Concept Theory

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> *It cannot be overemphasized that changes in con-*
> *cepts have far more impact than new discoveries*
>
> **(Mayr, 1997, p. 98)**

Concept theory is an extremely broad, interdisciplinary and complex field of research related to many deep fields with very long historical traditions without much consensus. However, information science and knowledge organization cannot avoid relating to theories of concepts. Knowledge organizing systems (e.g., classification systems, thesauri, and ontologies) should be understood as systems basically organizing concepts and their semantic relations. The same is the case with information retrieval systems. Different theories of concepts have different implications for how to construe, evaluate, and use such systems. Based on "a post-Kuhnian view" of paradigms, this article put forward arguments that the best understanding and classification of theories of concepts is to view and classify them in accordance with epistemological theories (empiricism, rationalism, historicism, and pragmatism). It is also argued that the historicist and pragmatist understandings of concepts are the most fruitful views and that this understanding may be part of a broader paradigm shift that is also beginning to take place in information science. The importance of historicist and pragmatic theories of concepts for information science is outlined.

Introduction: The Aim of This Article

Theories of concepts have not previously been considered systematically in information science[1] although some specific theories have (e.g., "formal concept theory" by Priss, 2006). To provide an overall discussion of concepts seems in itself a relevant job because different theories of concepts have importance for our field (this point will be addressed later).

This article starts by outlining the present state of concept theory: It shows that today there is not consensus about what concepts are, which theories of concepts are most important, or how theories of concepts should be classified.

There are, however, different views of concepts made by great philosophers and scientists that are associated with different world-views and epistemologies and which tend to compete with each other.

Since philosopher of science Thomas Kuhn (1922–1996) wrote his famous book *The Structure of Scientific Revolutions* (1962), "paradigm" has been a popular term in many fields, although it has also been seriously criticized.[2] It is less well known that Kuhn also developed a theory of concepts that corresponds with his theory of paradigms and that has been considered an important contribution to concept theory.[3] This connection between "paradigms" and "concepts" is the point of departure for the present article. An important view of concepts today can be said to be "post-Kuhnian" in the sense that it is recognized that different theories and "paradigms" may be considered the most important mechanism for the development of concepts. However, the criticism of Kuhn's theory of paradigms suggests, among other things, that different "paradigms" do not totally replace each other but exist together and compete with each other in all domains all the time (see, e.g., Mayr, 1997, pp. 98–99[4]). These criticisms are the reason for using the term "post-Kuhnian" rather than "Kuhnian" in the present article. The term "post-Kuhnian" should not, however, be seen as an indication that the underlying view is primarily taken from Kuhn. There are perspectives, such as pragmatism, activity theory, and hermeneutics, that are both older and have played a greater role for the views developed in the present article. These perspectives have, however, so far been rather neglected by mainstream researchers in concept theory, and this is why historical and theory-oriented studies in this field are mainly due to the influence of Thomas Kuhn.[5]

Armed with such a "post-Kuhnian view of concepts," a dominant contemporary understanding and classification of theories of concepts is presented and discussed by considering some of the arguments that have been put forward.

Alternatively, it is suggested that each of the major epistemologies (empiricism, rationalism, historicism, and pragmatism) implies its own theory of concepts. These theories of knowledge are, thus, in this article suggested as being the best way to understand and classify theories of concepts. This theoretical outlook is exemplified by considering specific

concepts in specific disciplines, for example, the concept of "species" in biological systematics. It is, thus, demonstrated that the way scholars define a given concept is a reflection of their methodological ideals.

The "post-Kuhnian" view of concepts has many important implications for research and practice in information science. It is argued that knowledge organizing systems (such as thesauri and ontologies) should be considered to be organized collections of concepts (a view not shared by all researchers). Among the aims of a theory of concepts in information science is to support the design, use, and evaluation of such systems. This article argues further that the most fruitful theories of concepts are related to historicism and pragmatism, and it sees the adoption of these views as related to a broader "paradigm shift," which is also visible in information science.

In the period around 1980–1990, information science was dominated by a cognitive view related to artificial intelligence and cognitive psychology. At that time (and also in former periods), concepts were mainly studied by means of experimental studies of human cognitive processes. Concepts were often considered "files" in long-term memory in the human brain (cf., Woodfield, 1991), and books about cognitive psychology (containing physiological chapters about the brain) were used in information science teaching. What seemed to be the most problematic aspect of the cognitive view of that time was what was left out: The naturalistic study of concept development in scholarly fields. Hjørland (1991) criticized this approach in information science and began developing an alternative "domain analysis" (Hjørland & Albrechtsen, 1995) in which concepts are studied in domains and disciplines in relation to, among other things, theories and paradigms in those domains and, thus, informed by a post-Kuhnian view. Today, more researchers in cognitive science are studying concepts from the perspectives of the history and philosophy of science and from broader cultural perspectives, and because of this, cognitive science seems to be more fruitful today compared with 1991. This short historical outline expresses a theoretical view forming the present article: *A shift in the understanding of concepts is part of a broader shift in our understanding of cognition, knowledge, and information.*

Interdisciplinary Research on Concepts

Research on concepts goes back at least to Plato (428–348 BC) and Aristotle (384–322 BC). Weitz (1988) provided an overview of the major philosophical tradition's view of concepts. It contains a chapter on each of the following philosophers' concept theory: Plato, Aristotle, Augustine, Aquinas, Descartes, Spinoza, Leibniz, Hobbes, Locke, Berkeley, Hume, and Kant in addition to two chapters on some nineteenth and twentieth centuries theories.[6] In spite of this impressive coverage, this book is, of course, selective and based on the author's view,[7] but according to the introduction (pp. xiii–xvi), it was written in frustration of a previous lack of such an overview.

Margolis & Laurence (1999a) have edited what they regard the "core readings" in concept theory. However, their treatment of classics such as Plato and Aristotle is almost absent,[8] and among contemporary views, this book does not mention, for example,

- "Begriffsgeschichte" (history of concepts),[9]
- Hermeneutics,
- Lev Semenovic Vygotskij or the *Cultural Historical Activity Theory,*[10]
- Pragmatism,[11] and
- Speech-act theory.[12]

All these perspectives on concept theory, which I consider important, seem to be unknown to or ignored by mainstream researchers in concept theory (or not to fit with the dominant paradigm). This need for alternative views is confirmed by considering book reviews in this field (see Bloom, 2003[13] and Benzon, 2004[14]).

The seeming lack of a core may also be caused by the interdisciplinary nature of research in concepts. It is related to psychology, philosophy, linguistics, sociology, artificial intelligence, and many other fields. Many new and interdisciplinary fields such as semiotics, discourse analysis, terminology, information studies, etc. also have implications for the understanding of concepts. The complexity of the theory of concepts is partly based on the fact that concept theory is related to all these fields. It is characteristic, however, that the psychological perspective dominates the literature on concepts today and that other views are often ousted.[15] This may be seen as the dominance of the individualistic paradigm rather than the dawning social paradigm that informs the present article.

Today, there is no consensus on what concepts are (although it often seems to be very simple to define [concept][16,17] as well as to define specific concepts such as [bachelor] or [gold][18]). The difficult nature of the term has been described by Paul T. Durbin (1988, p. 51), who said that [concept] is among the most controversial concepts in the Western philosophical tradition.

One summary of present day candidates for the definition of "concepts" in the philosophy of mind is provided by Georges Rey,[19] who points to *the pragmatic principle* that concepts (including the concept of concept) should be defined in relation to the work we want them to perform for us. By implication, if we cannot clarify our goals, then we cannot clarify our concepts either. The problem in defining concept is, thus, according to Rey, due to lack of agreement on what we want this concept to perform. (This principle belongs to one theory of concepts, but is contrary to other theories, as will be discussed later).

Major theories of concepts as presented and discussed in the contemporary literature are as follows:[20]

- "The classical theory" of concepts (attributed to Aristotle). According to this view, a concept is a summary representation of some sets of things in terms of conditions that are singly necessary and jointly sufficient for determining membership

in that set. It is also often assumed that to possess a concept means to know its defining conditions.

- Probabilistic theories of concepts, including "the prototype theory" (attributed to Ludwig Wittgenstein[21] and Eleanor Rosch). These theories differ from the classical view by considering the conditions that define a concept to be probabilistic rather than either/or. By implication, some exemplars are more typical examples of a concept compared with other exemplars.
- Theory-based theories of concepts understand concepts as defined in a theoretical framework, often by a causal theory in which the discovered properties are central (e.g., Murphy & Medin, 1985; Carey, 1991; Keil, 1989; Gopnik & Meltzoff, 1998).
- Neoclassical theories of concepts (associated with, for example, Steven Pinker and Ray Jackendoff) have only partial definitions of the condition for membership.
- Conceptual atomism (in particular associated with Jerry Fodor) is mainly a negative theory about what a concept is not. A concept is not a definition, but its content has an appropriate causal relation to things in the world. This view is related to the rationalist view of innate primitive concepts.

However, there is no consensus today that this is the most relevant way of distinguishing theories of concepts. On the contrary, this classification has been seriously criticized by Margolis (1994[22]).

Among the omissions in the list above is *the empiricist view of concepts*. Empiricism has been influential and is often regarded as the scientific revolution's answer to Aristotle. This tradition developed a view of concepts that—although much younger—may also deserve the label "classic." The empiricist view is outlined and discussed later.

