

Revisiting Farradane's Relational Indexing in a Consumer Health Context

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Abstract

Farradane's relational indexing system uses a psychological paradigm to establish a matrix of relationships between concepts, based on axes of association and discrimination. While the system has never been widely adopted in indexing, it provides a useful basis for the discourse analysis of consumer health information, particularly in relation to Alzheimer's Disease. Using Farradane's relational operators to analyze textual information provided both by medical professionals and by patients suffering from Alzheimer's Disease, this study found that gaps in medical knowledge about the causes of Alzheimer's manifest themselves in the matrix as a tension between association and functional dependence. The testimony of Alzheimer's patients, on the other hand, showed a tension between the self-activity and dimensional relationships: between intransitive activities, on the one hand, and a strong desire to tell the stories of their lives. Findings of the study suggest that Farradane's relational system has the potential to identify important gaps between professional and consumer health information vocabularies, and to enhance the embedded relationships in consumer health web information systems.

Introduction

Few would argue that Jason Farradane made an important contribution to the theory and practice of knowledge organization, and it is fitting that we revisit that contribution at ISKO UK in 2011. It would be all too easy, however, to turn that revisitation into a eulogy. Farradane invented a complex and time-consuming method of human indexing, in the face of growing interest in automatic indexing. He based his method on a theory of human psychology, at a time when many other theorists were consumed with indexing as a language. His method never achieved widespread adoption, and even the simpler and faster indexing practices that survived in his wake are now threatened by today's search engines and tomorrow's intelligent agents. One could easily argue that Farradane is irrelevant to modern knowledge organization.

This paper takes a different approach, and argues that Farradane's legacy continues to be relevant today, in unexpected and surprising ways. I will argue that Farradane's matrix is useful as a means, not necessarily of document indexing but of document analysis. I will argue that the matrix may not apply universally, but does apply with surprising relevance to a specific context: that of consumer health information, particularly in the area of complex and poorly-understood afflictions such as Alzheimer's disease. This exploratory study will use Farradane's relational operators to analyze discursively a professionally-produced patient information sheet on Alzheimer's disease, together with the

testimonies of various Alzheimer's patients. I will argue that Farradane's matrix of relationships enables us to recognize and isolate important tensions in health information discourse that could be sources of confusion. Furthermore, Farradane's matrix enables us to detect profound differences in the perspectives of health professionals and health consumers.

Relationships in information organization

Information theorists and practitioners alike have long acknowledged the importance of relationships in information organization and presentation, and one could argue that relationships stand at the very heart of the ubiquitous environment of the World Wide Web. From its inception, the Web has embodied the conviction of Tim Berners-Lee that 'the world can be seen as only connections, nothing else [A] piece of information is really defined only by what it's related to, and how it's related' (Berners-Lee & Fischetti 2000, p.12). The widespread adoption of hyperlinking has enabled the sophisticated link analysis performed by search engines such as Google. Developments in the Semantic Web community rest upon a core descriptive standard, the Resource Description Framework, which adopts a fundamentally syntactic approach of making meaningful statements about resources. And the emerging HTML 5 promises to enrich the linking capabilities of the Web by enabling us to encode far more sophisticated and useful information about the nature of our hyperlinks.

The knowledge organization community has long recognized the importance of relationships: our tools have emerged from a recognition that subject access is both a semantic and a syntactic challenge. Not only must we have consistent and useful vocabularies for the concepts represented in documents; we must also have consistent and useful ways of representing how those concepts combine together (Foskett, 1982). Even relatively loose constructions, such as the Library of Congress Subject Headings, distinguish between equivalence, hierarchical and associative relationships. The FRBR paradigm, which serves as the basis of Resource Description and Access, founds bibliographic description upon a series of one-to-many relationships between works, expressions, manifestations and items, thereby creating a set of primary relationships that can be encoded in bibliographic records. Rebecca Green offers four fundamental categories of relationships: relationships based on bibliographic descriptions; those based on inter-and intra-textual relationships, such as citations, links and elements of textual structure; subject relationships; and relevance relationships (Green, 2001).

Current practice and theory rests upon the significant contributions of past figures, and the fame of these predecessors is by no means evenly distributed. Ranganathan has enjoyed a renaissance in recent years: the information architecture community has embraced his concept of facet order and facet analysis, and the PMEST formula—once taught as an eccentricity on the fringes of formal classification instruction—now appears on many conference slides, and can be seen, in fractured and distorted form to be sure, in the many faceted interfaces offered on shopping websites.

