities, or endowments? While eclecticism is about the choice of entities to be represented, parochialism concerns the definitions given for the chosen entities. If the definitions are given as if such entities do not exist outside the topical field, i.e. outside of cancer research, this affects the interoperability with other terminology databases. It should be clear that representations of social entities are especially prone to parochialism, though it might also occur with representations of natural entities.

(3) Often, the NCIT follows topical associations rather than ontological guidelines, as they are provided by, say, BFO or OntoClean (Guarino/Welty 2004). E.g., the item “Business Rules” has 39 sub-items. An NCI business rule is, e.g. the “Improve access”-rule, which is: “Support the effective dissemination, communication, and utilization of HIV/AIDS information to all constituent communities of the NIH.” It should be noted that this is a particular rule, not a rule-type, and thus no proper argument for the “true is_a hierarchy” the NCIT intends to provide. The quotation is, of course, a formulation of the rule, which cannot be used as a description of it: The rule is in the imperative mood, descriptions and definitions are in indicative mood. The NCIT should thus affix a phrase like “The rule that prescribes to ...” to the formulation of the rule in order to get a description of it. Nor is the plural of the term “Business Rules” appropriate if the term is to feature in a subsumption relation. Rather, the following would be appropriate (I follow the typographical conventions of the OBO relational ontology as described in Smith et al., 2005 and Schwarz/Smith, 2008 and use, e.g., italics for terms referring to universals and relations between them, and bold type for relations involving particulars):

Business_Rule is_a Rule

Improve_access **instance_of** *Business_Rule*

But most of the sub-items of “Business Rules” are neither rule-types nor rule-instances. One sub-item of “Business Rules”, e.g., is “Employment Opportunities”, which are (again rather parochially) defined as “Jobs available at NCI”. These are, of course, no business rules at all. Rather, the process of filling employment opportunities with suitable candidates is something that is governed by business rules. Similar things are to be said with regard to “Academia”, “Animal Sources”, “Business Commerce Fiscal Consultation”, “Commercial Sources”, “Completion Status”, “Contingency Fund”, “Contracting”, “Discipline”, and so on. Even the “FDA Modernization Act of 1997” is not a business rule, but a legal document that may contain such rules. Nor is “Enhancing Accessibility to Health Care” a rule. It is an activity, even if it is an activity that is prescribed by a rule. The monstrous “Non-programmatically Aligned Cancer Center Research Member Section of Cancer Center Support Grant Application” is no rule either. It is a part of a document, i.e. of a support grant application written by a Cancer Center, listing people able to support a certain research program. The rule is to include such a section in an application. But this does not make the section a rule itself, nor is it a good reason to list it under the heading “Business rules”. Thus, most of the items among the sub-items of “Business Rules” are no business rules at all, but either documents containing such rules, fields governed by such rules or entities such rules refer to.

Another example is provided by the sub-items of “Funding”: Most of the purported sub-

types are not kinds of funding but concern things somehow related to funding, like “Concept review” “Funding Category”, “Funding Opportunity” or “Special Exceptions Process”.

(4) The NCIT often mixes ontological categories. E.g., “Clinical Research” is given as a synonym of “Clinical Study”. But this cannot be true: Clinical research is the overall activity which relates to a clinical study as uncountable stuff to countable things (for this analogy cf. Galton, 1984, 153-156). The NCIT also confuses the “Personal Medical History” of a person with its record, since the former is defined as a “record of a patient’s background regarding health and the occurrence of disease events of the individual”. “Funding” is defined in the NCIT as “a sum of money or other resources set aside for a specific purpose”. The NCIT takes this definition from the *American Heritage Dictionary*, where it is not the explanation of “funding”, but of “funds”, while “funding” refers to the activity of allocating money or resources for a certain project (Pickett et al. 2000). In any case, it is incoherent to subsume something defined as a sum of money under the semantic type of “Governmental or Regulatory Activity” at the same time, as the NCIT does.

(5) The NCIT entries often do not reflect actual properties of the entities classified. An item like “Other Minority” cannot, of course, refer to the property of otherness instantiated by certain minorities. It makes sense only in relation to the rest of the classification given in the NCIT. It does, thus, not reflect the ontic structure of the social world, but only the classification in this database, which could as well have been different than it is. Such “other” items (there are more than hundred of them in the NCIT) are, of course, means to secure exhaustivity of the classification on that level. The price to be paid for this is that the ‘property’ used for classifying comes into existence through the very classification in which it is referred to. There are several modifiers in the NCIT that are similarly troublesome because they employ epistemic notions for defining ontic matters, among which are “None or Not Applicable”, “Not Defined”, “Not Otherwise Specified”, “Not Stated” or “Unknown” (for more on this cf. Bodenreider/Smith/Burgun, 2004).

