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Discovery Systems and Information Literacy (Part I). Musings on the Current State of Search Interfaces

Abstract I: In generale, i cataloghi online delle biblioteche universitarie offrono agli studenti un'interfaccia con un'ampia casella di ricerca. Questo modello di interfaccia intende fornire un'esperienza di ricerca simile a quella di Google. Tuttavia, a differenza di Google, i *discovery systems* includono anche la navigazione a faccette, che permette di raffinare i risultati della ricerca. Chi non conosce il dominio d'interesse trova problematico questo approccio, perché necessita di una guida concettuale per comprendere meglio lo spazio informativo prima di eseguire una query. La ricerca esplorativa è un processo aperto caratterizzato da attività cognitive e di apprendimento che possono migliorare le competenze di *information literacy*.

Abstract II: University online library catalogues typically provide undergraduate students with a user interface organised around a large search box. This design is clearly intended to mimic a Google-like search experience. However, unlike Google Search, discovery systems also include faceted navigation, which allows users to filter search results according to multiple criteria. This approach is problematic for users who are unfamiliar with the subject domain of interest and need conceptual guidance to consolidate their understanding of the information space they are about to explore in advance of a query. Exploratory search is an open-ended process involving cognitive and learning activities that can improve information literacy skills.

Keywords: Library Discovery Systems, Information Literacy, Search User Interfaces, Faceted Search, Thesauri.

The brain is hungry not for method but for content,
especially content which contains generalizations
that are powerful, precise, and explicit
Frederick Turner (1991: 123).

1. Introduction

Effectively searching a library catalogue or discovery system is not an easy task for learning-oriented users. Many libraries have revamped their catalogues with the faceted search

functionality to better help their patrons accomplish their search and browse tasks. However, what they typically provide is a simple flat list of topical terms with no other structure to the data.

On the one hand, the use of a flat format display may have contributed to simplifying interface design and enhancing usability. On the other hand, it poses serious challenges to novice users who want to perform exploratory tasks as they cannot leverage on the semantic structure of a subject domain to make sense of it.

This is a two-part exploratory essay which focuses on this specific problem. Part I examines how topical terms are presented in current generation online public access catalogues (OPAC) and discovery systems and provides some musings on how to escape the tyranny of the search box by taking a more subject-oriented approach. Part II discusses the specifics of this approach and shows how it can foster learning and support information literacy.

2. Background

While we still need time to fully understand the impact of generative artificial intelligence (GenAI) tools on students' information-seeking behaviour and library systems development, it is worth considering the assumptions that have led discovery system developers to follow Google's model to date.

The so-called 'Google Generation' has grown up using the Internet as the primary source of information. The term "googling" has become synonymous with searching for information itself, and the expression "Just Google it!" implies that Google Search can provide answers to any information need. The "googlization of everything" attests to both the ease and speed with which one can access information online through Google Search and how central Google Search has become to the digital information landscape (Johannessen 2017: 90; Frampton & Fox 2020; van Dijck 2013: 7).

Accordingly, library professionals have come to three conclusions: (1) "users form their information-seeking behaviors by using Google" (Wang & Mi 2012); (2) "library users are essentially Google users" and (3) users "have the same information searching needs" (Nelson & Turney 2015: 76). University libraries and library systems vendors have uncritically endorsed these assumptions by upgrading or replacing their old library systems with others that are more attuned to the demands of their patrons – in large part young people accustomed to accessing information quickly and easily via Google Search.

As web-scale discovery systems, university library online catalogues offer the capability to search across library information resources in different formats and/or a broad range of licensed and open-access bibliographic databases through a large-scale centralised index. These systems have simplified their interfaces by providing a single search box as the default mode of interaction to look for information online. This page layout clearly reflects Google's search paradigm and is intended to replicate a Google-like search experience (Calhoun *et al.* 2009: 12).