Farradane has enjoyed less fanfare in recent years, which is surprising, perhaps, given his prescience about modern trends. As Davies pointed out some years ago, Farradane was a pioneer in the area of transitive knowledge discovery: the ability to find unforeseen connections through the examination of transitive statements in scholarly work, in the form of 'A causes B', and connecting those statements in a

meaningful way (Davies, 1989). Farradane's theoretical work, however, has suffered to some degree from the pressures at the time to create practical working tools (Brookes, 1986). His method of relational indexing never gained widespread adoption as an indexing tool, and, like PRECIS, is typically remembered either as a good but flawed idea, or as a testament to the unwillingness of the library community to cast off its mediocre tools in favour of good ones. While many in the information retrieval community have acknowledged ruefully that his scepticism about keyword access is well-founded, his work on syntactical relationships between indexing terms has gone largely unnoticed in recent years.

Nonetheless, Farradane's work anticipated the Semantic Web: like the developers of OWL and RDF, Farradane envisioned a "logical machine" ... capable of ... amalgamating two or more indexing statements and indicating the resulting inference; finding contradictions between supposed facts; recognizing analogies between subjects' (Davies, 1989, p. 280). For this resemblance, if for no other reason, Farradane deserves a fresh look in 2011.

Relational Indexing

Like many of his contemporaries, Farradane isolated two requirements of an indexing system: a controlled vocabulary, and 'a method of structuring terms from the vocabulary to express the meaning between words' (Farradane, 1980, p.267). Like Selye's Symbolic Shorthand system and Gardin's Syntol system, Farradane developed a means of expressing relations between terms. His, however, proceeded from a psychological theory of basic thought processes. Arguing, after George Steiner, that 'language may be regarded as a translation of thought into a surrogate for the purposes of communication' (Farradane, 1980, p.268), he defined a matrix of relationships along two axes which stood for the 'two main "mechanisms" for interconnecting concepts: association and discrimination' (Farradane, 1980, p.269). As seen in Figure 1, Farradane assigned three points along a continuum of association, moving from awareness, through temporary association, to fixed association. Along the continuum of discrimination, he defined concurrent conceptualization, not-distinct conceptualization and distinct conceptualization. This produced nine separate relations: concurrence, self-activity, association, equivalence, dimensional, appurtenance, distinctiveness, action and functional dependence, or causation.

		Associative mechanisms		
Discriminatory mechanisms		Awareness	Temporary association	Fixed association
	Concurrent Conceptualization	Concurrence /0	Self-activity /*	Association /;
	Not-Distinct Conceptualization	Equivalence /=	Dimensional /+	Appurtenance /(
	Distinct Conceptualization	Distinctiveness /)	Action /-	Functional dependence /:

Figure 1. Farradane's Relational Matrix (Farradane, 1980).

Farradane assigned a notation to each relation, and provided extensive examples of how the concepts in documents could be identified, linked according to these notations, encoded for computer processing, and used to generate a series of intricate pre-coordinated index entries. Taking as an example Tague and Carroll's JASIS article 'Information in an Informationless World or The Making of an Information Scientist', we can see how Farradane encoded it as follows (Farradane, 1978, p.15):

Information science /; education /; curriculum /- needs /; society

Like PRECIS, Farradane's system separated the intellectual act of indexing from the work of encoding and constructing the headings, and, again like PRECIS, a single act of indexing could generate multiple index entries that were syntactically constructed to preserve contextual meaning among the various terms (Farradane, 1978, p.15):

Information science
education curriculum affected by needs of society

Education
of information science. Curriculum affected by needs of society

Curriculum
of education of information science. Affected by needs of society

Farradane's system was never adopted as a widespread standard, for various reasons. By the time he had created it, indexing services had committed too fully to systems that already existed (Brookes, 1986). Indexers have argued that the system was more difficult to implement than Farradane claimed for little tangible benefit (Foskett, 1984). Researchers in information retrieval have argued that the system suffers from an unequal granularity (some relations are more precisely defined than others) and from ambiguity (some relations could easily be classified in multiple categories) (Sung & McHale, 1991).

By using a psychological paradigm rather than a linguistic one, Farradane placed himself at odds with other indexing ventures. And, like all systems that purport to rest on universal principles of categorization and combination, his makes little allowance for social and cultural specificities that significantly shape and define the ways in which different human communities define and operationalize their categories and relationships.