3. Four Rules for Classifying Social Entities

If a sound underlying ontology is necessary for a coherent terminology, a sound social ontology is necessary for a classification of social entities. In what follows, I want to suggest four ontological guidelines which should, in a favourable course of events, in the future be integrated in a unified ontology of the social world: (1) Do not forget standard ontology, (2) classify a social *F* as an *F*, (3) respect specific social categories and (4) make explicit the ontological relations between social entities.

3.1 First Rule: Do Not Forget Standard Ontology

Most formal ontological dichotomies apply to the social realm, too. In particular, this is true of the three fundamental dichotomies that also lie at the ground of BFO, i.e. continuant vs. occurrent, independent vs. dependent, individual vs. universal. While I am a continuant being wholly present with all my spatial parts at every moment of my existence, my life is not wholly present at any point of time: it has a lot of temporal parts and stretches out in time. And I am a bearer of many properties like my weight or the colour of my skin, the change of which I can easily survive, whereas these properties cannot change their bearer: They are dependent entities, while I am – ontologically speaking – an independent entity. Taken together, these two dichotomies yield three main top-level categories (Smith, 2003b; Smith, 2005; Jansen, 2008b):

- independent continuants (including Aristotelian substances),
- dependent continuants (including properties and relations), and

- occurrents (including processes, actions and events).

Characterizations of these categories can be found in Table 1, where I also (for use in this paper) distinguish between properties and relations as two kinds of dependent continuants.

The third basic ontological dichotomy is the distinction between universals (or types or classes) on the one hand and particulars (or tokens or elements) on the other hand. All of myself, my life and the colour of my skin are particular entities. These particulars instantiate the universals *Human Person*, *Life* and *Colour*, respectively. And these universals are, in their turn, to be subsumed under the top-level categories *Independent Continuant*, *Occurrent* and *Dependent Continuant*.

Table 1: Top-level categories (Spear, 2006; Jansen, 2008b)

<i>Continuant</i> = an entity that exists in full at any time in which it exists at all, that has no temporal parts and persists through time while maintaining its identity.
– <i>Independent Continuant</i> = a continuant entity in which other entities may inhere but that cannot itself inhere in anything. Examples: an organism, a heart, a symphony orchestra, a chair.
– <i>Dependent Continuant</i> = a continuant entity that inheres in or is born by other entities. Examples: the colour of a tomato, the disposition of fish to decay, the function of the heart to pump blood.
– <i>Property</i> = a dependent continuant which is dependent on exactly one bearer.
– <i>Relation</i> = a dependent continuants which is dependent on more than one bearer.
<i>Occurrent</i> = an entity that has temporal parts and happens, unfolds or develops in time.
Examples: the life of an organism, a surgical operation, a day, a concert.

3.2 Second Rule: Social Fs are Fs

There are social entities that are continuants like the American president or a national border, and there are social entities that are occurrents, like the inauguration of the president or immigrating into another state. Social entities, too, come along as particulars and universals, like the business rules in the NCIT. Moreover, social entities can also be classified according to the Aristotelian categories like natural entities: There are social quantities like prices, social qualities like academic degrees, social relations like being married to someone, social actions like a promise or a political manifestation, and even social substances or at least quasi-substances like companies or states (Jansen, 2005).

In the history of ontology, it has been a matter of dispute whether the same categories apply to natural and social entities (Kobusch, 1997). And indeed it can be asked whether the appropriate category of, say, *Academic Degree* is *Quality* or rather something like *Social Quality*, which is then subsumed under a top-level entry *Social Entity*, disconnecting the classification of social entities from the classification of other entities. To answer this question, a reflection on the logic of the qualifying phrase “social” is of help. There are some qualifying phrases like “pseudo-...” or “bogus ...” which are alienating phrases. If you have something written by Pseudo-Aristotle, it is not written by Aristotle. If you have a bogus proof, it is in fact not a proof. Other qualifying phrases, however, are separable, like “living” or “good”. If something is a living horse, it is both a horse and living, and if someone is a good thief he is a thief (though probably not good in an unqualified sense). I take it that the attributive adjective “social ...” is not an alienating modifier but rather a separable phrase. If something is a social phenomenon, it is a phenomenon, if something is a social activity, it is an activity. Thus, as a rule, a social *F* is an *F*, *F* being some universal. This should be reflected in an ontology-based taxonomy: social activities should be classified as activities, social properties should be classified as properties, social circumstances should be classified as circumstances, etc.