Conversely, library discovery systems behave like a black box, meaning that users know the input and the output, but not what happens in between. That is,

> [i]t is often unclear what content is included, how that content is indexed, and how the discovery system determines the order the various search results are displayed. Vendors of discovery systems have legitimate reasons for the black box approach, including the need to maintain their competitive advantage, as well as the difficulty in maintaining a transparent and useable list of the vast set of resources being indexed (Moulaison *et al.* 2015: 3).

The problem becomes all the more acute when it comes to subject metadata because different content providers may use different controlled vocabularies and indexing languages for the semantic description of information resources. This makes it difficult to achieve a coherent semantic representation of the information space covered by the system, which is a prerequisite for providing domain-novice users with the necessary scaffolding to successfully navigate the information space along different dimensions.

However, unlike Google, library discovery systems include another capability: faceted navigation. Faceted navigation (aka faceted search, guided navigation) allows users to explore the search space from different angles based on the facets displayed in the interface, and then to filter search results by whatever facet they choose. One of the major drawbacks of this search-and-browse approach is that it tends to support the information-seeking behaviours of users who have clear information needs and goals in mind, or advanced users, more than those of novice users, because the latter are more likely to enter the search cycle by browsing first and then refining their browsing with a query.

3. Searching an Online Library Catalogue

Effectively searching an OPAC, either stand-alone or as part of an integrated library system, is not an easy task for end users as it requires some background knowledge, skills and know-how (Borgman 1986; Borgman 1996; Julien *et al.* 2012: 148; Markey 1984: 81-84; Matthews *et al.* 1983: 155-164). This is especially the case when end users want to engage in exploratory search (high-level searching and browsing activities) rather than lookup search (aka known-item search).

According to White and Roth, exploratory search

> requires search systems to help users clarify vague information needs, learn from exposure to information in document collections, and investigate solutions to information problems. Systems supporting exploratory search facilitate intellectual growth and long-term personal/professional development, as well as task completion and user satisfaction (White & Roth 2009: 3).

The above definition has many aspects that overlap with the goals of information literacy instruction, which aims at fostering lifelong learning both in the workplace and society at large. Markey (2007) notes that most

> people are domain novices about their topics of interest. Undergraduate students especially are just beginning to learn the summary knowledge of a discipline. They

> have no depth, do not know the discipline's influential authors, important questions, cutting-edge research, or research methodologies.

What is more, researchers typically work both within and beyond disciplinary boundaries. Their research interests may be intra, cross, multi, inter, or even transdisciplinary, with the latter encompassing a scattered spectrum of subjects. Fifty years ago, one irritated library patron, the intellectual historian and Florida State University professor Robert J. Rubanowice boldly and bluntly wrote:

> Among those influences most inimical to the aims of intellectual history I would list the names of Melvil Dewey, Charles A. Cutter, Henry Evelyn Bliss, and a collective villain simply called LC [Library of Congress …]. Perpetuating the myopia of these classificationists of knowledge are those contemporary straight-jacketed librarians who unthinkingly give students outmoded advice such as: History can be found in the 900's […]. The intellectual historian, or historian of ideas, is interested in everything. Probably his activity is not so much disciplinary as *transdisciplinary* – with this latter word not just in contrast to the concept of "disciplinary", but also in contrast to the notion of "interdisciplinary" as well. The intellectual historian rises above traditional academic disciplines, asking any and all questions, using any and all methodologies, borrowing from accepted approaches, modifying and adapting where needed, and creating anew (Rubanowice 1975: 264-265, emphasis in original).

Although Rubanowice was speaking from the intellectual historian's standpoint, many scholars working in the so-called 'cultural sciences' and 'natural sciences' alike would agree with him that subjects are multidimensional. Consequently, locking them in one place does not do justice to their complexity. Every 'science' develops certain concepts and uses them to establish a systematic survey, differentiation, and classification of the phenomena falling under its domain of application. However, as researchers are called to answer increasingly complex questions and problems, they often transcend disciplinary boundaries and adopt a more holistic approach, opening up whole new fields of knowledge, where new concepts and ideas are born. Exploring subjects, especially complex and transdisciplinary ones, across different dimensions is of paramount importance for end users to accomplish their learning and investigation tasks.