However, Farradane's system, while it may not fit all situations, does fit one situation remarkably well: consumer health information environments, considered holistically as the entire network of human and machine-readable processes of intermediation between health information professionals and end users. While Farradane's matrix may not have provided us with a universal indexing method, it does provide us with a way of understanding some of the more persistent problems in mediating information of a

complex nature in the area of health information, and particularly in the area of cognitive disorders such as Alzheimer's Disease.

Consumer Health Information

The advent of medical and consumer health informatics has accentuated our awareness of an enduring problem: that the vocabulary of medical professionals often differs significantly from that of end users of medical and consumer health services, and that this difference presents formidable challenges to anyone who wants to create a useful health information system. 'Laypersons ("consumers") often have difficulty finding, understanding, and acting on health information due to gaps in their domain knowledge. Ideally, consumer health vocabularies (CHVs) would reflect the different ways consumers express and think about health topics' (Zeng & Tse, 2006). Great emphasis, therefore, has been placed on reconciling vocabularies, giving rise to various initiatives that attempt to bridge differences between communities and the terms they use, for example the National Library of Medicine's Metathesaurus, the AMLA's 10,000 Questions Project, and Harvard's Consumer Health Vocabulary Initiative (Fortier, 2008).

Throughout this concern with vocabulary we can perceive an implicit emphasis on relationships, primarily in the care and intricacy of the hierarchical relationships of such vocabularies as the Medical Subject Headings (MeSH). Because medical topics are often searched by experienced intermediaries, databases such as Medline support more than mere Boolean combination, and use hierarchically-constructed headings to facilitate the explosion of terms, as well as other sophisticated techniques.

Some of our most urgent problems in health care, however, exhibit complex and ambiguous relationships on many different levels. Mood disorders such as depression, and cognitive disorders such as Alzheimer's Disease, present complex challenges, both to intermediaries and to end users, challenges that extend far beyond the problem of accurate information retrieval. Effective retrieval often depends on the existence of a reasonable scholarly consensus on causes, symptoms, and diagnosis of disorders and diseases, and on a disease's relationships with other disorders that might interact with it. Unfortunately, human societies in the early twenty-first century are facing escalating incidence of disorders that defy such consensus. Depression, for instance, exhibits a combination of emotional and physical symptoms that can be meaningfully if not comprehensively discussed within any number of discursive and treatment contexts, ranging from neurophysiology to psychiatry to nutrition and fitness. Similarly, cognitive disorders such as Alzheimer's Disease are intricately and ambiguously related to other cognitive disorders such as vascular dementia; in many cases they cannot be accurately diagnosed, and they can be affected by treatments as diverse as medication, psychotherapy, language therapy, nutrition and fitness.

With such disorders, information intermediaries are faced with the daunting task of explaining to end users phenomena that by nature defy easy categorization. And the confusion faced both by medical practitioners and by lay consumers of information can be analysed along much the same axes as those defined by Farradane: association and discrimination. When a patient is experiencing a network of symptoms—depression, short-term memory loss, impaired language skills—the medical practitioner

must come to understand to what degree these symptoms are associated; in making a diagnosis, that practitioner must discriminate one disorder from others which are very similar; in prescribing treatment, the practitioner must understand the difference between correlation and causation. And the patient and his or her family must navigate these complex waters as well.

The challenge, however, is not necessarily a problem of indexing. Farradane's matrix is relevant, though it could not necessarily enhance information retrieval in the classic sense. Rather, the matrix provides us with a means of analyzing information itself: assessing textual gestures towards explaining problems so complex as to nearly defy explanation, and identifying where the confusion inherent in the subject is manifested within the documents themselves. The larger study of which the paper forms a part identifies three primary sites of analysis:

- Website structure: how the relationships between the key structural parts of health information websites manifest certain key relationships as defined by Farradane;
- Web links: how the hyperlinks within these websites manifest certain relationships;
- Information discourse: how the very text of information sources, provided both by professional practitioners and by patients, manifests key relationships.

The remainder of this paper will focus on the third of those sites. It will use Farradane's matrix as a means of exploring and comparing intra-textual relationships, as manifested in the texts of two sources of information, viz:

1. The entry for Alzheimer's disease in the A.D.A.M. Medical Encyclopedia, reviewed by the VeriMed Healthcare Network, and posted as a 'Patient Handout' on the Medline Plus website of the National Library of Medicine in the U.S. (Retrieved from <http://www.nlm.nih.gov/medlineplus/ency/article/000760.htm>);
2. A set of testimonies from people suffering from Alzheimer's Disease, posted online by the Alzheimer's Association. (Retrieved from http://www.alz.org/living_with_alzheimers_8510.asp.)

