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The Reviews of Concepts in Knowledge Organization

Orthogonality and Factorization

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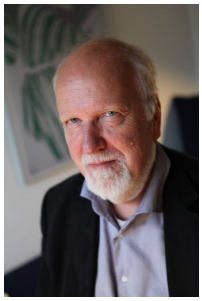

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Abstract

Orthogonality of facets in classification and Boolean searching means that facets are independent of, and non-overlapping with, one another—an important underlying assumption in much of information retrieval. This article introduces the concept and the literature surrounding it in information science and knowledge organization. It demonstrates how orthogonality in faceted classification is closely related to orthogonality in online search strategies and semantic theories, including theories of semantic primitives, all of which can be viewed as special cases of concept factorization, although these notions have rarely been examined together. The article further examines orthogonality in light of G. W. F. Hegel's distinction between external and internal relations. Relations are external when the relata are fully what they are independently of the relation—for example, two rocks lying next to one another. Internal relations, by contrast, are constitutive: the identity of the relata depends on the relation itself, which is not optional, and removing it destroys the object as that object (as in the master–slave relationship). The article argues that Hegel's distinction provides a deep philosophical grounding for why orthogonality and factorization sometimes succeed and sometimes fail. Orthogonal facets, building-block search strategies, and factorization presuppose external relations and therefore break down in domains where internal relations prevail.

Keywords: orthogonality; factorization; faceted classification; building-block search strategies; external relations; internal relations; concept theory

1. Introduction

Orthogonality is a seldom-used concept in information science and knowledge organization (KO) and has so far been discussed primarily in relation to faceted classification, where it denotes that facets are independent of, and non-overlapping with, one another. As this article argues, however, orthogonality has much broader implications for information science.

Outside information science, orthogonality is used with different meanings in different disciplines (cf. Orthogonality, 2025).[1] In computer science, it has been employed in a sense close to that used in the present article.[2] Lee et al. (2021) provide the most comprehensive treatment of orthogonality in KO to date. Although their study focuses on facets in music, it remains the most important general introduction to the concept in information science and KO. At the same time, it leaves several questions unanswered, including why orthogonality is important and what the consequences are when it is not fulfilled.

When orthogonality is not maintained, some authors—notably Vickery (1959, p. 36)—use the term *differential* to denote dependent facets, a property that has generally been regarded as problematic. Orthogonality has thus been treated as a theoretical ideal in KO, even though it is not always realized in actual classification systems. Precisely because orthogonality is often violated in practice, Lee et al. (2021, p. 581) raise the following question:

> Future research could usefully explore whether a bibliographic classification scheme of music could be built that avoids dependency, and whether it could include music facets that are truly orthogonal. Could dependency within music classification be "designed out"?

The article's main contributions are as follows. First, it generalizes the problem of orthogonality from faceted

classification to search strategies based on Boolean searching, as well as to concept factorization and theories of semantic primitives, thereby showing that orthogonality is a fundamental issue in information science broadly understood. Second, it provides a theoretical basis for understanding when orthogonality succeeds and when it fails. This analysis is grounded in Hegel's theory of external and internal relations. However, the article is not intended as a contribution to Hegel scholarship, nor as a general introduction to Hegelian philosophy for information science and knowledge organization,[3] both of which would require separate articles. Third, it provides an answer—or at least a tentative answer—to a question that has been raised in the literature on faceted classification: can dependency among facets be "designed out"?

The article is organized as follows. Section 2 examines orthogonality in faceted classification, the principal context in which the concept has been discussed in information science. Section 3 demonstrates the same phenomenon in building-block search strategies in bibliographic databases using the Boolean operators AND and OR. Section 4 discusses orthogonality in relation to factorization and semantic primitives. Section 5 examines orthogonality in light of philosophy and concept theory, in particular Hegel's theory of external and internal relations, which provides a theoretical basis for explaining when techniques that require orthogonality succeed and when they fail. Finally, Section 6 draws together the arguments developed in the preceding sections and provides an answer to the question of whether dependency among facets can be "designed out".