Yet few OPACs have fully exploited the syndetic structure of controlled vocabularies in a meaningful way to make subject access intuitive and uncomplicated for end users (Olson & Boll 2001: 185; Yu & Young 2004: 170). Libraries, archives, and museums (LAMs) "have often focused on what collections are made up (*Ofness*), while many users prefer to learn what collections are about (*Aboutness*)" (Schaffner 2009: 6, emphasis in original).

Notwithstanding OPAC persistent shortcomings in providing subject access, end users have not stopped doing subject searching. Making a virtue out of necessity, they have simply replaced subject searching with title keyword searching (Bates 1988; Larson 1991: 199; Schaffner 2009: 6). Using title as a subject access point can sometimes be an effective alternative retrieval strategy, but to think that there is a fixed correspondence between title

and subject is naïve and misleading (Hjørland 1992: 172-173; Hjørland 1997: 58-59; Hjørland & Kyllesbech Nielsen 2001: 263-269). For this reason, it seems more reasonable to see titles as part of descriptive rather than subject cataloguing (Bates 1988: 403).

4. The Issue of Subject Access

Subject access is the most problematic area of OPAC's interface capability (Julien *et al.* 2012; Hildreth 1993: 13; Larson 1991; Long 2000; Marchionini 1995: 24; Matthews *et al.* 1983; Olson & Boll 2001: 276; Taylor 1995; Yu & Young 2004). Library end users are typically unaware of or unfamiliar with the subject headings and classification numbers underpinning OPACs and expect that they behave exactly like general-purpose web search engines (Butterfield 2012: 533-534; Calhoun *et al.* 2009: 14), only to discover with great disappointment that they do not.

Most present-day OPACs have not advanced much beyond what Hildreth (1984) has termed "second-generation catalogues", meaning that they still largely rely on Boolean logic for their design and operation. All too often, changes to OPACs have focused more on improving their appearance than their core capability (Novotny 2004: 534; Tennant 2005). No wonder, then, that OPACs have repeatedly been criticised by library patrons for being, among other things, outdated, unfriendly, frustrating, time-wasting, lacking in key features and functionalities, or laden with unnecessary features and functionalities (e.g., Antelman *et al.* 2006; Silipigni Connaway *et al.* 1997).

The information-seeking needs and behaviours of OPAC users are as diverse as the users themselves. End users and library staff (as providers and users) have conflicting opinions and expectations about an OPAC's perceived utility. The former "want to find and obtain needed information", while the latter "have work responsibilities to carry out" (Calhoun *et al.* 2009: v). Although collection management and content management are to some extent overlapping processes, they have different core requirements, which demand different strategies and capabilities. It is because of this persistent failure to clearly separate the library staff's administrative and management needs from end users' expectations for increased access and relevance, coupled with the librarians' tendency to impose their search and browse mental model on end users, that the latter have developed a general dissatisfaction with OPACs and have eventually turned to general-purpose web search engines to accomplish most of their search tasks.

Nowadays, search engine use is one of the top-most performed online activities (Purcell *et al.* 2012: 3). General purpose web search engines, notably Google Search, have become the primary tools to find information online (Battelle 2005; Jeanneney 2008; Hillis *et al.* 2013; Vaidhyanathan 2012). Not surprisingly, contemporary society is often described as a "query-driven society" (König & Rasch 2014). Nielsen (2005) points out that current internet users have developed a firm mental model of how search should work, which includes three core components: an input box, a search button, and a vertical list of top results. This is the standard search interface model proposed by current major web search engines. Nearly every internet user is familiar with this basic interface. It has become so ingrained in their lives that it is assumed that presenting them with an alternative model is likely to baffle them (Nielsen 2005).