A.D.A.M.: Alzheimer's Disease

The first two paragraphs of the A.D.A.M. encyclopedia entry defines Alzheimer's Disease as follows:

'Dementia is a loss of brain function that occurs with certain diseases. Alzheimer's disease (AD) is one form of dementia that gradually gets worse over time. It affects memory, thinking, and behaviour.

Memory impairment, as well as problems with language, decision-making ability, judgment, and personality, are necessary features for the diagnosis.' (A.D.A.M., 2010)

One can find many different relationships expressed in these two short paragraphs. Here are three, classified according to Farradane's matrix:

Passage	Symbol	Relation
Alzheimer's disease (AD) is one form of dementia	/ (Appurtenance: whole/part or generic relation Dementia / (AD
It affects memory, thinking, and behaviour.	/ -	Action: any thing or operation acting on or affecting another Memory / - AD Thinking / - AD Behaviour / - AD
Memory impairment, as well as problems with language, decision-making ability, judgment, and personality, are necessary features for the diagnosis.	/ ;	Association Memory impairment / ; AD Language problems / ; AD Judgment problems / ; AD Poor decisions / ; AD Personality disorders / ; AD

Throughout the document, the authors make heavy use of the association relation: as Soong and McHale predicted (1991), the association relation often threatens to subsume the others, since everything can be classified as an association of one form or another. Of particular interest, however, are the moments when the document changes from association to another, more specific relation.

In the section labelled 'Causes', the document starts with a list of risk factors: features which are associated with Alzheimer's Disease. Predictably, the disease is associated with older people; in addition, it is associated with having a relative with Alzheimer's, or having a particular combination of genes. Alzheimer's is also associated with longstanding high blood pressure, a history of head trauma, and the female gender. While it is tempting to class high blood pressure as an action relation, to suggest that high blood pressure affects Alzheimer's (AD / - blood pressure), the language of the document is cagey about the causal nature of these risk factors. Because the cause of Alzheimer's Disease is not entirely clear to us, risk factors are typically presented passively as 'being present'.

Even when the authors address the causes directly, they confine themselves to very vague terms, linked through a mixture of functional dependence and appurtenance. 'The cause of AD is not entirely known, but is thought to include both genetic and environmental factors':

Cause of AD / (Environmental factors

Cause of AD / (Genetic factors

AD / : Environmental factors

AD / : Genetic factors

In the next paragraph, the authors revert back to association: Alzheimer's disease is associated with the presence of neurofibrillary tangles, neuritis plaques and senile plaques, which appear in the brain tissue,

and which can only be found after death. Within this section, however, we find one interesting variation. 'As you get older,' the document states, 'your risk of developing AD goes up. However, developing Alzheimer's disease is not a part of normal aging.'

There is an association of age with risk of AD, and the relation could be expressed as an association, or perhaps with the dimensional indicator:

Risk of Alzheimer's /+ advanced age

However, the second sentence makes an important distinction: Alzheimer's is not considered part of the normal aging process:

Alzheimer's Disease /) Normal aging

In the discussion of symptoms that follows, the association relation once again predominates, with a few notable exceptions. Again, difficulties with language, memory, perception, emotional behaviour or cognitive skills are associated with Alzheimer's Disease. However, when discussing the stages of the affliction, the document introduces the dimensional relation by establishing a continuum from normal forgetfulness through Mild Cognitive Impairment (MCI) to the more severe stages of Alzheimer's. And once again, the discrimination relation is invoked: 'Not everyone with MCI develops AD.'

Cognitive impairment/+Early stages

Alzheimer's disease /+ Later stages

Mild cognitive impairment /) Alzheimer's Disease

The action relation also appears, when the document deals with the effect of symptoms upon the patient: 'As the AD becomes worse, symptoms are more obvious and interfere with your ability to take care of yourself.'

Self-care /- symptoms

In discussing the exams and tests, the document shifts into a tension between the action and the functional dependence relation. Patients with Alzheimer's Disease are often tested for various conditions: thyroid disease, vitamin deficiency, brain tumor, stroke, intoxication from medication, chronic infection, anaemia and severe depression. These tests are ordered 'to help determine whether other medical problems could be causing dementia or making it worse.'

Attempting to apply Farradane's matrix to this section yields problematic results, for a very suggestive reason. Thyroid disease is not, as far as I'm aware, a cause of Alzheimer's disease. But it could be a cause of dementia, and if the patient suffers from dementia of the Alzheimer's type, it could aggravate the condition. The inherent uncertainty which plagues the diagnosis of dementia finds its way into the

relationship structure at this point. If the document is discussing Alzheimer's, then the relation would be encoded as:

Alzheimer's disease /+ Thyroid disease.