As can be seen from Table 2, there are examples for all three of the top-level classes and for some of the Aristotelian categories among the social items represented in the NCIT. All of the sample terms in Table 2 actually feature in the NCIT, though under different top-level categories. Again, I follow the convention to use italics for names of universals or classes and normal letters for names of particulars.

Table 2: Social entities from the NCIT

Independent continuants:
– individual institutions: American Cancer Society, University of California at Santa Cruz, United States, National Cancer Institute, ...
– universals of institutions: <i>Company, Family, Hospital, State, University, ...</i>
– universals of collectives: <i>Group, Minority Group, Research Personnel, Staff, ...</i>
– universals of role holders: <i>Employee, Employer, Scientist, Statistician, Laboratory Technologist, ...</i>
– universals of concrete social relatives: <i>Legal Relative, Participant, Responsible Person, Spouse,...</i>
<hr/>
Dependent continuants:
– properties: <i>Academic Degree, Board Eligibility, Education Level, Employment, Marital Status, ...</i>
– relations: <i>Affiliation, Consent, Ownership, ...</i>
<hr/>
Occurrents:
– <i>Administration, Admission, Advising, Conference, Research, Submission, ...</i>

3.3 Third Rule: Respect Specific Social Categories

In addition to the general categories of formal ontology, there are categories specifically pertinent to the social world. A famous example of a label for a specific social category is “institution”. Unfortunately, this label is ambiguous in natural language and is, in fact, used for **three distinct though interrelated categories of social entities** (Jansen, 2005): (a) for institutional rules (e.g., constitutive rules of the “counts-as” type; cf. Searle 1995), (b) for things instituted, and (c) for the act of instituting something. Note that institutional rules (a) are to be categorized as dependent continuants, while institution acts (c) are to be categorized as occurrents. In its own definition of “Institution”, the NCIT opts for a sub-type of institutional entities (b), defining “institution” as “[a]n established society, corporation, foundation or other organization founded and united for a specific purpose, e.g. for health-related research” – the additional information “also used to refer to a building or buildings occupied or used by such organization” should rather form a distinct entry. Thus defined, institutions are independent continuants. Examples are listed in Table 2, both for individual institutions and universals of institutions. But institutions in the sense of (b) can also be found among dependent continuants, like academic degrees or a marital status, and among occurrents, like rituals or festivals (Jansen, 2005). Furthermore, the three meanings of “institution” have to be kept apart, which does not always happen in the NCIT. For example, “marriage” can denote (a) the abstract institution of marriage to be found in some societies but not in others, (b) a concrete marriage, i.e. a couple’s being married, and (c) the act of getting married. The definition of “marriage” in the NCIT illegitimately confounds (a) and (b).

A specific problem of social ontology is also to differentiate different kinds of groups and of group unity (Jansen, forthcoming) and to analyze social actions (Vizenor, 2004). Various examples for groups represented in the NCIT can be found in Table 2.

An important variety of independent social continuants in Table 2 are the universals for role-holders like *Statistician*, defined in the NCIT as a “person responsible for the compilation, organization, and analysis of mathematical data”. This definition closely

resembles Bolzano's schema for the content of concrete ideas, i.e. "something that has property *P*" (Bolzano, 1837/1978, 93-97). Bolzano's concrete ideas are, of course, closely related to the corresponding abstract ideas of "having the property *P*". Similar with (social and other) roles: Roles as such are dependent continuants, but the thing that plays that role is normally an independent continuant: The social roles of employer and employee, of statistician and laboratory technologist are all played by human persons (which are then the role-players). Though it is typical for humans to play social roles, it is neither essential nor typical for humans to play any particular of these roles. Playing a role is something contingent as opposed to having a certain function, which is something typical or even essential (Spear, 2006, 55-56). We can thus distinguish between the role-player, the role and the role-holder (a term also used, e.g. by Mizoguchi et al., 2007). In our example, a human person as the role-player and the role of being responsible for the statistics yield together the statistician as the role-holder. Or, to use another example, *Person* is not the parent of *Chairperson* (as in the NCIT); rather, persons are potential role-players for the role of acting as chairperson.