2. Orthogonality in Faceted Classification

Probably the most influential classification theory developed within KO is facet analysis (see Hjørland, 2013). One of the leading contributors to this approach was S. R. Ranganathan (1892–1972), who developed the Colon Classification using the well-known Personality–Matter–Energy–Space–Time (P–M–E–S–T) formula. The fundamental categories (PMEST) are the highest level of universal facets, under which other facets are organized. (See Table 1 for an example). In S. R. Ranganathan's theory, orthogonality properly applies to facets including the fundamental categories. In this tradition, *facets* are typically understood as classification criteria for logical division.[4] The classical rules of logical division require that subclasses be mutually exclusive, collectively exhaustive, and derived from a single principle of division. They regulate how a class is subdivided according to a single criterion at a time, but do not require that different criteria used in separate divisions be independent of one another. For example, nationality and spoken language constitute distinct criteria of classification, yet they are strongly correlated in many cases. The demand that such criteria are independent—orthogonality—arises when they are combined in faceted systems to construct compound subjects.

As already stated, facet analysis, including Ranganathan's PMEST, is based on the assumption that facets are orthogonal, meaning that each facet can be applied independently of the others. For example, a classification of treatments is assumed to be applicable to any disease, and diseases are assumed not to be inherently tied to particular treatments.[5]

Since Ranganathan facet theory has undergone a gradual relaxation of its a priori assumptions. In Ranganathan's own view, PMEST constituted a universal and a priori set of fundamental categories, which he considered to be analogous to philosophical categories of thought. In *Prolegomena to Library Classification*, Ranganathan (1967) explicitly presents the five categories as fundamental, claiming that they are applicable to any subject and are not inductively derived from subject matter but imposed analytically upon it. By contrast, British work associated with the Classification Research Group and with the second edition of the Bliss Bibliographic Classification (BC2) expanded the number of facets and weakened their universal status. Vickery (1960), for example, argued that a list of thirteen fundamental categories had proved useful for bibliographic classification in science and technology. In BC2, different disciplines sometimes introduced additional facets, thereby relaxing both the a priori and the universal character of faceting. Although orthogonality is still presupposed, even these more relaxed approaches largely stop short of asking under what conditions faceting itself becomes misleading—that is, when problems of orthogonality arise because conceptual decomposition is undermined by internal relations. The present article provides a new step in this development by arguing that the prerequisite for this technique, orthogonality, is domain-dependent (see Section 5).

Orthogonality in classification theory is often treated as an ideal condition of complete independence between classificatory dimensions. In practice, however, many domains exhibit partial dependencies between dimensions that remain analytically distinguishable. For example, language and literary genre are treated as separate dimensions in bibliographic classification and can be combined in many ways (e.g., English poetry, French drama). Yet literary history shows that certain genres have developed primarily within specific linguistic traditions and are not evenly distributed across languages. Such cases suggest that orthogonality in knowledge organization is often approximate rather than absolute.

The KO literature has long recognized that complete orthogonality between facets is difficult to achieve in practice. Vickery (1975, pp. 34ff.) discussed "dependent facets", while Satija (2002, pp. 87–90), Foskett (2010), and Lee et al. (2021) relate orthogonality and dependency to the concept of "differential facets", defined by Foskett (2010, p. 1820): "[A differential facet] is a facet of a class

Table 1. An example of classification using Ranganathan's faceted principles (source: Colon classification, 2026; CC BY-SA).

"Research in the cure of the tuberculosis of lungs by x-ray conducted in India in 1950s" is classified as follows:
The main classification is Medicine; (Medicine) [Basic subject]
Within Medicine, the Lungs are the main concern [Part of Personality]; (Medicine,Lungs)
The property of the Lungs is that they are afflicted with Tuberculosis [P: Personality]; (Medicine,Lungs;Tuberculosis)
Tuberculosis is being performed (:) on, that is the intent is to cure (Treatment) [E: Energy]; (Medicine,Lungs;Tuberculosis:Treatment)
The matter that we are treating the Tuberculosis with is X-Rays [M: Matter]; (Medicine,Lungs;Tuberculosis:Treatment;X-ray)
And this discussion of treatment is regarding the Research phase [E: Energy]; (Medicine,Lungs;Tuberculosis:Treatment;X-ray:Research)
This Research is performed within a geographical space (.), namely India [S: Space]; (Medicine,Lungs;Tuberculosis:Treatment;X-ray:Research.India)
During the time (') of 1950 [T: Time]; (Medicine,Lungs;Tuberculosis:Treatment;X-ray:Research.India'1950)
And finally, translating into the codes listed for each subject and facet the classification becomes L,45;421:6;253:f.44'N5