If, on the other hand, the document is discussing dementia in general, then the relation would be encoded as:

Dementia (unspecified) /: Thyroid disease.

If we're discussing dementia in general, thyroid disease could be a cause, and therefore in a relation of functional dependence. If, on the other hand, we're discussing Alzheimer's, thyroid disease is merely acting upon the disease.

Discussion of treatment and prevention generally make use of the action relation: the effect of drugs and supplements upon the condition:

Alzheimer's disease /- Drugs

Alzheimer's disease /- Supplements

Discussion of prognosis, on the other hand, takes place largely within the dimensional relation, since the prognosis typically involves discussion of the duration of the condition in its various stages:

Alzheimer's disease /+ Duration

Alzheimer's disease /(Final stage /+ Duration

If we place these relations on Farradane's grid, we can see that the encyclopedia entry on which this patient handout was based emphasizes relationships based on fixed associations, with a tension between symptoms, which show association relationships, and causes, which show functional relationships. Treatment and prevention appear on the action relationship, and outlook on the dimensional relationship, with occasional use made of the distinctiveness and appurtenance relationships.

		Associative mechanisms		
Discriminatory mechanisms		Awareness	Temporary association	Fixed association
	Concurrent conceptualization	Concurrence /0	Self-activity /*	Association /; SYMPTOMS
	Not-distinct conceptualization	Equivalence /=	Dimensional /+ OUTLOOK	Appurtenance /(
	Distinct conceptualization	Distinctiveness /) FALSE SYMPTOMS & CAUSES	Action /- TREATMENT & PREVENTION	Functional dependence /: CAUSES

Figure 2: Patient handout relationships, according to Farradane's matrix

Patient Testimonies

When we move to the testimonies of people who suffer from Alzheimer's disease, we notice a different pattern. The comparison has important limitations: these testimonies are not created for disseminating diagnosis or treatment information, but rather to describe what it's like to have the disease. But in describing the incidents and the sensations of their affliction, the patients make important use of two relationship types: dimensional and the self-activity.

Dimensional

Dimensional relationships place a concept within time or space, and in formal indexing are often used to indicate chronological or geographic limitations on the subject matter. Most of the testimonies express a powerful need to tell a sequential, chronological story. Often the story starts with the first symptoms. Ted begins his story with his initial difficulties in his job in 2004, and narrates the steps with which he and his wife coped with his increasing difficulties, attained a diagnosis, and sought treatment. Sandy starts with the first day she found herself unable to find her way home, and Pete describes his first premonitions of illness while watching television in 2002. Eileen starts earlier, and describes her upbringing with an abusive and alcoholic mother and her previous history with alcohol and drugs.

Rarely are the narratives causal in nature: instead, they manifest a powerful need to place events in a proper sequence, and to assemble a meaningful biographical narrative which preserves important details, but which also refrains from forming a distinct causal chain. Eileen does not present her difficult upbringing and history of substance abuse as causes of her dementia. Rather, those facts are sources of tragic irony: having lost all but 19 of her 55 years to parental and substance abuse, she is now facing the loss of her later years ('Out of 55 years of life, I have only lived 19.') Ted makes use of the functional relationship of causation, but only for very specific instances of resentment or gratitude: gratitude for Social Security for processing his disability, and resentment of his workplace for unfair dismissal. He also uses the functional relationship to show not the causes that gave rise to his condition, but the

consequences that his condition is having on his life: the loss of his home, the loss of his independence, his straitened finances.

Actions also figure within these narratives: particularly decisive moments of initiative, such as Eileen's decision to get sober, Richard's decision to get involved with an Alzheimer's Association support group, and Sandy's decision to travel. All of these actions, however, take place within an insistently-emphasized narrative of a temporal process of degeneration that is happening *to* the patients. Their actions take place as isolated gestures, often moving and courageous, against a dimensional progression that they cannot avoid.