Among the five listed groups of theories of concepts mentioned above, the present article is most in accordance with "theory-based theories of concepts," which represent a relatively new approach in cognitive science.[23] Although some researchers choose not to consider theory-based theories of concepts, others, like Alan F. Chalmers, take the opposite stand. His view is quoted below at some length because it is seen as an interpretation of what in this article is termed "the post-Kuhnian understanding of concepts":

> Observation statements [in science] must be expressed in the language of some theory. Consequently, it is argued, the statements, and the concepts figuring in them, will be as precise and informative as the theory in whose language they are formed is precise and informative. For instance, I think it will be agreed that the Newtonian concept of mass has a more precise meaning than the concept of democracy, say.
>
> It is plausible to suggest that the reason for the relative precise meaning of the former stems from the fact that the concept plays a specific, well-defined role in a precise, closely knit theory, Newtonian mechanics. By contrast, the social theories in which the concept "democracy" occurs are vague and multifarious. If this suggested close connection between precision of meaning of a term or statement and the role played by that term or statement in a theory is valid, then the need for coherently structured theories would seem to follow directly from it. (Chalmers, 1999, pp. 104–105)

Chalmers considers alternative ways of defining scientific terms by, for example, lexical or ostensive definitions. The main problem with *lexical definitions* is that concepts can only be defined in terms of other concepts, the meanings of which are given. If the meanings of these latter concepts are themselves established by definition, it is clear that an infinite regress will result unless the meanings of some concepts are known by other means. A dictionary is useless unless we already know the meanings of many words. Newton could not define mass or force in terms of previously available concepts. It was necessary for him to transcend the limits of the old conceptual framework by developing a new one. The main problem with *ostensive definitions* is that this is difficult to sustain even in the case of an elementary notion like "apple." It is even more implausible when we come to the definition of something like "mass" in mechanics or "electric field" in electromagnetism or "aboutness," "subject," or "topicality" in information science. The dependence of the meaning of concepts on the structure of the theory in which they occur—and the dependence of the precision of the former on the precision and degree of coherence of the latter—is made plausible by noting the limitations of some of the alternative ways in which a concept might be thought to acquire meaning.

Chalmers also points out that the typical history of a concept, whether it be "chemical element," "atom," "the unconscious," or whatever, involves the initial emergence of the concept as a vague idea, followed by its gradual clarification as the theory in which it plays a part takes a more precise and coherent form.

From the pragmatic point of view, it is important to consider what task the concept of "concept" should do for us. This is the focus of the next section.

The Functions of Concepts

Rey (1999, p. 282ff) provides an overview of the main functions that concepts have been invoked to perform. He lists four main categories: (a) stability functions, (b) linguistic functions, (c) metaphysical functions, and (d) epistemological functions. The stability function is probably the primary function, which holds the key to the other functions as well, and this is why we here limit our attention to that function.

We shall illustrate the stability function of concepts by considering a famous quote. Heraclitus (535–475 BC) is probably best known through Plato, who wrote: "Heraclitus, I believe, says that all things go and nothing stays, and comparing existents to the flow of a river, he says you could not step twice into the same river" *(Plato in Cratylus* 402a = DK22A6[24]). However, it *is* possible to say that the same person stepped twice into the same river precisely because we use concepts that stabilize what we are talking and thinking about. When we speak about a particular person (such as the philosopher Ludwig Wittgenstein), or about a particular river (such as the Nile), we ignore the changes that take place from one moment to another.[25] Because concepts are pragmatic constructions, we may, according to our needs,

vary what abstractions we make. In philosophy, for example, one speaks of the young and the old Wittgenstein as separate concepts because it is felt that his philosophy changed, and, therefore, it is important to distinguish between the writings of Wittgenstein at different times.

The basic function of concepts is thus to fixate something in a sign (or in the mind) to be able to think about it, to communicate about it, and to act in relation to it. Because of this, it has been claimed that concepts cannot change. We shall now consider this issue.

Conceptual Stability and Change

The American pragmatic philosopher and psychologist William James (1842–1910) found that concepts must always remain stable. The world changes, the perceiving subject changes, but concepts *must* remain unchanged because their function is to fixate what is thought about.[26] Although the logic of his argument seems valid, an interdisciplinary field about conceptual change has grown up (for an overview see Vosniadou, 2008). The idea of conceptual change has been traced back to Georg Wilhelm Friedrich Hegel (1770–1831; cf., McInnis, 1995,[27] pp. 35–36; Thagard, 1992, pp. 15–16). Harold I. Brown has proposed the following solution to the paradox of the change of the unchangeable:

> Unfortunately, this view [about the stability of concepts] allows us to lose sight of the rather important point that a "new" concept can be more or less similar to the older concept it "replaces." It is in those cases in which, rather than simply rejecting a concept, we move to a similar concept, that talk of conceptual change is most clearly appropriate. (Brown, 1986)

What, then, are the mechanisms regulating conceptual stability and change? Probably the best explanation is given by Activity Theory, according to which our concepts are stabilized by the standardized practices that they serve within a community:[28]

> Activity Theory explains also how we are involved in a world with historical depth, and how we come to acquire this world. This last thing is particularly interesting. As described by Leontjev this acquisition cannot be made by learning empirical correlations between properties in the world—even if this learning is very thorough and complete. The acquisition assumes that the objects are understood as human products which are associated with intentions and *standardized practice* [italics added]. . .
>   To learn the meanings of the objects [i.e. concepts] is not just about establishing a connection between objects and signs[29] which by principle is an arbitrary relation, but instead to understand the historical co-evolution between the objects and human practice." (Mammen, 1994, pp. 52–53, translated from Danish by BH)

The theory of concepts developed within Activity Theory may be interpreted as follows: We have in society more or less standardized forms of practices such as teaching in schools, singing in churches, driving cars, etc. All such practices are more or less stable and standardized but changes dynamically in the longer or shorter run. When human beings develop new practices, they associate signs with them. For example, we associate the word "school" with places for teaching or the word "hymn" for what is sung in churches. Concepts are tools formed to think about and communicate about such practices. *Concepts thus co-evolve with human practices.* They classify the world by subjective interests, as James (1890, p. 482) also said. But where James spoke of subjective classifications according to "private ends," Activity Theory speaks of classification with regard to social or collective ends. For any such practice, there will almost always be more or less conflicting views. There are, for example, conflicting views of what to sing in churches. A Danish committee revising the Danish book of hymns considered including a popular (non-religious) song by Kim Larsen. Such a change may be considered a small change in the concept of "hymn." The dominant views and the dominant practices have the greatest impact on defining concepts. Minority views may or may not develop alternative concepts.[30] Alternative concepts (and alternative conceptions) are needed to work towards a change in a form of practice. In general, it should, thus, be expected that different competing concepts may be identified in any domain. Such different concepts are often connected to different theories or interests.

As formerly mentioned, a present-day trend in understanding concepts and conceptual development may be termed "post-Kuhnian." Following Thomas Kuhn, concepts and conceptual changes are increasingly associated with developments in scientific theories and, therefore, historical studies of science have become important in cognitive studies.[31,32]

Let us also briefly consider the change of concepts in individuals. Concept development is studied in developmental psychology,[33] animal psychology, and artificial intelligence. Such studies in behavioural and cognitive science used to be experimental studies that ignored the cultural historical dimension in conceptual development (with the exception of the Russian school of Cultural Historical Activity Theory). Thomas Kuhn has, however, also influenced these fields, and in the post-Kuhnian era, this cultural historical dimension is increasingly observed (cf., Keil, 1989; Thagard, 2003). In the so-called "theory theory" conceptual developments in children are seen as analogous to conceptual developments in scientists (with possible "paradigm shifts"). In this way, the relation between psychology and science studies seems to have been reversed:

- Traditionally, epistemology tended to be psychologized (i.e., to understand knowledge from the perspective of individual psychology).
- A historical turn tends to epistemologize psychology (i.e., to understand individual psychology from the perspective of epistemology, including "paradigms," culturally situated and domain-specific knowledge).

We may conclude this section by stating: *Concepts are dynamically constructed and collectively negotiated meanings that classify the world according to interests and theories. Concepts and their development cannot be understood*

in isolation from the interests and theories that motivated their construction, and, in general, we should expect competing conceptions and concepts to be at play in all domains at all times.

In the next section, we shall consider how competing concepts are related to competing paradigms and theories of knowledge.

Theories of Knowledge and Corresponding Concept Theories

To handle the many epistemologies,[34] it is important to develop an overall view of classes or "families" of theories (guided by the pragmatic principle of which differences are most important in regard to what we want them to do for us). Based on previous articles (e.g., Hjørland, 1998b, 2003), we shall consider four basic views or "families" of theories of knowledge in this article.[35] These four views seem to exist in any domain as competing views, and most of the existing paradigms seem to fall within one or another of them. Based on studies in, among other fields, psychology and knowledge organization, they seem to work well. In the present article, examples from biology will primarily be used.[36] The four families of epistemologies to be presented are as follows:

- empiricism
- rationalism
- historicism
- pragmatism

Empiricism

"Empiricism" should not be mixed up with "empirical research." It is today generally accepted that research and science should somehow be empirical.[37] The four mentioned approaches should be regarded as different ideals for doing empirical research (although this may at first seems strange, in particular, about rationalism). If this was not the case, other views would simply be obsolete and not worth considering outside the history of philosophy.

Empiricism is the ideal of basing knowledge on observations (and on inductions from a pool of observations). Theoretical selections and interpretations of observations have to be avoided. (If not, we have moved to another approach). Observations are seen as "given," not as contextual or theory-dependent. Empiricist approaches are based on bottom-up analysis (information is read out of objects, perception is seen as a receiving or a passive process).

Classical empiricism criticized the Aristotelian doctrine of concepts as abstracted essential characteristics of things.[38] Empiricism argues that concepts are formed on learning based on relations of resemblance among things and through acquired or learned conventions between things and words. Prinz (2002) is a contemporary monograph defending the empiricist theory of concepts. This book does not, however, defend epistemological empiricism, but it explicitly defends concept empiricism as opposed to both epistemological and semantic forms of empiricism. This is different from the present article in which the relations between these three forms of empiricism are understood in the following way:

- Epistemological empiricism is the ideal of basing all knowledge on observations, i.e., animal classification should be based on observed similarities (rather than, for example, on common origin).
- Semantic empiricism is the ideal of defining meanings based on observable features. For example to define the meaning of the word "cat" by a set of observable features.
- Concept empiricism is the view that concepts are derived from sensations, for example, the concept [cat] is derived by considering similarities among sets of objects.