in which the terms are secondary to another facet and may differ according to the term to which they are attached in the primary facet." These discussions indicate that facets may remain analytically distinguishable while nevertheless exhibiting systematic dependencies or asymmetries in their applicability. Orthogonality in KO may therefore function less as an absolute condition than as an ideal approximation achieved to varying degrees in different domains.

3. Orthogonality in Building-Block Search Strategies

Orthogonality is also highly relevant to online search strategies, particularly to search strategies based on Boolean operators. This is particularly evident in what is commonly known as the *building-block search strategy*,[6] although orthogonality is rarely discussed explicitly in this context. This extension of the orthogonality discussion is important because it demonstrates that the issue is not merely theoretical, concerning the design of classification schemes, but also operational, affecting search behavior and retrieval effectiveness.

To illustrate this point, consider a simplified version of the example introduced in Section 2, concerning research on the treatment of pulmonary tuberculosis using X-rays[7] (see Fig. 1). In this simplified case, three facets may be distinguished:

(1) a disease facet (*tuberculosis*),

(2) an anatomical facet (*lungs*), and

(3) a treatment facet (*X-rays*).

The basic assumption of the building-block strategy is that each block (or facet)[8] is orthogonal to the others. To ensure retrieval of all relevant documents, each facet must be expanded to include all the ways in which the corresponding concept may occur in relevant records—that is, through "synonyms" understood in a broad sense.[9] Because searchers cannot anticipate all such variants in advance, exploratory searching is required to build as comprehensive a synonym set as possible. Boolean OR here functions as a classical *recall device*, intended to maximize retrieval of relevant documents. Boolean AND, by contrast, serves as a *precision device*, limiting retrieval by requiring the co-occurrence of at least one term from all facet blocks (These devices, however, do not necessarily function in the same way in modern search engines).[10]

In procedural terms, each block or facet is internally expanded through OR, while blocks are externally combined through AND. This procedure instantiates orthogonality by treating each block as an analytically independent dimension of relevance.

Misapplication of the building-block strategy reveals the failure of orthogonality when internally related medical concepts are treated as independent facets. A query such as *(tuberculosis) AND (lung) AND (X-ray therapy)* presupposes that disease, anatomical site, and treatment method are independent modifiers—that is, externally related. In medical knowledge, however, *pulmonary tuberculosis* constitutes a single disease entity, and historical X-ray therapy is internally related to specific phases of tuberculosis treatment and research. Controlled vocabularies such as Medical Subject Headings (MeSH) do not require exhaustive or orthogonal decomposition of subjects into all possible facets. Instead, they rely heavily on precoordinated disease entities and role-qualified descriptors.[11] While indexers may add anatomical or technical terms when these are substantively relevant, such decomposition is selective rather than systematic.

As a consequence, studies indexed under precoordinated concepts such as *Pulmonary Tuberculosis*—