Yet the simple search box alone, however familiar it may be to internet users, is also a black box (Hillis *et al.* 2013: 14; Nicholson 2000: 17). Since search engine matching and ranking algorithms are held secret, internet users only know the input (the query) and the output (the search engine results pages) of the box (Nicholson 2000: 17). Anything that happens between the two sides of the process – how the query module converts their keyword or natural language query into a language that the search system can understand, as well as how the matching and ranking module fetches the set of relevant pages from the query module and ranks it – is wilfully concealed from them (Hearst 2009: 15).

In a way, the search box is like a camera: "the camera does what the photographer wants it to do, even though the photographer does not know what is going on inside the camera" (Flusser 2000: 27-28). Just as the novice photographer can be photographically illiterate, so the novice searcher can be algorithmically illiterate (see Rainie & Anderson 2017). Novice photographers may have an idea of the picture they are trying to take, but they do not know or care how to make their camera work to get the picture they want. Unwilling or unable to struggle with the complexities of the manual mode, many novice photographers choose to shoot in the full auto mode. In this way, all they need to do is to point and shoot. Although it can often yield 'good enough' pictures, the fully automatic nature of the mode means that they cannot make any adjustments when the camera gets it wrong because the camera decides all the settings for them based on its own guessing of a photographic situation.

By way of comparison, novice searchers may have an idea of what they are looking for, but do not know or care how to formulate good queries to help the search engine better understand their information need. Hoping for the best and unprepared for the worst, they usually pay little to no attention to the way in which they combine their keywords or phrases in the search box.

Query assistants help them formulate well-formed queries, but they do not prevent irrelevant or overwhelming results. Advanced search operators and commands would allow them to narrow down or broaden their search to perhaps get better results, but they seldom use them, either because they are unaware of their existence or because it takes too much time and practice to master them (Marchionini & White 2007: 211). On the one hand, the query "represents the *maximum freedom for the user* in interacting with the web search tools" (Stacey & Stacey 2004: 48, emphasis in original), but on the other hand, it is "the point which can make or break a search for information on the Internet" (Stacey & Stacey 2004: 49; see also Marchionini & White 2007: 209-210).

Although the kind of technological advances deployed by current web search engines are somewhat capable of compensating for the user's possible lack of searching skills (Stacey & Stacey 2004: 48), in most cases the decision to stop searching and use some of the results is only "satisfactory rather than optimal and searchers accept results that are 'good enough'" (Marchionini & White 2007: 228). This is especially true for exploratory search tasks (aka exploratory subject searches in Library and Information Science terminology). In the early days of the Web, large-scale subject directories such as Yahoo! and LookSmart allowed unskilled and uneducated internet users to easily browse websites organised by general subject areas and to drill down through a hierarchical index while often taking advantage from relevance feedback to adjust their query (Wheatley: 2000: 133). But with the

exponential growth of the Web, the manual approach underpinning subject directories has become unsustainable, and so they have fallen out of fashion. Furthermore, because searching via a web search engine has now become so routine and effective, mainstream information specialists have assumed that anyone would hardly adopt a browsing-first approach (Bawden 2011: 2). Emblematic of this attitude is Yahoo's decision to discontinue its directory – once the company's cornerstone service.

5. Lookup and Exploratory Searches

Present-day web search engines have proven to be immensely powerful tools for lookup tasks, but ill-suited for exploratory tasks (Marchionini 2006; White & Roth 2009). This imbalance is not surprising given that much of computer science research and development applied to information retrieval systems and interfaces seems to have been driven by the implicit or explicit goal of eventually automating every step of the search process (Bates 1990: 575). Indeed, one of the reasons for the average internet user to prize the standard search interface described above is its simplicity and ease of use. Yet this premium comes at a cost: the higher the system's degree of automation, the lower the user's possibility to proactively control the pace and direction of the search (Bates 1990: 575).