There are, thus, logical relations between these three forms of empiricism: If a researcher is influenced by epistemological empiricism, she or he needs also to subscribe to semantic empiricism and to concept empiricism to be coherent. If we look at a given domain, say biological systematics, there tends to be agreement between epistemological views, semantic views and the way concepts are being defined. Today the concept "species" is considered a fundamental category of biological organization and, by implication, in biological knowledge organization. There is, however, not consensus on the definition[39] and different groups of biologists prefer different concepts of species.[40] We shall, here, present the empiricist conception of species and, later, other definitions, and in each case, demonstrate the connection between the epistemological ideal and concept definition.

In biology Ereshefsky's (2000) presentation of "cluster analysis" and of "pheneticism" can be seen as two paradigms in biological systematics, both corresponding to the ideals of empiricism. They divide organisms into groups whose members share a cluster of similar traits and try to avoid theoretical assumptions and to base their findings on as many visible properties as possible. By implication, they also tend to define the species concept on visible properties. A corresponding empiricist definition of species is as follows:

> A species is a set of organisms that look similar to each other and distinct from other sets. (Ridley, 1993)

This example demonstrates our thesis about the correspondence between concept empiricism and epistemological empiricism.

Computer-based techniques, known as neural networks, may be seen as attempts to model concept formation artificially in ways that are basically in accordance with empiricism. Together with the example from biology is an illustration that the ideals of empiricism are still very much alive in contemporary science.

Empiricism has been discussed and criticized by, for example, Cooper (2005), who found that the technique known as "cluster analysis" cannot be used to construe an atheoretical classification system.[41] However, from the perspective of empiricism, theories cannot be accepted because they introduce a kind of subjectivity that should be avoided by sticking to pure observations. We have a tension between two views. The empiricist view of trying to avoid theoretical

preferences and the criticism of empiricism claiming that theory cannot be avoided in research, and, therefore, the empiricist position, thus understood, is untenable.[42] Thus, even if we concluded that empiricism is very much alive, we may also conclude that serious arguments are being raised against this position, arguments that cannot be dismissed.

It is, thus, typical of empiricism's ideal of concepts that it relies only on features that can be observed and tries to avoid theoretical selection of which properties are most important because such theoretical considerations are considered problematic from this methodological ideal.

Rationalism

Rationalism is the ideal of basing knowledge on logics, principles, rules, and idealized models. Rationalism is skeptical about empiricism and about sense experiences that are not organized according to principles, which are, in one way or another, a priori in relation to experience (for example, fast-wired into our cognitive systems). Rationalism may seem strange from a modern, empirical point of view. It is, however, a strong classical position with arguments that cannot be ignored: Every process of obtaining information is always an interaction of bottom-up and top-down processing, where rationalism is needed to account for the latter kind of information processing. Reality is interpreted in logical concepts and categories.[43] "Logical division" is a rationalist method (and in knowledge organization the facet-analytic approach comes closest to this ideal). Empirical research inspired by theoretical models should be considered rationalist if these models are not themselves derived empirically.[44]

Rationalism understands concepts as prior to sense-experience and as forming logical structures. Complex concepts are analyzed, decomposed and defined according to simple concepts that constitute them. In mathematics, computer science and information science *Formal concept analysis* is a contemporary and prominent form of rationalist concept theory (cf., Priss, 2006).[45] (See Figure 1).

Uta Priss writes:

> Formal concepts in FCA [formal concept analysis] can be seen as a mathematical formalization of what has been called the "classical theory of concepts" in psychology/philosophy, which states that a concept is formally definable via its features. . . .. The criticism against the classical theory of concepts is not relevant as long as FCA is used in a formal domain (such as in software engineering). But if FCA is to be used in domains that are primarily concerned with human cognition, such as psychology or linguistics, the same amount of careful modeling and caution is required for FCA as is required for statistical methods in these domains." (Priss, 2006)

The present article is an attempt to demonstrate that information science also needs the kinds of concept theory that Priss assigns to the domain of "human cognition" and, thus, that rationalist methods and rationalist concepts alone are not sufficient. FCA is about *formal objects*, but *natural kind concepts* are not formal objects and, therefore, other approaches to concept theory are also needed—also
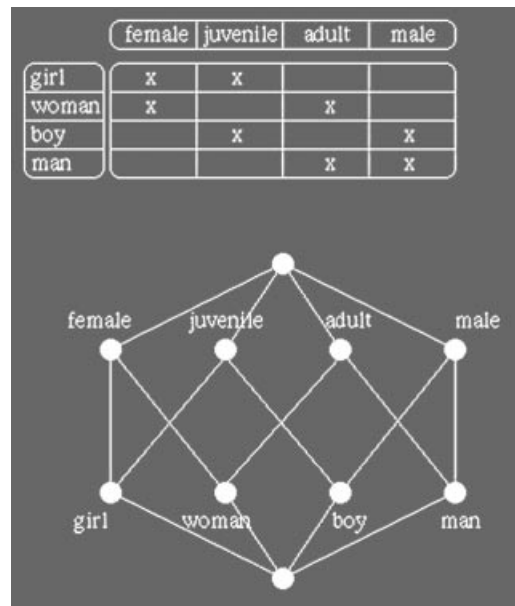

FIG. 1. An example of a formal context and a concept lattice (Galois lattice). Copyright 2007 Uta Priss. Reprinted from Priss (2007) with permission.

in software engineering. FCA (or rationalist approaches in general) cannot select, for example, the most appropriate definition of the competing biological concepts "species"—or any other natural kind concept. In regards to the biological debate concerning the species concept, it seems rather obvious that such a concept should not be established formally without considering the empirical research and the various findings, theories, and arguments in the scientific literature. Such an approach has nonetheless been suggested by "the theory of conceptual analysis,"[46] which is based on "direct a priori definition of concepts" or "indirect "transcendental argumentation." Although it is today generally considered "defunct" (Hanna, 1998), it is worth mentioning because this method of defining concepts is probably sometimes used without being recognized or questioned.[47]

In biology, rationalism is related to essentialism i.e., the assumption that some characteristics are essential and that species should be defined as a set of necessary properties. "Logical division" as a method in biology corresponds to rationalism. By implication the so-called "typological species concept" has been defined as follows:

> A species is a group of organisms conforming to a common morphological plan, emphasizing the species as an essentially static, non-variable assemblage. (Mayr, 1969)

It is, thus, typical of rationalism's ideal of concepts that it relies on a system of logically exclusive and mutually exhaustive classes constructed on logical principles rather than based on observing reality. It imposes order on a messy reality to improve our possibilities of thinking, computing, and communicating about this reality. A main problem is the empirical basis on which these decisions are made. In spite of this problem, rationalism contains insights and arguments. Like the

role of mathematics in the empirical sciences, rationalism must be regarded as both powerful and necessary.

Logical positivism (and logical empiricism) may be considered a combination of empiricism and rationalism characterized by reducing concepts to combinations of sensory attributes and, thus, ignoring historical-cultural and pragmatic dimensions of concepts.[48] It was influential in the first half of the 20th century, but lost influence from about 1962 when Kuhn published *Structure*.[49] We shall not consider this view any further because the most important principles underlying this view are present in pure form in empiricism and rationalism.

The Pendulum of Empiricism and Rationalism–and Alternatives

Although many people know about and accept the difference between empiricism and rationalism, many disregard or disapprove of historicism and pragmatism as approaches to knowledge. Prinz (2005), for example, writes:

> The history of Western philosophy can be viewed as a debate between rationalists and empiricists. Rationalists emphasize innate concepts, the power of *a priori* reasoning, and the unreliability of perception. Empiricists regard perception as the source of our concepts and the primary means of attaining knowledge. Since Plato and Aristotle, the pendulum has been swinging back and forth between these positions. (Prinz, 2005, p. 680)

Prinz (2002, 2005) does not, however, examine different concepts (such as species) in contemporary scientific discourses. Prinz explores concepts by exploring individuals, not discourses. It is, thus, based on the traditional understanding that is characterized by what has been termed "the empiricist-rationalist trap" (to be outlined below) and opposed to the social turn in cognition and in epistemology. It neglects the views that, in this article, are connected to historicism and pragmatism. Besides the pendulum described by Prinz, other views have existed, which will be addressed now.

Historicism

Historicism is the ideal of basing research on social contexts, on historical developments, and on the explication of researchers' pre-understanding. It is based on the understanding that observations are "theory-laden," or culturally influenced (as opposed to neutral and "objective") processes.[50]

Hermeneutics belongs to historicism, as understood in this article. However, it was not formerly considered a theory of knowledge, but a theory of interpreting texts and, thus, associated with the humanities rather than science. In the 20th century, hermeneutics, however, is increasingly considered a philosophy of science. Cooper (1994), for example, examines medicine from the perspectives of hermeneutics and argues that the three main dangers often associated with historicism and hermeneutics—relativism, skepticism, and antirealism—can all be avoided.

In retrospect, Kuhn's book (1962) *Structure* may be seen as an hermeneutic interpretation of the sciences because it conceives scientists as governed by assumptions, which are historically embedded and linguistically mediated activities organized around paradigms that direct the conceptualization and investigation of their studies. Scientific revolutions imply that one paradigm replaces another and introduces a new set of theories, approaches, and definitions. According to Mallery, Hurwitz, and Duffy (1992), the notion of a paradigm-centered scientific community is analogous to Hans-Georg Gadamer's, the influential hermeneutical thinker, notion of a linguistically encoded social tradition. In this way, hermeneutics challenges the positivist view of unmediated observations of "objective facts": Observations are always made on the background of theoretical assumptions; they are theory dependent.