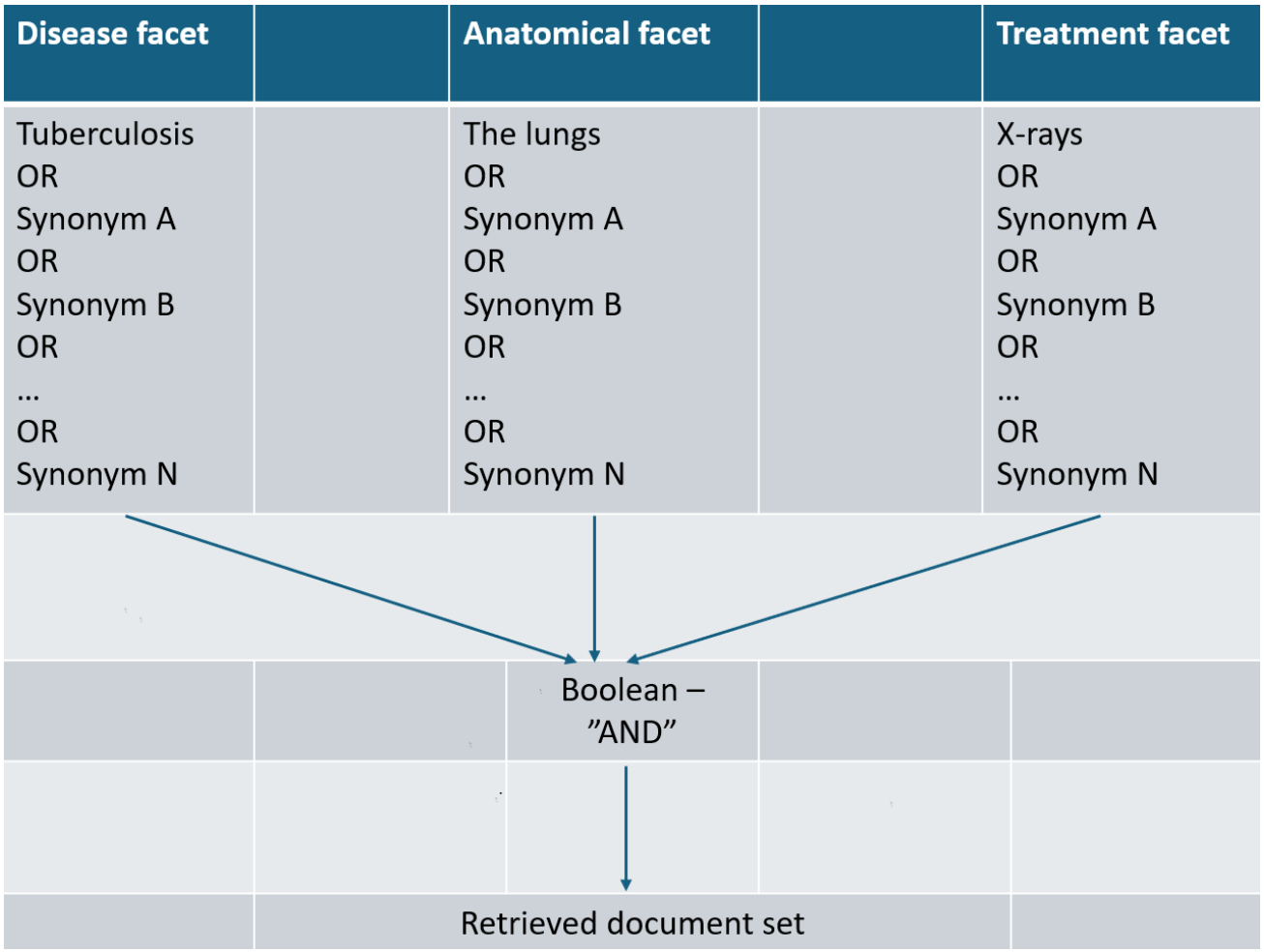

Fig. 1. Example of a building-block search query.

Radiotherapy, or described using historically specific treatment terminology, may fail to satisfy all three building blocks and are therefore systematically missed. The resulting loss of recall is not a failure of Boolean logic but an indication that the building-block strategy presupposes a factorization that has not been realized in the indexing language.

The same misapplication also reduces precision. Queries combining tuberculosis, lung, and X-ray retrieve many documents on diagnostic imaging and screening, despite the searcher's therapeutic intent. This loss of precision arises because Boolean conjunction treats technique and clinical role as orthogonal, whereas in medical knowledge organization these roles are internally differentiated and encoded through distinct descriptors. Precision loss thus complements recall loss as further evidence that uncritical reliance on orthogonal faceting misrepresents the semantic structure of the domain. Accordingly, indexing languages such as MeSH distinguish diagnostic and therapeutic roles through precoordinated headings and qualifiers (for example, *Radiography* versus *Radiotherapy*), rather than requiring their recombination through independent facet blocks at search time.