A similar analysis applies to the concrete relatives in Table 2, which have the structure of "something that stands in a relation *R* to some other thing". A spouse is someone that stands in the relation "being married to" to someone else. Here, too, we deal with a combination of a dependent continuant (in this case a relation) and an independent continuant. Because of their similar treatment, such relatives are sometimes called "abstract roles" (Loebe, 2007). And because they involve an independent continuant, they are themselves to be classified as independent continuants. Indeed, spouses can have properties like a weight or an age and cannot themselves be the property of anything – and it is the defining feature of independent continuants in BFO, that they "are the bearers of qualities and realizables; entities in which other entities inhere and which themselves cannot inhere in anything" (Spear, 2006, 43). On closer analysis, however, concrete relatives could be decomposed into a relation and its bearer. One reason for the comparatively small number of examples for social relations in the NCIT (cf. Table 2) is that many social relations are hidden in the entries for concrete social relatives, as, e.g., the relation of "is married to" is a constitutional part of *Spouse*.

3.4 Fourth Rule: Make Explicit Ontological Relations between Social Entities

Social entities are not isolated. They do not stand alone in the social world, but are interconnected to other social entities as well as to natural entities. Formal relations that apply to other realms of reality also apply to the social reality, like the relations "is a", "part of", "depends on" and so on (Smith et al., 2005; Schwarz/Smith, 2008). The NCIT, for example, contains both "Social work" and "Social Worker", but they remain totally unconnected. But of course, a social worker is someone who is trained or employed to do social work; this is the expected role-performance of a social worker. A necessary pre-condition for making this explicit is to list all entities referred to in the definition themselves as items in the ontology (Ceusters/Smith/Goldberg, 2005).

A specific social relation is the relation of membership. While some have argued that membership is just a variety of parthood (Quinton, 1975/76), there are good reasons for regarding it to be a (social) relation in its own right: parthood is a transitive relation, membership is not; the same members can constitute several distinct groups, while the same parts uniquely assembly to exactly one whole; localized parts form localized wholes, while localized members can form non-localized organizations (Ruben, 1985, ch. 2).

Social relations can be at times quite complicated and are not at all well accounted for by the subsumption-relation. For example, the "Subcommittee B Basic Sciences" of the National Cancer Institute is described by the NCIT as: "Subcommittee of the Board of Scientific Counselors, NCI, [...]". At the same time, the NCIT lists the "Board of Scientific Counselors" as a super-item of the subcommittee. The formal relation appropriately describing the relation

between a sub-item and its super-item (e.g., a species and its genus) is the “is a” relation. But, according to the NCIT-definition, “Subcommittee B Basic Sciences *is_a* Board of Scientific Counselors, NCI” is not a true proposition. It is indeed false or even nonsense, because both terms are proper name of individual institutions. In order to be meaningful, the *is_a*-relation requires general terms on both sides, i.e. terms that allow for multiple instantiations. Thus, already for syntactic reasons, the Subcommittee cannot be a sub-type of the NCI Board of Scientific Counselors. Nor can the Subcommittee be an instance of the Board, for the Board is a particular and not a universal (and only universals can have instances). Presumably, the intended meaning is that all Subcommittee members are Board members or that Subcommittee membership requires Board membership. But this cannot be represented by a subsumption relation between the respective institutions.

As can be seen from Table 2, over and above to universals or types, the NCIT does also contain terms for particular institutions, like the American Cancer Society and the National Cancer Institute itself. The NCIT is even self-referential in so far as it lists itself among other particular information resources like the Gene Ontology or the medical online bibliography PubMed. Normally, particulars do not feature within an ontology, which is sometimes characterized as a hierarchy of universals only. Nevertheless, individuals like those that are mentioned within the NCIT, are systematically related to these universals and are thus important for ontology. Such systematic relations between entities from Table 2 (and others) can be represented by means of formal ontological relations like those suggested by BFO or the OBO relational ontology (Grenon/Smith, 2004; Smith et al., 2005). In Table 3 I list some examples for instances of basic ontological relations using terms from the NCIT for the *relata*.