Historicism differs from both empiricism and rationalism in important respects. It has, in the words of Mammen (2008, p. 25), "escaped the empiricism-rationalism trap" according to which our individual knowledge must either come from the senses or be inborn. Concepts must, therefore, evolve from processing sense information according to cognitive mechanisms. These mechanisms are by empiricism and rationalism considered biologically given, not culturally or socially developed. The escape from the empiricism-rationalism trap is, thus, the realization that experiences related to the learning of languages and other symbolic systems change our cognitive system in fundamental ways.[51]

According to historicist theories such as activity theory the learning of a concept (say [a cup]) is not just to associate the word "cup" (sound or image) with objects with some specific combinations of physical and chemical properties (as empiricism supposes). Also, we do not match a sensory input with a set of logical categories (as rationalism supposes). We learn concepts with "historical depth," i.e., we learn something about the function of cups and of humankind's accumulated experiences regarding cups and their functions. This also means that conceptions are culturally relative and can only be understood in a cultural context. As the Danish philosopher Søren Kierkegaard (1813–1855) wrote:

> Concepts, like individuals, have their histories, and are just as incapable of withstanding the ravages of time as are individuals. (Kierkegaard, 1966, introduction, para.2)

Gadamer emphasized the role of historically developed meanings on individual thought:

> When you take a word in your mouth you must realize that you have not taken a tool that can be thrown aside if it will not do the job, but you are fixed in a direction of thought that comes from afar and stretches beyond you. (Gadamer, 1982, 496)

We shall now turn to the biological example of the species concept: In Ereshefsky's (2000/2007) use of the term, a system following "the historical approach" classifies entities according to their causal relations rather than their intrinsic qualitative features. This way of defining concepts is clearly

different from both empiricism and rationalism as presented above. There are several species concepts based on the theory of evolution defining species according to their ancestry, for example, the so-called "phylogenetic species concept":

> A species is the smallest diagnosable cluster of individual organisms within which there is a parental pattern of ancestry and descent. (Cracraft, 1983)

This aspect of historicism's way of defining concepts may be termed "genealogical."[52] It is, however, also typical of historicism's ideal of concepts that it tries to see them as historically developed meanings related to discourses and epistemologies (e.g., to Darwin's theory of evolution). To clarify a concept involves the uncovering of the discourses in which it has been developed and used as well as its underlying set of assumptions.

Pragmatism

Pragmatism is the ideal of basing knowledge on the analysis of goals, purposes, values, and consequences. It is a kind of Darwinism[53] applied to epistemology (knowledge is understood as developments made to increase humankind's adaptation to the physical, biological and cultural environment). It is closely related to historicism by understanding that observations are contextual and "theory-laden." The difference is that pragmatism tries to be explicit about the purpose of research and cognition. Examples may be classifications developed on the basis of feminist theory (i.e., knowledge organizing systems developed to support a stated goal such as women's liberation). Pragmatism is not, however, limited to leftish, feminist, or other "alternative" points of view. Although it seems to be, on the face of it, opposed to basic scientific ideals of searching truth (rather than to politicize), pragmatism is based on the assumption that knowledge cannot be neutral (because of its teleological nature) and, therefore, it is important to uncover the inherent values and consequences in any knowledge claim, in any conception, and in any classification.[54]

Pragmatism understands concepts as a way to fixate parts of reality in thought, language, and other symbolic systems. These parts of reality are not fixated just by similarity (as assumed by empiricism), by logical division (or similar rules as assumed by rationalism), or by genealogy (as supposed by historicism), but by what is considered to be *functional equivalent classes of things*. The concept "food" is a good example because what is considered food is not based on resemblance, but on function. Very different kinds of things may serve as food, and the concept food must be understood as created for people to cope with the world. All other concepts are also seen in a similar way (including the concept of "concept"). The pragmatic view of concepts was first formulated by William James.[55] A more recent definition of concepts from the pragmatic perspective has been formulated by computer scientist John F. Sowa:

> Concepts are inventions of the human mind used to construct a model of the world. They package reality into discrete units

for further processing, they support powerful mechanisms for doing logic, and they are indispensable for precise, extended chains of reasoning. But concepts and percepts cannot form a perfect model of the world, —they are abstractions that select features that are important for one purpose, but they ignore details and complexities that may be just as important for some other purpose." (Sowa, 1984, p. 344)

What is important in the quote by Sowa is the realization that different purposes require different concepts. Thus, different cultures have different concepts of "food," and different scientific theories have different concepts of, for example, "mass," "chemical element,"[56] and "species." Scientific progress is tied to the development of well-justified theories, conceptions, and concepts and by the development of tighter constrains in the definition of concepts.[57]

Returning to our example of the biological species concept: How can [species] be defined from the pragmatic point of view? Let us first consider some problematic ways of doing so. Clearly the classifications of animals in categories like "pets," "domestic animals," and "pests" represent pragmatic concepts, but the scientific classification of animals is almost the opposite: seemingly independent of human interests. Another problematic version was discussed by *The Economist:*[58] There is a tendency that biologists today define more species because they hope this may be an argument for protecting more endangered animals (the more species, the more annihilated species, the better the arguments are for protecting them). However, as *the Economist* concluded that such a strategy has proven problematic. The lesson from the economy is that inflation is a bad strategy, i.e., this attempt to be "pragmatic" in defining species may turn out to be the opposite. How, then, can the definition of biological species be defended from the pragmatic point of view?

Pragmatists tend to see concepts as related to specific tasks, thus seeking different concepts of animals in different domains and paradigms. Biological species concepts are, thus, related to underlying views of what biology is and what is should be. Hjørland (2008a) suggested that Ereshefsky's (2000/2007) arguments about criteria for defining species can be seen as pragmatic in the way that they are connected to certain goals of biological research, more specifically, Ereshefsky's criteria help preserving the unity of biology. Whether this example turns out to be satisfactory, the claim of pragmatic philosophy is that human concepts serve human goals. Some ways of defining concepts (e.g., "pets") are directly pragmatic, while other ways may be pragmatic in a much more indirect and abstract way. By implication, concepts should be evaluated in relation to the goals and values they are supporting (in science this is often related to causal explanations because causal explanations enable human beings to control nature). The pragmatic view is based on the view that empiricism, rationalism, and historicism *alone* cannot account for conceptual developments.[59]

The pragmatic view, thus, considers concepts to be signs representing functional equivalent classes of things. What is to be considered equivalent depends on purpose, interests, and theoretical perspective. To define a concept is, thus,

to involve oneself actively in the struggle between different views. Studies of how a term has been used cannot alone help us to decide how we should define it. When we use language and terms, we perform some kind of act (cf., the formerly mentioned "speech act theory") with the intention of accomplishing something. The different meanings of the terms we use are more or less efficient tools to help us accomplish what we want to accomplish. In this way, according to pragmatic philosophers such as Charles Sanders Peirce (1905), the meaning of a term is determined by not just the past, but also by the future.

Conclusion of Section: Concept Theories and Theories of Knowledge

We have now seen that four distinctly different ways of understanding concepts are related to four epistemological views:

- The ideal of empiricism is to define concepts by clustering similar objects (relying on features that can be observed "objectively" and avoiding theoretical selection of defining properties).
- The ideal of rationalism is to define concepts by a set of primitive concepts (or "semantic primitives") considered "given."
- The ideal of historicism is to define concepts (a) genealogically and (b) by explicating their relations to theories and discourses.
- The ideal of pragmatism is to define concepts by deciding which class of things best serves a given purpose and then to fixate this class in a sign.

We have also exemplified these four theories of concepts in contemporary science (especially in biological taxonomy) and, thus, shown that they are represented in contemporary scientific discourses and may be seen as competing theories of concepts, not just at the philosophical level, but also specifically in the way scientific concepts are developed in different domains. In this way, the theory of concepts has been naturalized just as the relevance of concept theory in science has been demonstrated. For the rest of this article, we shall consider the implications for information science.

Relations to Library and Information Science

> The biggest challenge in information retrieval is concept identification in a specific domain of interest! (Soergel et al., 2004)

Concepts seem to be all-present and pervasive in library and information science (LIS). Concepts are what are behind users' questions, in the understanding of intermediaries and in the "information" being sought and retrieved. And the goal of Information Retrieval (IR) technology is, as stated by Soergel et al. (2004), to identify information corresponding to a certain concept, but which is often hidden under different labels and symbols that mix up different concepts and, thus, produce noise as well as a lack of recall. Most directly concept theory is related to knowledge organization, to the development

of classification systems, taxonomies, thesauri, ontologies, and so on. Different theories of concepts have implications for how LIS investigates its core topics and, therefore, the theoretical assumptions have to be examined.

The importance of concept theory, in general, and historicist/pragmatist concept theory, in particular, is illuminated in the following three different fields of LIS:

- bibliometrics
- information literacy
- knowledge organization

A Bibliometric Example

To initially illuminate the role of concept theories, we will start with a bibliometrics example: How to measure the most cited authors in a given discipline, e.g., LIS. The core concept to be defined is thus [LIS]. How do our four different theories of concepts apply to this task?

The empiricist ideal is to determine [LIS] by some observable criteria (while avoiding theory), for example, to ask researchers whether they consider themselves part of this discipline or to consider which journal applies this label or to develop an algorithm to select journals corresponding to some criteria, such as the relative frequency of words such as "information," "search engine," or "Internet." The empiricist problem immediately becomes obvious. Which terms should be considered synonyms with "LIS"? Should terms such as "Internet studies," "information management," and "scholarly communication" be included? Not every journal or article about "information" belongs to [LIS] and some journals/articles about [LIS] use other terms. What criteria should be used to clarify this issue? Bibliometric results vary extremely much depending on such decisions. Clearly something else beside observations is needed to solve this problem.

A rationalist alternative is to divide sciences in logical groups according to essential characteristics and then assign each journal/article to each group according to some matching criteria (for example, sciences about formal kinds, sciences about natural kinds, and sciences about artifacts such as cars and computers). This comes close to the methodology of facet-analysis as developed in LIS. Its basic strength is the potential for clear order, structure, and well-defined concepts. Although this might be done rather efficiently, we face the problem that such a classification probably does not correspond to empirical reality, e.g., to the way people in the field understand it. This is the conflict between a formal concept and a non-formal kind: We need some kinds of empirical criteria to be included, not just speculative, armchair criteria.[60]

The historicist view is based on an understanding of the development of [LIS], including its various metatheoretical approaches that [LIS] is, for example, a merger of two former fields—[information science] and [library science]—starting about 1964. Much more knowledge is of course needed to establish a genealogical definition of [LIS]. The historicist-minded researcher also acknowledges that the selection of

journals will necessarily be biased by his or her own pre-understanding of [LIS], and, therefore, he or she explicates his or her view of what [LIS] is (as far as this is possible) and then explicates how the journals have been selected in accordance with this understanding. To do this properly, the process must be done in an *iterative* fashion: The researcher develops his or her understanding while doing such studies and uses his new knowledge to improve future studies (i.e., the hermeneutical circle). The more knowledge the researcher has got about [LIS], the more precisely and consciously the selection criteria can be established and communicated. It would be wrong to consider this "subjective." On the contrary, the better qualified a researcher is the more "objective" his or her research will tend to be because he or she can eliminate more misinterpretations.