4. Orthogonality in Factorization and Semantic Primitives

Soergel (1985, pp. 256–261) discusses concept combination, semantic factoring, and their relation to facet analysis. He illustrates how the concept *ship* can be analyzed as *vehicle* : *water transport*, which may in turn be decomposed further, for example into *means* : *transportation* : *mobile* and *water* : *transport*. This yields the representation:

ship = *means* : *transportation* : *mobile* : *water*.

Soergel (1985, pp. 280–281) offers arguments in favor of semantic factoring, but he does not address potential disadvantages of the method or the consequences of pursuing factorization too far. By contrast, ISO 25964-1 (2011, Section 7.3), under the heading "Deciding whether or not to admit a complex concept", explicitly acknowledges that such decisions are often difficult and subjective. This raises a fundamental question: to what extent should indexing languages such as thesauri pursue the analysis of concepts into increasingly primitive components?

Some semantic theories posit a final level consisting of a limited, universal set of semantic primitives from which all other concepts are constructed (see Hjørland, 2026 for

further discussion). If such primitives exist, they could be considered candidates for thesaurus descriptors, allowing all complex concepts to be constructed through combination. Alternatively, they could serve as the building blocks of upper ontologies, forming the basis for more specialized ontologies. However, strong arguments have been raised against the theory of semantic primitives (cf. Hjørland, 2026).

The central point here is that factorization represents a strong form of orthogonality. In its strongest sense, orthogonality is equivalent to factorization: to say that a concept can be factorized is to say that it can be decomposed into components that are independent, recombinable, and jointly exhaustive. Formally, and often implicitly in KO and information retrieval (IR) practice, factorization can be expressed as:

$$\text{Meaning}(X) = A \times B \times C \times \ldots$$

where each factor can vary independently of the others and the whole can be reconstructed from its parts. Such factorization, however, embodies a theoretical assumption that is valid only under certain conditions. Nevertheless, it underlies faceted classification, building-block search strategies, semantic factoring, many approaches to ontological engineering, and numerous theories of semantic primitives. While factorization is often introduced pragmatically as a technique for analysis or retrieval, it presupposes a stronger commitment to orthogonality—namely, the assumption that the dimensions being combined are externally related and semantically independent. Failures of factorization therefore indicate failures of the orthogonality assumption rather than merely technical shortcomings.

5. Orthogonality in the Light of Philosophy and Concept Theory

Two contrasting views on things and relations can be distinguished: the analytic view and the Hegelian or historicist view.[12] In analytic approaches, the identity of entities is typically specified in terms of intrinsic properties, while relations are treated as external connections between independently defined entities. In contrast, Hegelian and historicist approaches emphasize that some relations are constitutive: the identity of the entities involved cannot be specified independently of the relations that define them. Many analytic approaches in semantics assume that concepts possess relatively stable cores (often associated with conceptual atomism or essentialist assumptions), that relations are combinatorial, and that meaning is compositionally reconstructible. These assumptions align closely with a metaphysics of external relations.

Bertell Ollman (1993, p. 34) characterizes what he calls the "commonsense" or analytic view as one in which things and relations are treated as distinct and separable: entities are assumed to possess their identities independently of the relations in which they stand. This intuition is often illustrated by Bishop Butler's dictum,[13] adopted by G. E. Moore as a motto, that "everything is what it is, and not another thing" (Moore, 1903, title page), together with Hume's observation that "all events seem entirely loose and separate" (Hume, 2007, p. 54).

A central claim of the Hegelian view is that things and their relations cannot always be treated as independent: relations may be constitutive rather than optional for the identity of objects (cf. Hegel, 2010; Raspa, 2016). Karl Marx (1888), drawing on this tradition, famously claimed that the human essence is the "ensemble of the social relations". On this view, some concepts cannot be defined abstractly and independently of the social and historical contexts in which they are constituted.[14] Hegel's distinction between external relations (*äußerliche Beziehungen*) and internal relations (*innere Beziehungen*) captures this difference.[15] External relations presuppose that entities retain their identity regardless of the relations in which they stand. Physical time exemplifies this logic: a date can be attached to any event without specifying its nature. This model suits measurement, coordinates, timestamps, and clock-time indexing. Internal relations, by contrast, are constitutive: a father, for example, is a father only in relation to his child. Many historically and theoretically constituted concepts—including major historical events and biomedical concepts—are defined through such internal relations. In these cases, analytic decomposition and semantic factorization are not merely inadequate but conceptually misguided.