Self-Activity

Farradane defines self-activity as the intransitive relation: a relation in which no direct object is possible:

man /* walking
woman /* sleeping

In the patients' narratives, the intransitive relationship surfaces as a synchronic expression of states of being that contrast sharply with the diachronic narrative of events. As the patients describe their own situations, they express themselves frequently in intransitive actions. They travel. They think. They pray. They worry:

'I turned off the television, took some deep breaths, closed my eyes, leaned back on the couch, and let my mind go blank. I tried to relax, not to think about what might be happening to me; but it was there, like the sound of distant thunder, lurking on the horizon. I knew something was wrong, had sensed it for some time, and it was beginning to scare me.' (Pete)

If we plot these responses upon Farradane's matrix, we find more emphasis on the middle column than on the far right:

		Associative mechanisms		
Discriminatory mechanisms		Awareness	Temporary association	Fixed association
	Concurrent conceptualization	Concurrence /0	Self-activity /* STATES OF BEING	Association /;
	Not-distinct conceptualization	Equivalence /=	Dimensional /+ LIFE HISTORY	Appurtenance /(
	Distinct conceptualization	Distinctiveness /)	Action /- RESPONSES TO AFFLICTION	Functional dependence /: EFFECTS OF AD UPON LIFE

Figure 3: Patient testimonies on Farradane's matrix

While causation and action are important features of these narratives, the primary focus appears to be on the dimensional and self-activity relationships: the two seem to work together to help the Alzheimer's patient make sense of the affliction by casting it within a sequential narrative, punctuated by intransitive expressions of states of being.

Conclusions

This paper makes only a tentative first step towards using Farradane's relational matrix in a new way. Much more needs to be done. My own current inexperience in using the relational operators has undoubtedly limited the effectiveness of the analysis, and a wider sampling of documents is clearly called for, as well as further exploration of different avenues for comparison. But hopefully the study shows promising avenues for information intermediaries who are trying to explain complex and frightening information to those afflicted with cognitive disorders. If the findings of this study are borne out by more systematic research, health care intermediaries could well afford, at the very least, to emphasize the dimensional aspects of cognitive disorders in order to provide assistance to patients who are trying to make sense of their affliction and to cast it in some coherent narrative that provides them with a structure for action, learning, and, ultimately, being. Farradane's story, eccentric as it is, is not over yet. In attempting to create a universal indexing method that would enhance the information society of the late twentieth century, he has created a conceptual tool that could provide significant assistance to an information society of the twenty-first century, one that, with the rise of Alzheimer's disease, is facing one of the most serious health-care crises in human history.

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References

A.D.A.M. (2010). Alzheimer's disease. *Medline plus: trusted health information for you*. Retrieved from <http://www.nlm.nih.gov/medlineplus/ency/article/000760.htm>.

Alzheimer's Association. (2011). Personal stories. *Living with Alzheimer's*. Retrieved from http://www.alz.org/living_with_alzheimers_8510.asp.

Berners-Lee, T. & Fischetti, M. (2000). *Weaving the Web: the original design and ultimate destiny of the World Wide Web*. New York: HarperBusiness.

Brookes, B.C. (1986). Jason Farradane and relational indexing. *Journal of Information Science*, 12, 15-18.

Davies, R. (1989). The creation of new knowledge by information retrieval and classification. *The Journal of Documentation*, 45.4, 273-301.

Farradane, J. (1978). *Relational indexing: introduction and indexing*. London [Ont.]: School of Library and Information Science, University of Western Ontario.

Farradane, J. (1980). Relational indexing. Part I. *Journal of Information Science*, 1:267-276.

Fortier, A. (2008). Consumer health vocabulary. Unpublished. London [Ont.]: University of Western Ontario.

Foskett, A.C. (1982). *The subject approach to information*. 4th ed. London: Clive Bingley.

Green, R. (2001). Relationships in the organization of knowledge: an overview. In C.A. Bean & R. Green (Eds.). *Relationships in the organization of knowledge*. Dordrecht: Kluwer Academic Publishers.

Perreault, J. (1994). Categories and relators: a new schema. *Knowledge Organization*, 21, 189-198.

Sung, H.M., & McHale, M.L. (1991). Toward a relation hierarchy for information retrieval. *Proceedings of the 2nd ASIS SIG/CR Classification Research Workshop*. Washington, D.C., October 27, 101-113.

Zeng, Z.T. & Tse, T. (2006). Exploring and developing consumer health vocabularies. *Journal of the American Medical Association*, 13.1, 24-29.

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[Leonard W1] According to Microsoft Word's dictionary, this is spelt with a "c" in Canadian English, which is the language shown as being used for this paper.

[Leonard W2] I don't think that you can say that "confusion ... works ... along axes"

[Leonard W3] The recommended character for surrounding URLs in text is the angle bracket rather than the square bracket. See <<http://tools.ietf.org/html/rfc398>>