The pragmatic view is close to the historicist view, but it is explicit in acknowledging underlying values and goals. This could be an interest in supporting certain cultural values and the use of [LIS] as a means to facilitate the development of these values. Compared with historicism, less emphasis is put on former ways of understanding and more on the anticipated future use of concepts. If the goals and values are not explicated, then it does not imply that the research is neutral or objective. It just means that the underlying goals and values are hidden and, thus, more difficult to detect and control (and, thus, for others to have other goals and values satisfied).[61]

The historicist and pragmatist views should not be seen as representing relativism, skepticism, or anti-realism: When such iterative processes have been made enough times, stabilization may occur.[62] Such stabilization depends on many factors and is probably much more easily established in some cases compared to other cases.

Information Seeking and Information Literacy

To be able to seek relevant information (and to be "information literate"), individuals must be able to identify the labels (words or other symbols) under which the relevant information can be found. Such labels are subject to the principle of the semiotic triangle: They represent something for some interpreters (but something else for different interpreters). In other words, the information seeker approaches information systems with his or her given pre-understanding expressed by some symbols, but cannot in advance know whether—or to what extent—these specific symbols have been used as labels for exactly the information sought. In many cases, we would say that professional users know the correct terminology (and hence labels), but that non-professionals do not. From the perspective of post-Kuhnian epistemology, this is more complicated because competing perspectives often use different symbols/labels: Different concepts represent different theories and interests and are crucial factors in what users need and what is considered relevant (cf., Hjørland, 2002; Hjørland & Sejer Christensen, 2002).

To seek information is, thus, intimately connected to studying how concepts and conceptions are distributed in the *information ecology*. Every time users discovers a new relevant item, they have the opportunity to learn something about what labels have formerly been used to describe what they consider relevant items. In some cases, this is easy; in other cases, it is difficult. The level of difficulty depends on two issues: (a) To what degree has there been consensus in the domain about what items are relevant in relation to the given problem? (b) To what extent has terminology been consistently applied?

Information systems and information professionals should help users to identify and select the different views and concepts and, thus, help to develop their personal understanding. Mostly, the underlying view in information sciences has been based on the positivist assumption of finding the correct term rather than on the hermeneutic/semiotic view of mapping different meanings. We will discuss this further below. Here, it should be mentioned that information specialist Raymond G. McInnis (1995) has combined the issues of concept theory, instruction in literature searching, and compiling a set of dictionaries intended to support users' knowledge of concepts. McInnis' views and aspirations are related to what is attempted in the present article and may be considered the application of an historicist concept theory in the field of instruction in information seeking.

The Design and Evaluation of Knowledge Organizing Systems

The subfield of LIS known as knowledge organization (KO) is concerned, among other things, with the construction and evaluation of knowledge organizing systems (KOS), such as classification schemes, thesauri, and ontologies. It will here be argued that such systems are essentially systems of organized concepts.[63] A thesaurus, for example, comprises descriptors representing concepts and relations between the concepts. Some authors (e.g., Smith, 2004) argue, however, that KOS do not represent concepts but reality.[64] To consider this issue, suppose that biologists disagree whether a specific animal should be considered a "horse" or a "zebra." Perhaps the majority consider this specific creature a zebra. However, in the collected literature of zoology, both views are present and no consensus has been established. We may say that there are different theories about the extension of the terms "horse" and "zebra," both of which are based on scientific arguments and findings. If Barry Smith claims that a given classification of animals represents reality rather than a conception, then he has taken a stand in such a dispute. He has made a choice and claimed that this choice represents reality and not just his own opinion.[65] This point of view seems unfortunate, at least in relation to LIS: Smith has denied the existence of other views and made a system that makes alternative views invisible and, thus, difficult to retrieve. This is the opposite of what may be the most important goal for LIS: To enable users to form their own opinion by providing access to different theories. It, thus, seems well based when KOS are considered the organization of concepts.[66] By implication the theory of KO is closely associated with the theory of concepts. *Scientific*

observations, theories and concepts are always mediated by presumptions, and competing views and conceptions exist in almost every field of knowledge. The most important task of research on KOS is to argue which conceptions should be preferred as the basis on which to construe and evaluate KOS. We have already demonstrated this in the case of biological systematics.

How have KOS been constructed and evaluated according to KO literature? Hjørland (2008b) has outlined the different approaches that have appeared during the history of KO. In some cases, the identification of the corresponding concept theory seems rather straightforward (rationalism in facet theory respective empiricism in numerical taxonomies such as cluster analysis). Often, however, it is difficult to establish a connection between existing approaches and a corresponding theory of concepts. Sometimes is it suggested that subject specialists should define the concepts and establish their relations to other concepts. At other times, it is implied that librarians or users define the concepts. Sometimes it is vaguely suggested that "literary warrant" or scientific consensus (or just something practical) should be used to define the concepts and their relations. In the present article, we outlined different concepts of "species" and their relations to different paradigms in biological systematics. KO is concerned with how such a concept should be represented in KOS. With domain analysis as the exception, no approaches to KO have seriously addressed the problem on how to do so. Almost always it has been assumed that the definition of concepts and their semantic relations have a correct solution and that it is trivial how to find this solution. However, consider WordNet's definition of the word "synonym": "equivalent word (two words that can be interchanged in a context are said to be synonymous relative to that context)."[67] We see that synonyms are (more or less) relative to contexts. If we generalize from synonyms to all kinds of semantic relation, then we can say that *the definition of terms and their relations is relative to a context*. It follows that *the methodology of KO should somehow provide methods and guidelines for establishing this context*. Again, only the domain analytic approach has addressed this problem based on a post-Kuhnian version of paradigm theory (i.e., stated that the needed context is partly identical with paradigms in or across domains).

A few authors have considered hermeneutical approaches to ontologies and other kinds of KOS. In general, by contrast, the underlying view has been rationalist/positivist assuming that the correct definition and relations can be established objectively, for example, by following some indexing rules or classification standards or if done by the right kind of people. However, outside LIS other kinds of KOS have been established. Based on *Begriffsgeschichte* (conceptual history), certain kinds of dictionaries have been developed that come close to the ideals of historicism. In recognizing that the meaning of terms is imbedded in cultures and is constantly changing, these dictionaries map how a given word has been associated with different meanings. The insistence upon historical perspectives makes Begriffsgeschichte an alternative to positivist orientations and to most kinds of knowledge

organizing systems (KOS) as described in the literature of library and information science.

The very existence of such dictionaries—and the neglect of them as well as of their theoretical basis—suggests the relevance of concept theory for KO. Compared with such dictionaries, which map the contexts in which concepts are given their meaning, traditional kinds of KOS and their underlying assumptions seem to be somewhat naïve and simplistic. It is not a question of such dictionaries being considered "better" than traditional KOS. In many situations, they may not be practical or functional. It does, however, raise some important theoretical questions as follows:

- If concepts are relative to contexts and certain KOS outline these contexts carefully, then how do other KOS then identify the contexts for which their concept-relations are valid?
- Given the investment of much manpower in providing dictionaries based on Begriffsgeschichte, should we not expect future generations of search engines somehow to benefit from this kind of KOS?
- How do we decide what level of details and documentation of concepts and their relations are needed for different kinds of tasks?
- Begriffsgeschichte has so far only been applied in the humanities. Are the principles employed by Begriffsgeschichte also relevant in the so-called "hard sciences"?

In conclusion, KOS should not consider concepts to be universal but to be linked to certain discourses and interests. KOS should acknowledge the pragmatic and historical nature of concepts and try to make this explicit in every case by linking concepts with paradigms and discourses. Information scientists are already involved in studying domains using bibliometrics methods, and these two fields should be better integrated.

These three examples should be sufficient to claim that library and information science cannot develop a proper understanding of its own domain without considering theories of concepts, in general, and, in particular, concept theories based on historicist and pragmatic epistemologies.

Conclusion: Implications for Information Science

Any view of concepts in information science is, of course, related to the overall approach to the field. If information scientists are mainly influenced by empiricism and rationalism, then their corresponding views of concepts tend also to be influenced by empiricism and rationalism. If information scientists, on the other hand, are influenced by hermeneutics or other social/historical epistemologies, then their corresponding understanding of the term "concept" tends to reflect such a social and historical view.

Developments in information science have be interpreted as developed from a "physical" to a "cognitive" paradigm (Ellis, 1992; Cronin, 2008) and from a cognitive turn to a social turn (Cronin, 2008).

> The cognitive viewpoint's emphasis on the individual's knowledge state can cause us to lose sight of the epistemological significance of social relations and social structures. As I

have noted elsewhere [Cronin, 2005, p. 1]: The texts we write and the texts we cite bear the marks of the epistemic cultures, socio-cognitive networks and physical places to which we belong at the different stages of our professional lives. " Cognition is not an exclusively individual phenomenon. (Cronin, 2008, p. 470)

The view of concepts presented in this article is clearly social. Concepts have been understood as socially negotiated meanings that should be identified by studying discourses rather than by studying individual users or a priori principles. The implication of the presented view of concepts, thus, calls for an argument both as to why the social point of view is important and for the role of concept theory in the fulfillment of the potentials of a social turn in information science.