Once the search engine has executed the query, the initial simplicity and ease of use are easily lost to novice users who do not know how to take advantage of document surrogates to judge whether what the search engine has found is relevant, trustworthy, and complete and hence worth a click. Some users are willing to compromise and let the system do everything for them, others instead want to be constantly in control of their search, able to refine it on the fly, and interact with results as they are displayed while the search is still ongoing (Bates 1990: 575). Because of their closed-ended nature, lookup tasks can be conveniently completed through analytical search strategies based on keyword-oriented queries (Marchionini 1995: 8; Marchionini 2006: 42).

By contrast, due to their complex, vague, and open-ended nature, exploratory tasks can only be best accomplished through a combination of searching and browsing strategies that strongly depend on on-the-fly "selection, navigation, and trial-and-error tactics" (Marchionini 2006: 42). The difference between the two types of tasks is not so much one of degree in search depth and breadth as of goal: whereas lookup tasks are aimed at finding a specific piece of information or answer to a question, exploratory tasks are more geared towards learning and investigation (Marchionini 2006: 42), intended not only as simply knowledge acquisition, but also as the development of high intellectual skills in a subject domain (White & Roth 2009: 13). In this sense, exploratory search is thought of as a means to an end rather than an end in itself.

The traditional and dominant black box model underpinning much of today's search interface design is increasingly seen as a poor representation of general information-seeking behaviour. Bates, among other scholars, has been one of the strongest critics of this model, arguing "that it represents some searches, but not all, perhaps not even the majority, and that with respect to those it does represent, it does so inadequately" (Bates 2016: 197). The core of her argument is that under this model the query, and the search terms, are mistakenly conceived as something static rather than changing and evolving. In her alternative "ber-

rypicking model" she metaphorically likens searching to picking berries in the woods. The analogy being that as berry foragers gather berries one by one from scattered bushes while they explore the environment and interpret the visual information encountered to find the right area, searchers typically gather information in bits and pieces and adjust their strategy to fit the need at hand. Thus, "the query is satisfied not by a single final retrieved set, but by a series of selections of individual references and bits of information at each stage of the ever-modifying search" (Bates 2016: 198).

Bates' model seems to provide a good general theoretical framework for the design of OPAC interfaces that support exploratory search and browse behaviour, especially if seen in relation to her conceptualisation of browsing as an activity that goes beyond mere intentional visual scanning. For, although both scanning and browsing involve visual and body movement, according to Bates (2007), they are different in that the former consists of "smooth, sequential, orderly actions", while the latter encompasses "a series of glimpses, usually followed by actions between the glimpses".

Put it another way, one is one-dimensional, or linear, the other is multidimensional or non-linear. More precisely, browsing seems to have four components which can be reiterated indefinitely within an episode: "1. glimpsing a field of vision; 2. selecting or sampling a physical or representational object from the field; 3. examining the object; and 4. physically or conceptually acquiring the examined object, or abandoning it" (Bates 2007). Components 2-4 need not occur in every episode, but 1 *does* as "glimpsing a field of vision" is understood to be the very essence of browsing, that without which there would be no such thing (Bates 2007).

If so, how can then the standard OPAC search interface be turned from a black box into an "engine of visualization" (Maynard 1997: 119-120), a tool for not only locating information resources, but also for enhancing the users' power to see and understand relationships among concepts conveyed by information resources in a manner that lowers the cognitive load associated with learning a large amount of complex information and allows for "programmed serendipity"?

The following actionable insights provided by Bates seem to point in the right direction:

> Good browsable interfaces would consist of rich scenes, full of potential objects of interest, that the eye can take in at once (*massively parallel processing*), then select items within the scene to give closer attention to.
> Creating a virtual physical layout on the screen may make it easier for the searcher to think of moving among familiar *categories* of resources in an information retrieval system, in the same manner in which they move among resources in the actual library (2016: 211, emphasis added).

By adopting these insights, library systems developers can create intuitive and engaging interfaces that foster positive interaction and learning, and at the same time reduce the cognitive load associated with searching and navigating complex information spaces and processing large amounts of information. Bearing this in mind, the second part of this essay puts forward and discusses some suggestions for aligning information literacy instruction with learning-oriented users' information needs and requirements.

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