This distinction can be illustrated using space and time as facets. A geographical area can be defined externally by longitude and latitude, or internally by toponyms such as *Denmark* or *Europe*. These expressions do not merely designate spatial regions; they denote historically developed concepts associated with human activities and institutions (which is a general feature of Hegelian concept theory, cf. Blunden, 2012). The legal meaning of *Denmark* today includes airspace, maritime zones, and subsurface resources—extensions that emerged with aviation, fisheries regulation, and resource extraction. Historical concepts of Denmark may include former territories. Similarly, *Europe* refers to multiple, historically shifting concepts (Leclercq, 1978).[16]

Historical events can likewise be defined externally by temporal intervals (for example, 1939–1945) or internally by concepts such as *the Second World War*. The latter cannot be reduced to a combination of years and places; it resists factorization. Existing library classification systems such as the Dewey Decimal Classification combine externally and internally defined classes, thereby illustrating the practical difficulty of achieving full orthogonality and factorization.

In Hegel's philosophy, external relations are appropriate to abstract, quantitative description, whereas internally related determinations belong to the concept of the object itself and are constituted through social and historical prac-

tice. Geographical names thus function not as neutral labels for physical areas but as historically evolving concepts.

Philosophical conceptions of space and time further illuminate this issue. Kant treated space and time as a priori forms of intuition: conceptually distinct, universally presupposed, and structurally independent. This framework strongly supported the classical faceted intuition that time and place constitute naturally orthogonal dimensions of description. Einstein destabilized this Kantian separation by unifying space and time into spacetime, rendering their relationship theory-dependent within modern physics. Ernst Cassirer offers a crucial mediation (see Friedman, 2023). For Cassirer, space, time, number, and causality are *symbolic forms* whose structure depends on the symbolic system in which they operate—physics, history, myth, or art. No single symbolic form has ontological priority.

This example illustrates a broader philosophical issue concerning the facets of time and space. *Kant's position* was that time and space are innate forms of intuition through which all phenomena must necessarily be apprehended. This view supports a classification theory in which these categories are universally applicable and cannot themselves be questioned. *Einstein's* concept of spacetime challenged Kant's separation of space and time and may imply that space and time are not orthogonal dimensions, and therefore cannot straightforwardly satisfy the requirements of faceted classification. *Cassirer* mediates between these positions by treating the use of space and time as orthogonal facets as a domain-specific issue (i.e., transformed the question of whether space and time are orthogonal facets into a domain-specific issue).

This yields a key insight for KO: orthogonality is domain-relative rather than metaphysically fixed. Accordingly, physics may unify space and time, historiography may treat them as separate, and music theory may partially entangle rhythm, tempo, and form. Cassirer thus offers a non-positivist justification for faceted independence where it is epistemically appropriate.

6. Conclusion

This article has described how orthogonality expresses an ideal that must be satisfied by faceted classifications, online search strategies, and semantic factorization if these are to function optimally. It was also argued that, in its strongest sense, orthogonality is equivalent to factorization and that orthogonality in faceted classification, building-block searching, and related approaches can be understood as special cases of factorization (which justifies the inclusion of factorization in the title).

The article further developed a domain-analytic and Hegelian critique of universal analytic methods in relation to orthogonality and factorization, grounded in classification practice, retrieval design, and semantic theory.

Returning to the question posed by Lee et al. (2021)—whether dependency among music facets can be "designed out"—the present analysis provides a principled answer. Different conceptions of genre reflect deeper philosophical commitments regarding the nature of relations. Analytically oriented approaches tend to treat genres as externally defined classes characterized by shared features and stable membership criteria, making them amenable to orthogonal faceting. Historicist and practice-oriented approaches, by contrast, understand genres as historically constituted forms of social action, internally related to the activities, institutions, and communicative purposes they serve. In such cases, genre membership is constitutive rather than externally attributable. The genre *hymn*, for example, may be defined analytically as a song that explicitly worships God, or historically and pragmatically as a song performed in specific social and ritual contexts such as church services or funerals. The latter conception corresponds to Miller's (1984) influential definition of genres as "typified rhetorical action based in recurrent situations".