Admittedly, information technology has developed strong search engines and other impressive results without being based on a social paradigm or a theory of concepts. Extremely efficient tools have been developed by relative simple techniques such as putting words in huge databases and constructing algorithms matching users' queries with document representations. The potential for further improvement along such lines may, however, soon be exhausted. When words are put into databases, the context that provides at least part of their meanings is more or less lost (cf., Hjørland, 1998a). From the perspective of socially and historically oriented paradigms, the future refinement of IR technology is connected to the possibilities of reestablishing the lost contexts that determine the meaning of words, i.e., the concepts. Although this has partly been done (e.g., by utilizing link structures in search engines), this issue has never been considered systematically. A first step must be to develop an understanding of concepts, meaning, and semantics that is suited to this task. Former papers have addressed some semantic issues (Hjørland, 1998a, 2007). The present article is an attempt to develop a theory of concept serving this purpose.

Acknowledgement

Endnotes

[1] In this article, the terms information science and library and information science (LIS) are considered synonyms.

[2] The word "paradigm" is central in Kuhn's theories, who defined it as "a universally recognised scientific achievement that for a time provides models, problems and solutions to a community of practitioners" (Kuhn 1962). Kuhn was, however, not fully consistent in his use of paradigm; Masterman (1970, p. 65) pointed to 21 different meanings in which Kuhn used the term. The concept was also criticized by Mayr (see note 4). A post-Kuhnian understanding of paradigms is proposed by Tjörnebohm (1974, pp. 1–2) as a means to grasp systems of (explicit or implicit) basic assumptions and epistemic ideals in scientific disciplines. A paradigm is a superindividual structure of meaning, which is formed and reproduced in disciplinary socialization, teaching and scientific communication. Tjörnebohm distinguished between the following components of paradigms:

1. "ideals and beliefs about science, such as epistemic goals methods and criteria in the production and evaluation of scientific results inside the discipline;

2. world view hypotheses, including basic social ontological assumptions about the part of the world studied inside the discipline, and;

3. ideals concerning the extra-scientific significance of knowledge produced inside the discipline, such as significance for society and culture, for practical use, and for enlightenment."

[3] Concerning Kuhn's theory of concepts and his contribution to cognitive psychology, see, for example, Andersen, Barker, and Chen, 1996 and Barker, Chen, and Andersen, 2003. Andersen et al. (p. 30) writes: "As a broad, but fairly exact generalization, it is true to say that this view of concepts [as a summary representation of some sets of things in terms of conditions that are singly necessary and jointly sufficient for determining membership in that set] was universal, in the Western philosophical tradition, and related fields such as psychology, until the mid-1970s. There were only two important exceptions: the mature Wittgenstein, and the young Kuhn." Andersen et al. (pp. 31–32) further write about Kuhn's theory of concepts: "One learns a concept by being guided through a series of encounters with objects that highlight the relations of similarity and dissimilarity currently accepted by a particular community of concept users. Teaching and learning depend upon examining similar or dissimilar features of a range of objects (Kuhn, 1974, 1979; see also Hoyningen-Huene, 1993, ch. 3.6). Kuhn's standard example is the child learning to distinguish ducks, geese, and swans"

[4] "Finding virtually no confirmation of Kuhn's thesis in a study of theory change in biology inevitably forces us to ask what induced Kuhn to propose his thesis? Since much of explanation in physics deals with the effects of universal laws, such as we do not have in biology, it is indeed possible that explanations involving universal laws are subject to Kuhnian revolutions. But we must also remember that Kuhn was a physicist and that his thesis, at least as presented in his early writings, reflects the essentialistic-saltationistic thinking so widespread among physicists. Each paradigm was at that time, for Kuhn, of the nature of Platonic *eidos* or essence and could change only through its replacement by a new *eidos*. Gradual evolution would be unthinkable in his conceptual framework. Variations of *an eidos* are only 'accidents,' as it was called by the scholastic philosophers, and, therefore, variation in the period between paradigm shifts is essentially irrelevant, merely representing normal science." (Mayr, 1997, pp. 98–99; emphasis in original)

[5] Kuhn's theory of concepts was influenced by the late Wittgenstein, who has also independently been influential in concept theory.

[6] Chapter 13: Frege, Russel and More; Chapter 14: Ryle and Geach.

[7] The pragmatic philosophers Peirce, James, and Dewey, for example, are only briefly mentioned. The same is the case with Hegel. No researcher in the critical theory/Marxist traditions is mentioned. Thomas Kuhn is not mentioned. Wittgenstein is mentioned in many places, but just in passing when other philosophers are being discussed.

[8] The section termed "the classical view" contains no chapter discussing Plato's view (just a reprint of his Euthyphro) and no chapter presenting or discussing Aristotle's view, which is often today termed the classical view.

[9] See Hampsher-Monk et al. (1998) for an introduction to "Begriffsgeschichte" in English. See Bödeker (1998) for a discussion of how "concept" is understood in Begriffsgeschichte, for example, "Begriffsgeschichte views a concept as a collection of experiences and expectations, perspectives and explanations, of historical reality" (p. 55). And, "[Koselleck] stressed that a history of concepts and a history of discourse mutually refer to one another. . ..A more detailed analysis of these relations, however, still needs to be conducted" (p. 64).

[10] Cultural-historical activity theory, CHAT, is often just referred to as "activity theory"—also later in the present article.

[11] Although the pragmatic philosopher William James is mentioned by Margolis & Laurence (1999a) in another relation.

[12] An introduction to speech act theory may be found in many places, including Wikipedia's entry "Speech act" (http://en.wikipedia.org/wiki/Speech_act; retrieved 2009-01-06).

[13] "If you skip to the end of the book looking for a clear resolution, you will be disappointed. Concepts, Murphy [2002] cheerfully concludes, are a mess. With the exception of the classical view ('a total flop'), each of the existing theories is the best explanation of a particular set of empirical findings". (Bloom, 2003)

[14]"Actually, it is not so much the book I'm uneasy about, as the field it reviews. . . . Thus, The Big Book of Concepts appears to be but a prolegomena to something else: the integration of these models and empirical techniques into a richer intellectual undertaking. If you are interested in that richer undertaking you probably need to know what is in this book, but mostly as background." Benzon (2004) wrote: "To actually navigate in those other territories you will need to consult other literatures."

[15]The comprehensive International Encyclopedia of the Social and Behavioral Sciences in 26 volumes (Smelser & Baltes, 2001)—which has a good coverage of science studies—has, for example, one article "Scientific Concepts: Development in Children," but none about scientific concepts development in science. It has also one about "Natural Concepts, Psychology of" but none about natural concepts (i.e., Natural kinds, which is an important concept in the philosophy of science).

[16]This article follows a convention according to which words are indicated with quotation marks, while concepts are indicated with square brackets, e.g., "cat" respective [cat] when the difference between words and concepts needs to be explicated.

[17]Concepts have, for example, been defined as follows: "mental representations used to classify the world into groups that will be treated as equivalent for some purpose" (cf., Markman, 2003). This definition also reflects the pragmatic nature of concepts, but seems to be challenged by the following quote: "The thesis that concepts are mental representations is a minority view in philosophy, where concepts are typically viewed as abstract objects along the lines of Fregean senses or as psychological or behavioural abilities. And in cognitive science, where RTM [Representational Theory of Mind] is more of a current currency, the compositional nature of the representational system remains a hotly debated topic" (Margolis & Laurence, 1999b, p. 487). Another important development is due to a changing understanding of "mental representations." This term is often connected to a controversial theory of mind that considers conceptual development a purely individual process going on "inside" a person and, thus, opposed to newer theories of "distributed cognition" (see, e.g., Hutchins, 2001). In the theory of distributed cognition "representations" are not just understood as "internal" (or "mental" as traditionally understood) but as distributed across the environment and the organism. This difference is of major importance for the theory of concepts (cf. Yeh & Barsalou, 2006).

[18]Bachelor is traditionally defined as "adult, unmarried male" in the philosophical tradition and gold as "the chemical element with the symbol Au and atomic number 79" in chemistry. The question is: What kind of concept theory has produced these definitions, and are they the only ones or the best ones? What kind of research can determine that?

[19]Rey (1995, p. 192) wrote: "We might summarize the present situation with regard to candidates for 'concepts' that have been discussed here as follows: there is *the token representation* in the mind or brain of an agent, *types* of which are shared by different agents. These representations could be *words*, *images*, *definitions*, or '*prototypes*' that play specific *inferential roles* in an agent's cognitive system and stand in certain *causal* and *covariant relations* to phenomena in the world. By virtue of these facts, such representations become associated with an *extension* in this world, possibly an *intension* that determines an extension in all possible worlds, and possibly a *property* that all objects in all such extensions have in common. Which of these (italicized) entities one selects to be concepts depends on the explanatory work one wants concepts to perform. Unfortunately, there is as yet little agreement on precisely what that work might be."

[20]Kavouras & Kokla (2007) introduce these theories of concepts (and use this classification of the theories). Margolis & Laurence (1999a) use a similar classification and has a detailed presentation and discussion of each theory.

[21]Sutcliffe (1993, p. 42) criticized Wittgenstein from the point of view of Aristotelean theory:

"2.2.1 Wittgenstein on 'family' and 'family resemblance'

Wittgenstein (1953), having had difficulty specifying defining conditions for the class language (language games), gave up the search for necessary and sufficient conditions, and then (without proof) asserted that:

These phenomena have no one thing in common which makes us use the same word for all. . . . You will not see something

which is common to all, but similarities, relationships, and a whole series of them at that. . . . We see a complicated network of similarities overlapping and criss-crossing: sometimes overall similarities, sometimes similarities of detail. I can think of no better expression to characterize these similarities than 'family resemblances' for the various resemblances between members of a family." (pp. 31–32)

After a thorough discussion of this problem, Sutcliffe (1993, p. 48) concludes: "The explanation of Wittgenstein's difficulty, then, is that in concentrating on 'family resemblances' he remained in the wrong context A1, when, to find the needed genus-definition for the monothetic concept language-games, he should have shifted to context A0 within which one can state the conditions which set off language-games as a class from other things which are not language-games."