Apart from the *is_a*-relation, these formal ontological relations are missing from the NCIT. The Part-of-relation for continuants is only defined for physical or conceptual parts, and even the *is_a*-relation is quite often used very strangely, as our discussion in the preceding sections has shown. Rigorous application of both a coherent set of top-level categories and such ontological relations will heavily improve the representation of social entities in general and in the NCIT in particular.

Table 3: Ontological Relations and Social Entities

Individuals are instances of universals:

- University of California at Santa Cruz **instance_of** *University*
- NCI Thesaurus **instance_of** *Thesaurus*
- Health Insurance Portability and Accountability Act **instance_of** *Law*

Universals are subsumed by higher-order universals:

- *College is_a School*
- *Doctorate Degree is_a Academic Degree*
- *Application is_a Document*

Universals are (not necessarily directly) subsumed under their top-level categories:

- *University is_a Independent Continuant*
- *Doctorate Degree is_a Dependent Continuant*
- *Conference is_a Occurrent*

Dependent continuants inhere in independent continuants:

- *Employment inheres_in Employee*
- *Culture inheres_in Population Group*
- *Marital Status inheres_in Person*

Occurrants have independent continuants as agents and participants:

- *Research project has_agent Research unit*
- *Grant application has_agent Scientist*
- *Exchange Programm has_participant Scientist*

Independent continuants can be part of other independent continuants:

- *Research unit has_part Scientist*
 - *University has_part Department*
 - *Document_body part_of Document*
-

5. Conclusion

The aim of this paper was to show how social ontology can help to classify social entities in medical information sciences. On the background of current research in social ontology, I presented four rules for the classification of social entities and applied them to examples from the NCIT. Using BFO and OBO standards, I then developed a small fragment of an ontology of social entities to demonstrate how together with these standards the rules suggested here can help to improve the representation of social entities in information systems.

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References

Ceusters, Werner; Smith, Barry; Goldberg, Louis. “A Terminological Analysis and Ontological Analysis of the NCI Thesaurus.” *Methods of Information in Medicine* 44 (2005): 498-507.

- Colditz, Graham A. "Introduction." *Encyclopedia of Cancer and Society*. 3 voll., Los Angeles: Sage, 2007, vol. 1, vii-ix.
- Coronado, Sherri de, et al. "NCI Thesaurus: Using Science-Based Terminology to Integrate Cancer Research Results." *Proceedings of MedInfo 2004*. Ed. M. Fieschi et al. Amsterdam: IOS, 2004, 33-37.
- Fragoso, Gilberto, et al. "Overview and utilization of the NCI Thesaurus." *Comparative and Functional Genomics* 5 (2004): 648-654.
- Galton, Anthony. *The Logic of Aspect*. Oxford: Clarendon Press, 1984.
- Gilbert, Margaret. *On Social Facts*. London: Blackwell, 1989.
- Golbeck, Jennifer. "The National Cancer Institute's Thesaurus and Ontology." *Journal of Web Semantics* 1 (2004): 75-80.
- Grenon, Pierre; Smith, Barry. "The Cornucopia of Formal-Ontological Relations." *Dialectica* 58 (2004): 279-296
- Guarino, Nicola; Welty, Chris. "An Overview of OntoClean." *The Handbook on Ontologies*. Ed. Steffen Staab and Rudi Studer. Berlin: Springer, 2004, 151-172.
- Jansen, Ludger. "Institutionen und die kategoriale Ontologie." *Institutionen und ihre Ontologie*. Ed. Gerhard Schönrich. Frankfurt M., Lancaster: Ontos, 2005, 45-57.
- Jansen, Ludger. "Aristoteles' Kategorie des Relativen zwischen Dialektik und Ontologie." *Philosophiegeschichte und logische Analyse* 9 (2006): 79-104.
- Jansen, Ludger (2008a). "Classifications." In: Munn/Smith (eds.), 2008, 159-172; German version in: Jansen/Smith (eds.), 2008, 67-83.
- Jansen, Ludger (2008b). "Categories: The Top-Level-Ontology." In: Munn/Smith (eds.), 2008, 173-196; German version in: Jansen/Smith (eds.), 2008, 85-112.
- Jansen, Ludger. "Unity and Constitution of Social Entities." *Unity and Time in Metaphysics*. Ed. Ludger Honnefelder and Edmund Runggaldier. Berlin: Akademie-Verlag, forthcoming.
- Jansen, Ludger; Smith, Barry (eds.). *Biomedizinische Ontologie. Wissen strukturieren für den Informatik-Einsatz*. Zürich: vdf, 2008.
- Johansson, Ingvar. "Money and Fictions." *Kapten Mnemos Kolumbarium. Festschrift to Helge Malmgren*. Göteborg, 2005.
<http://www.phil.gu.se/posters/festskrift2/mnemo_johansson.pdf> (last visit 30.10.2008).
- Kobusch, Theo. *Die Entdeckung der Person. Metaphysik der Freiheit und modernes Menschenbild*. 2nd revised and enlarged edition. Darmstadt: Wissenschaftliche Buchgesellschaft, 2007.
- Loebe, Frank. "Abstract vs. social roles. Towards a general theoretical account of roles." *Applied Ontology* 2 (2007): 127-158.
- Lowe, Jonathan E. *The Four-Category Ontology. A Metaphysical Foundation for Natural Science*. Oxford: Oxford University Press, 2006.
- Mizoguchi, Riichiro. "The model of roles within an ontology development tool: Hozo." *Applied Ontology* 2 (2007): 159-179.
- Munn, Katherine; Smith, Barry (eds.). *Applied Ontology: An Introduction*. Frankfurt M.: Ontos, 2008.
- NCICB (NCI Center for Bioinformatics). *The NCICB User Applications Manual*. 2004.
<<https://ncicbsupport.nci.nih.gov/sw/content/NCICBAppManual.pdf>> (last visit 17.07.2008).
- Pickett, Joseph P. et al. (eds.). "Fund." *The American Heritage Dictionary of the English Language*. 4th ed. Boston: Houghton Mifflin, 2000,
<<http://www.bartleby.com/61/24/F0362400.html>> (last visit 30.10.2008).
- Quinton, Anthony. "Social Objects." *Proceedings of the Aristotelian Society* 76 (1975/76): 1-27.
- Schwarz, Ulf; Smith, Barry. "Ontological Relations." In: Munn/Smith (eds.), 2008, 219-234; German version in: Jansen/Smith (eds.), 2008, 155-172.
- Searle, John R. *The Construction of Social Reality*. New York: The Free Press, 1995.