By invoking Hegel's distinction between external and internal relations and contrasting it with debates in analytic philosophy, the present analysis suggests that orthogonality can be achieved to varying degrees, but that fully satisfying the demand for orthogonality typically comes at the expense of other desiderata. At stake are issues of concept definition and of what constitutes a fruitful definition. Analytical approaches tend to support orthogonality, but often at the cost of adopting classificatory schemes that privilege external relations and decomposability over historically and socially constituted meanings. A historicist approach to classification instead takes its point of departure in the recognition that competing theoretical perspectives may yield divergent classificatory outcomes.

Exemplifying this in the domain of music, Abrahamsen (2003) demonstrates alternative classifications by comparing two Danish histories of music. One work (Brincker et al., 1982–1984), written from a Marxist and social-historical perspective, explicitly frames music as part of a broader historical process involving political, social, economic, and ideological factors. The other (Hansen et al., 1990), by contrast, treats music history as fundamentally distinct from general history, emphasizing the relative autonomy of musical works and focusing on composers and stylistic development. These differences reflect distinct paradigms within musicology and result in different periodizations, with clear consequences for classification and indexing practices. Every classification of music, including library classifications, reflects a particular theoretical stance. Classifiers cannot be regarded as neutral observers external to the domain but must be understood as participants in ongoing theoretical struggles.

The answer, therefore, is that dependencies among facets can indeed be designed out to some extent, but often only at the cost of analytically decomposing concepts whose meaning depends upon historically and socially constituted relations. Increased orthogonality may thus im-

prove formal combinability while reducing alignment with the conceptual structures operative within particular domains.

Availability of Data and Materials

This is a theoretical paper; no datasets were generated or analyzed. All sources used are cited in the references.

Author Contributions

BH confirms sole responsibility for the conception and design of the study, data collection, analysis and interpretation, drafting and revising the manuscript, and approval of the final version. The author has read and approved the final manuscript and agrees to be accountable for all aspects of the work.

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Conflicts of Interest

The author declares no conflicts of interest. Birger Hjørland is serving as one of the Editorial Board Members of this journal. I declare that Birger Hjørland had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to Natália Tognoli.

Declaration of AI and AI-Assisted Technologies in the Writing Process

The manuscript was reviewed using ChatGPT 5.5 as an AI-assisted language-editing tool. The review focused on grammar, style, readability, and idiomatic academic English, while substantive scholarly responsibility for the text remained with the author. All suggestions made by ChatGPT were considered by the author.

Endnotes

[1] Wikipedia represents a crowdsourced view of orthogonality and provides a broad interdisciplinary overview that I have not found in other sources.

[2] Scott (2009, p. 228) used it in computer science in a sense very similar to which it is used in this article: "One of the principal design goals of Algol 68 was to make the various features of the language as orthogonal as possible. Orthogonality means that features can be used in any combination, the combinations all make sense, and the meaning of a given feature is consistent, regardless of the other features with which it is combined. The name is meant to draw an explicit analogy to orthogonal vectors in linear algebra: none of the vectors in an orthogonal set depends on (or can be expressed in terms of) the others, and all are needed in order to describe the vector space as a whole."

[3] Hegel's philosophy has not been considered much in information science. Kislev (2021) described how Dewey Decimal Classification has falsely been considered inspired by Hegel and says, "Hegel's philosophy involves a sophisticated and detailed method for knowledge organization that has been completely unexplored". He has followed up on the idea in journals outside information science, of particular interest is Kislev (2024), which emphasizes Hegel's interest in the systematic organization of knowledge. Gross (2023) traced the roots of the ideas behind "sense-making" to Homer and Hegel's *Phenomenology of Spirit* but concluded that her paper is "opening avenues for future conceptual and perhaps even pragmatic, research" (which I read as a declaration that she does not consider any practical use of her article).