[22]"A standard view within psychology is that there have been two important shifts in the study of concepts and that each has led to some improvements. The first shift was from the classical theory of concepts to probabilistic theories, the most popular of which is prototype theory. The second shift was from probabilistic theories to theory-based theories. In this article, I take exception with the view that the first shift has led to any kind of advance. I argue that the main reasons given for preferring prototype theory over the classical theory are flawed and that prototype theory suffers some of the same problems that have been thought to challenge the classical theory." (Margolis, 1994)

[23]Kavouras & Kokla (2007, p. 90), however, dismissed this theory by stating: "The problem with the theory-based view is that people may have an inadequate or incorrect mental theory about a concept but still possess the concept." This problem has been addressed by, among others, Laporte (2004); Kavouras & Kokla's argument has, thus, been opposed.

[24]Plato is here quoted from the Internet Encyclopedia of Philosophy: http://www.iep.utm.edu/h/heraclit.htm

[25]There exists a theory, "general semantics," which reminds us of the above description by Plato/Heraclitus. General semantics is founded by Alfred Korzybski and has received some attention in information science (cf., Garfield, 1953; Read, 1973). In this approach, terms are "catalogued" by time indicators. Instead of speaking about, for example, the Nile or Wittgenstein, general semantics uses symbols such as "the Nile1957" or "Wittgenstein1950." This sounds like a very precise way of communicating, but, in reality, it denies our needs for general terms, and this is why it has been characterized as a kind of extreme nominalism (cf., Nordberg, 1977). It is possible to speak of, for example, the Nile or about any other thing because our concepts are abstractions.

[26]James (1950, pp. 461–462), wrote: "Each act of conception results from our attention singling out some one part of the mass of matter for thought which the world presents, and holding fast to it, without confusion [note omitted]. Confusion occurs when we do not know whether a certain object proposed to us is the same with one of our meanings or not; so that the conceptual function requires, to be complete, that the thought should not only say 'I mean this', but also say 'I don't mean that' [note omitted]. Each conception, thus, eternally remains what it is, and never can become another. The mind may change its states, and its meanings, at different times; may drop one conception and take up another, but the dropped conception can in no intelligible sense be said to change into its successor."

[27]McInnis (1995) writes about conceptual developments:

In scholarly disciplines, concepts, the building blocks of knowledge, are basic to enquiry and explanation. Scholars present their research findings in scholarly publications as explanations. These explanations, in turn, organize knowledge. And the principles and theories which emerge from this organization of knowledge are called concepts. We are indebted to Paul Thagard [1992] for a succinct account of the shifting concept of the concept of the period from Descartes through Hobbes, Locke, Hume, Kant, to Hegel. To understand scholarly progress, he argues, we need an account of how concepts can change. For Thagard, Hegel should be recognized as the founder of the study of conceptual change. Whereas Kant and the earlier empiricists tried to find a foundation for knowledge using both empirist

and rationalist ideas, Hegel stressed the importance of conceptual development. (pp. 35–36)

[28] This understanding of concepts is related to Miller's (1984) conceptualization of genre as "typified rhetorical actions based in recurrent situations." One of the few books about concepts written from a collectivist point of view is Toulmin (1972/1977).

[29] Mammen wrote here "concepts," but in an e-mail dated October 26, 2008, he has confirmed that "signs" should have been used.

[30] The Marxist concept "false consciousness" indicates that people may use concepts that are in conflict with their real interests—which of course is a point of view that may be true or false in each specific case—and probably turned out to be false as it was mostly applied by Marxists. However, the view that people can possess and use concepts without knowing their definitions (and without understanding their implications and consequences) represents an important insight and is opposed to most interpretations of the classical theory of concepts.

[31] The acceptance of the Copernican theory that the earth revolves around the sun required the rejection of the Ptolemaic theory that the sun revolved around the earth. Replacement was not merely a matter of one theory being substituted for another, but also involved shifts in meaning of the concepts used in the theories. In the Copernican revolution, for example, the concept "planet" shifted to include the earth and exclude the sun and moon. (Thagard, 2003)

[32] This connection between co-developments in theories and in concepts is of outmost importance. However, whereas many philosophers, for example, W.C. Quine, have found that there is no difference between a change in theory and a change in meaning, Laporte (2004) finds that conceptual revision provides no convincing grounds for rejecting a distinction between meaning change and theory change. Some terms (e.g.,"species" and "vitalism") did change their meaning with theory, whereas others did not. Harvey demonstrated that blood circulates, but according to Laporte that did not change the meaning of the terms "blood" or "circulate."

[33] An article in Encyclopaedia Britannica is says:

Concept formation

Process by which a person learns to sort specific experiences into general rules or classes. People are observed to lift a particular stone and to drive a specific car. When they seem to think about things, however, they often appear to deal with classes; apparently they know that stones (in general) sink and that automobiles (as a class) are powered by engines. They behave as if they think of these things in a general sense beyond any particular stone or automobile. Awareness of such classes can help guide behaviour in new situations. Thus, two people in a bakery may never have met before; yet, if one can be classified as customer and the other as clerk, they tend to behave appropriately. Similarly, many people seem able to drive almost any automobile by knowing about automobiles in general.

Concept formation is a term used to describe how a person learns to form classes; conceptual thinking refers to a person's subjective manipulations of those abstract classes. A concept is a rule that may be applied to decide if a particular object falls into a certain class. (Hunt, 2008)

[34] There are many epistemologies (see Hjørland & Nicolaise, "Epistemological lifeboat" at http://www.db.dk/jni/lifeboat/). Some are classic (e.g., empiricism and rationalism), some are new (e.g., social constructivism, feminist epistemology, and postmodernism). There is a tendency that epistemologies split up in a wide number of sub-theories and disagreements.

[35] For example, we do not consider feminist epistemology separately, but as a set of theories belonging to the family of pragmatism. We consider the core in feminist epistemology to be a kind of scepticism concerning the "neutrality" of knowledge. Much feminist epistemology is based on the view that women's perspectives and interests differ from those of men, and that is why they ask: "Whose knowledge are we talking about?" and make this question central in epistemological inquiry. This fundamental view is, however, shared with many other views such as social constructivism, Marxism and postmodernism, which can all be said to belong to the family "pragmatism" (to be further described below).

[36] In a book review of Ereshefsky (2007), *The Poverty of the Linnaean Hierarch,* Hjørland (2008a) demonstrated that the above mentioned theories of knowledge (empiricism, rationalism, historicism, and pragmatism) are also at play in biological taxonomy.

[37] Mathematics and formal sciences are exceptions in not being empirical sciences although empiricism is also a position in the philosophy of mathematics.

[38] "The main objection was the claim that we somehow have access to entities that lie outside the realm of ordinary experience. Forms or essences were, thus, subjected to skeptical attack, along with the doctrines of abstraction and innatism [innatism used by Plato and Descartes, not by Aristotle]. The empiricists had, therefore, to develop an alternative account of what is involved in the capacity to use words. Specifically, they argued that what is before the mind is a sensory *image* of the things thought about. By virtue of relations of resemblance among things and among sorts of things, we come to be able to use words to refer to things that are not present and to reidentify things or sorts of things when they are re-presented. The connections between the relations of resemblance and the words are established through acquired or learned conventions." (Wilson, 1997, emphasis in original; internal references are omitted).

[39] For a collection of different definitions of "species" see Matson (2006).

[40] "As a consequence of these differences, many alternative contemporary species concepts are incompatible in that they lead to the recognition of different species taxa depending on which concept is adopted. In other words, they lead to different species boundaries and different numbers of recognized species. For example, adopting the diagnosable version of the phylogenetic species concept commonly leads to the recognition of many more species taxa than adopting the biological species concept (24, 28, 29). The existence of alternative, and at least partially incompatible, definitions of the species category, hereafter referred to as the 'species problem,' creates difficulties given that species are used as basic units of comparison in diverse types of studies. On the one hand, species taxa recognized according to different species concepts often will not be comparable to one another with regard to the biological properties they possess. On the other hand, a study that uses species taxa based on a single species concept may yield very different results from one that uses species taxa based on a different species concept. This is not to deny that particular concepts are preferred by particular groups of biologists. Some such groups argue passionately about the superiority of their preferred concept over the alternatives. However, other groups argue just as passionately in favor of different species concepts. In addition, the species problem seems to be getting worse rather than better, which is to say the number of alternative species concepts has been growing rather than diminishing. Moreover, judging by the increasing numbers of critiques and proposed alternatives, Mayr's species definition, although still perhaps the most widely adopted, seems to be less popular now than 20–30 years ago." (de Queiroz, 2005, p. 6601)

[41] "It is worth noting that the discussion here is sufficient to show that no other numerical techniques are capable of producing atheoretical classification systems either. In all cases, a theory is going to be required to inform the selection of the variables that will be subjected to analysis. I conclude that classification systems must always draw on some theory or other, as a theory must be used to decide which features of the entities under study are of scientific interest. Classification cannot be theory-free." (Cooper, 2005, p. 96)

[42] The empiricist view of concepts was also criticized by the pragmatic philosopher John Dewey, who found that such concepts or ideas are "dead, incapable of performing a regulative office in new situations" Dewey wrote: "It should be noted that traditional empiricism has also misread the significance of conceptions or general ideas. It has steadily opposed the doctrine of their a priori character; it has connected them with experiences of the actual world. But even more obviously than the rationalism it has opposed, empiricism has connected the origin, content and measure of validity of general ideas with antecedent existence. According to it, concepts are formed by comparing particular objects, already perceived, with one another, and then eliminating the elements in which they disagree and retaining that which they have in common. Concepts are, thus, simply memoranda of identical features in objects already perceived; they are conveniences, bunching together a varity of things scattered about in concrete experience. But they have to be proved by agreement with the material of particular antecedent experiences; their value and function are essentially retrospective. Such ideas are

dead, incapable of performing a regulative office in new situations. They are 'empirical' in the sense in which the term is opposed to scientific-that is, they are mere summaries of results obtained under more or less accidental circumstances" (John Dewey, 1939, p. 883).

[43]For example, Chomsky's theory of language is explicitly rationalist (acknowledging Descartes) and regards real language a mess which must be understood on the basis of an underlying rational language.

[44]"Functional Requirements for Bibliographical Records" (FRBR) is a model developed within LIS mainly based on rationalist principles.

[45]Formal concept analysis is according to Priss (2006) "invented" in 1982. If we consider it a kind of rationalist theory, its roots go, however, centuries back in time, and it has been in confrontation with empiricism for just as long.