- Smith Barry (2003a). "From Speech Acts to Social Reality." *John Searle*. Ed. Barry Smith. Cambridge University Press: Cambridge, 2003, 1-33.
- Smith, Barry (2003b). "Aristoteles 2002." *Kann man heute noch etwas anfangen mit Aristoteles?* Ed. T. Buchheim, H. Flashar and R. A. H. King. Hamburg: Meiner, 2003, 3-38.
- Smith, Barry. "Beyond Concepts. Ontology as Reality Representation." *Formal Ontology in Information Systems. Proceedings of the Third International Conference (FOIS 2004)*. Ed. Achille Varzi, Laure Vieu. Amsterdam: IOS, 2004, 73-84.
- Smith, Barry. "Against Fantology." *Experience and Analysis*. Ed. Johann C. Marek and Maria E. Reicher. Vienna: HPT & ÖBV, 2005, 153–170.
- Smith, Barry. "Searle and de Soto. The New Ontology of the Social World." *The Mystery of Capital and the Construction of Social Reality*. Ed. Barry Smith, David M. Mark, Isaac Ehrlich. Chicago and La Salle IL: Open Court 2008, 35-51.
- Smith, Barry et al. "Relations in Biomedical Ontologies." *Genome Biology* 6.5 (2005): R46, <<http://genomebiology.com/2005/6/5/R46>> (last visit 30.10.2008).
- Smith, Barry; Searle, John R. "The Construction of Social Reality: An Exchange." *American Journal of Economics* 62 (2003): 285-309; also published in: *Searle on the Institutions of Social Reality*. Ed. Laurence Moss and David Koepsell. Oxford: Blackwell, 2003.
- Spear, Andrew D. *Ontology for the Twenty First Century. An Introduction with Recommendations*. Saarbrücken 2006. <<http://www.ifomis.org/bfo/manual.pdf>> (last visit 30.10.2008).
- Tuomela, Raimo. *The Importance of Us. A Philosophical Study of Basic Social Notions*. Stanford CA: Stanford University Press, 1995.
- Vizenor, Lowell. "Actions in Health Care Organizations: An Ontological Analysis." *Proceedings of MedInfo 2004*. Ed. M. Fieschi et al. Amsterdam: IOS, 2004, 1403-1408.