[4] Broughton (2015, p. 382) defined: "facet: a group of terms within a subject field produced by one broad principle of division; e.g., in medicine, the facets include 'parts of the body', 'types of disease' and 'methods of treatment'." In the literature "facet" is used on the most general classification criteria (such as time and space), while "sub-facet" or "array" represents classifications on a lower level (for example, shirts may be classified according to color, style, material, size, etc.). However, this distinction is not important in relation to the issues discussed in the present article.

[5] Fricke (2012, p. 207) wrote: "Faceted classification is typically considered to be a synthetic classification consisting of orthogonal facets which themselves are composed individually either of exclusive foci or of a hierarchy of foci." (Synthetic meaning combined of elements as opposed to analytic meaning divided into elements; foci (singular: focus) refers to the individual terms, concepts, or classes that make up a facet).

[6] For an introduction to building blocks strategies see Harter (1986, pp. 170–182), which recognizes prior authors on which it is based. The author wrote (ibid., p. 172): The building blocks strategy has informally and implicitly been used as a model in this book. It is, with its modifications, the most used and useful overall approach to professional online searching.

[7] According to Harter (1986, p. 172), more than three or four facets are seldom used in practice when applying the building-block strategy.

[8] Harter (1986, p. 244) defined: "facet–a concept group, consisting of terms [or symbols] that will be considered to be equivalent by a searcher for purposes of a given information need. Terms representing these concepts will be searched and the union of the resulting sets created using Boolean OR." Remark that the literature on facets in KO seldom has considered its use in online searching.

[9] Synonyms are mostly understood as words or expressions of the same language that have the same meaning.

However, in online searching, the same concept expressed in different languages and codes can be considered equivalent (or synonyms). For example, the term "psychology" may be treated as retrieval-equivalents with Dewey Decimal Classification (DDC) code 150 with subclasses.

[10] Robertson (2000, pp. 4–5) wrote "Precision devices aren't what they used to be! […] Just to pursue the same line of argument a little further, recall devices are also problematic, despite their logical (rather than statistical) status in the set-retrieval context. Again, in the Text Retrieval In Context (TREC) tradition, we tend to measure recall at some arbitrary large cutoff (say 1000 documents). This immediately destroys any claim to logical status for a recall-enhancing device. Even if we do something which (logically speaking) can only increase the size of the retrieved set, such as expanding the query with a lot of synonyms, it might still reduce recall at 1000 documents".

[11] Precoordinated subject headings were the standards in the age of printed catalogs. Postcoordinated terms (e.g., descriptors in thesauri) are difficult to justify in the print environment (given typical catalog affordances) but become functional in online searching. In the online environment their functionality assumes that precoordinated terms can be effectively factorized to descriptors—or rather the circumstances in which this can be done—which is the core issue in the present article.

[12] Kincaid (1991, p. 29) wrote: "For the greater part of this century Hegel was largely ignored by philosophers—and historians of philosophy—from the analytic tradition. No doubt many factors have shaped Hegel's reception, but chief among them is the very origin of the analytic tradition. When Russell and Moore rebelled against the philosophical orthodoxy of their day and began the analytic movement, they argued against two Idealist doctrines: the doctrine of internal relations and the radical holistic claim that no part of the universe can be understood on its own."

[13] Butler's statement appeared in Butler (1729, pp. 14–15).

[14] Some scholars defend a strong Hegelian thesis that all concepts are historically constituted. Blunden (2012) advances a strongly historicist and developmental conception of concepts inspired by Hegel and Vygotsky. He wrote (2012, p. 296): "We may not treat a concept as if it named an independently existing object or attribute, when it would be more correct to take it as naming a process or a role within some system of practice, outside of which it would not exist as such."

[15] It is outside the scope of the present paper to provide a deep discussion of internal versus external relations in the tradition from Hegel. Two relatively recent introductions: Kincaid (1991) and Bidell (2024), demonstrate the complexity of this task.

[16] Arp et al. (2015, p. 7) take a strong realist stance on identifiers, arguing that ISO codes are assigned to the country itself rather than to a concept of the country. This contrasts with the present paper's emphasis on historically constituted concepts.

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