[46]"The theory of conceptual analysis holds that concepts—general meanings of linguistic predicates—are the fundamental objects of philosophical inquiry, and that insights into conceptual contents are expressed in necessary 'conceptual truths' (analytic propositions). There are two methods for obtaining these truths:

1. direct a priori definition of concepts;
2. indirect 'transcendental' argumentation.

The movement of Conceptual Analysis arose at Cambridge during the first half of the 20th century, and flourished at Oxford and many American departments of philosophy in the 1950s and early 1960s. In the USA its doctrines came under heavy criticism, and its proponents were not able to respond effectively; by the end of the 1970s the movement was widely regarded as defunct. This reversal of fortunes can be traced primarily to the conjunction of several powerful objections: the attack on intensions and on the analytic/synthetic distinction; the paradox of analysis; the 'scientific essentialist' theory of propositions; and the critique of transcendental arguments." (Hanna, 1998).

[47]The theory of conceptual analysis may in particular be used in relation to rationalist approaches such as facet analysis and formal concept analysis and also connected to the view that a closed "universe of knowledge" exists that can be studied in isolation from all the other sciences' study of reality.

> An example: In the PsycInfo thesaurus (online October 4, 2008), "Neurolinguistics" is considered a related term to "Neurolinguistic Programming."
> (Neurolinguistics is the study of brain functions in relation to using languages, while Neurolinguistic Programming is closer to be a kind of alternative psychotherapy. There is no citation-overlap between the two literatures using these terms, and they are only terminologically related.)

This may be considered an error possibly caused by a kind of intuitive conceptual analysis based on a lack of relevant subject knowledge. It seems strange that such "direct a priory definition of concepts" has ever been seriously considered when we speak of natural kind concepts.

[48]Logical positivists favored for a time the so-called "operational definitions" of scientific concepts suggested by P.W. Bridgman (1927). Concepts should ideally be defined by the procedure used to measure them. [Intelligence], for example, should, thus, be defined operationally by the psychological tests used to measure intelligence. This way of defining concepts runs into difficulties, in particular the problem of infinite regress: Each test/procedure has to be defined by yet another measurement.

[49]The decline of logical positivism was not caused by Kuhn (1962), but was due to many influences. Kuhn admitted himself that he did not know the views of logical positivism in detail when he wrote Structure.

[50]Among the important epistemological works in the historicist tradition is Fleck's book (1935/1979) about syphilis, which is often considered a predecessor to Kuhn (1962).

[51]This cognitive view is mostly associated with Wygotsky and "historical-cultural activity theory." It is, however, present also in semiotics and hermeneutics.

[52]Hjørland (2008a, p. 257) wrote: "In Ereshefsky's use of the term, a system following 'the historical approach' classifies entities according to their causal relations rather than their intrinsic qualitative features. This corresponds only partly to historicism in epistemology. What Ereshefsky terms 'the historical approach,' Gnoli (2006) terms 'phylogenetic classification' (which, according to Gnoli, includes the classification of musical instruments). Perhaps 'genetic classification' or 'genealogical classification' would be a better term (understood broadly as the identification of the causes producing a phenomenon, as Michel Foucault uses it). My point here is that Ereshefsky's use of the term 'historical' only refers to the object of study, not to researchers' way of understanding the object (as reflected in, for example, the hermeneutic circle and in Fleck's, 1935, study of syphilis). If Ereshefsky had argued that it is necessary for the biological taxonomist to consider the different conceptions and theories (as, for example, those presented in his own book), historicism would be at work. For Ereshefsky's book to correspond to epistemological historicism properly speaking, this additional reflection on theory would be necessary."

[53]Pragmatism should not be confused with "social Darwinism" or with cognitive theories based on purely biological principles at the expense of culture. Pragmatism is closely related to semiotics by emphasizing the role of signs and culturally constructed meaning. An explicit Darwinist theory of concepts is proposed by Toulmin (1972).

[54]What would be an ugly outcome of "pragmatism" would be if purely political interests rather than careful studies and considering of evidence would be the consequence (i.e., manipulation or fraud). This is, however, a misunderstanding of pragmatism (or a vulgar version of it).

[55]James wrote: "*The function by which we, thus, identify a numerically distinct and permanent subject of discourse is called* CONCEPTION; and the thoughts which are its vehicles are called *concepts*" (James 1890/1950, p. 461; emphasis in original). He continued: "... and how the conception with which we handle a bit of sensible experience is really nothing but a teleological instrument. *This whole function of conceiving, of fixing, and holding fast to meanings, has no significance apart from the fact that the conceiver is a creature with partial purposes and private ends*" (James, 1890/1950, p. 482; emphasis in original).

[56]Scerri (2009) discussed the concept of "element," thus, demonstrating the contemporary importance of discussing basic concepts in relation to actual problems in chemistry.

[57]Dudley Shapere has done pioneering work on the concept of a domain (Shapere 1974, 1984). In considering the scientific characterization of electricity in the 18th century, he points out that "it is by no means obvious that all the phenomena which researchers today unhesitatingly group together as forming a unified subject matter or domain under the heading 'electricity' really do form such a unity" (Shapere, 1974, 273).

[58]"Species inflation." The economist. May 17th 2007. (Leader).

[59] Pragmatism should not be understood as an alternative to seeking truth. It is considered pragmatic for human cultures to know the truth. Certainly observations and rational intuitions form part of such criteria. However, the criteria for truths are, in the end, evaluated by their implications for human practice. Due to the problem of fallibilism these criteria are not easy to specify (and may later be modified), they are holistic by nature.

[60]The subject categories in ISI's Social Sciences Citation Index have probably, in part, been established this way. If we use the category "library and information science" as a basis for our bibliometrics investigation of the field, then we run into some problems because not all the journals are LIS journals but, for example, general journals published by library associations or journals about non-LIS subjects such as telecommunication. A researcher doing a study should control the journals used in that study and should argue for the criteria used for selecting the journals.

[61]Abrahamsen (2003), for example, interviewed some Danish music librarians about their attitudes towards different kinds of music. They claimed to be neutral, but he found that the kinds of music of most interest to himself were not well represented or organized compared to other kinds of music.

[62]Such stabilization may, of course, be interpreted as either a "social construction" or as "a true representation of reality." If the social constructivist interpretation should be considered interesting or fruitful, it should provide suggestions for how to change research in the field and, thus, to break the stability.

[63]As expressed by Ingetraut Dahlberg: "A concept is regarded as the common element of both classification systems and thesauri [and other kinds of

KOS]" (1974, p. 12). This is made explicit in the subtitle of the journal Knowledge Organization: *International Journal devoted to Concept Theory, Classification, Indexing and Knowledge Representation*. There has not, however, so far been much research in concept theory in this journal (or in the entire field of LIS). Among the few contributions some are written by the founder of Knowledge Organization, Ingetraut Dahlberg (e.g.,1974, 1981).

[64]Smith (2004) finds that to speak of concepts is to refer to something mental as opposed to something real, and, therefore, the use of "concept" is automatically to subscribe to philosophical idealism. Alternatively, Smith argues, KOS should be understood as representing reality rather than representing concepts and conceptions. He cites a definition of concepts and criticizes it:

> Concepts, also known as classes, are used in a broad sense. They can be abstract or concrete, elementary or composite, real or fict[it]ious. In short, a concept can be anything about which something is said, and, therefore, could also be the description of a task, function, action, strategy, reasoning process, etc. [Corcho & Gomez-Perez, 2000]

> This passage illustrates the way in which, in much of the relevant literature, concepts are not clearly distinguished from either entities in reality or names or descriptions on the side of language. (Smith, 2004)

> One obvious problem with the concept-centred view of ontology is that it is difficult to understand how ontologies could be evaluated on its basis. Intuitively, a good ontology is one which corresponds to reality as it exists beyond our concepts. If, however, knowledge itself is identified with knowledge of our concepts, and if an ontology is a mere specification of a conceptualization, then the distinction between good and bad ontologies seems to lose its foothold. (Smith, 2004)

Like Smith (2004) the present author also finds it important to avoid forms of philosophical idealism that have dominated many fields from psychology and linguistics to knowledge organization and information retrieval. In fact, the broader shift in our understanding of cognition, knowledge and information mentioned formerly should be seen as a turn that is mainly in line with Smith's demands. That does not implicate, however, that I fully agree in his argumentation.

[65]One anonymous reviewer of the present paper wrote: "The example of 'horse' and 'zebra' is odd. Biological taxonomy is the one area of classification which is different because it can be based on genetics. There is currently a move to rewrite taxonomies using genetic data. Because this is still a slightly new paradigm, there is some resistance among taxonomists to the change. But I suspect this will be transitionary." This quote may underline my point: Different views can be uncovered, and each part tends to believe in that his or her view is the best. Even if the referee is right, it may still be most fruitful to say that his conception at a given time developed to be the scientific consensus and, thus, not deny the possible existence of alternative conceptions. Lee (2004) finds that in some respects biological taxonomy based on DNA-analysis is inherently subjective and "unless an appropriate taxonomic framework constructed using all appropriate biological information is already in place, such molecular diagnosis will be premature".

[66]Gruber (1993) notoriously defines "ontology" as "a specification of a conceptualization" (Smith, 2004) while Smith explicitly rejects this definition. The argumentation here is, thus, on this specific point in line with Gruber and in conflict with Smith. This does not, however, imply philosophical idealism. Theories of concepts are not necessarily anti-realist. Mammen (1994) defends "a realist theory of concepts," and his article (which is unfortunately only available in Danish) has informed the theory of concepts presented here. Although Smith (2004) correctly finds that KOS should be based on realism and on the study of science rather than on the study of psychology (or language, or users), his implication of this view seems to be that KOS should be seen as unmediated reflections of reality. This view is in conflict with the view presented in this article.

[67]Notice that even if WordNet acknowledges that semantic relations are relative to contexts, it does not specify the context in which its own semantic relations are valid. This is a paradox, perhaps caused by a lack of consequence in its underlying concept theory.

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