Information behaviour of scholars

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Abstract

In recent years we have seen intensive debates over the changes in scholarly practice caused by increased accessibility of digital resources and tools. This has caused an evident and rapid trend towards the development of different information behaviours by scholars: what information resources they are using, how and when. Recent studies of scholarly information behaviour all show significant changes in the ways researchers communicate, publish their works, collaborate, look for information and use it. Studies describe previously unseen patterns of scholarly information behaviour (e.g. skimming, navigating, power browsing, squirrelling, cross-checking). This, in turn, can (or should) have significant impact on the development of the information tools and information services for scholars. The paper first addresses key information concepts in scholarly context (e.g. information, information need, relevance, pertinence, salience, information overload, avoiding information), presents some general characteristics of scholarly information behaviour (e.g. difference between scholars and other users of information, differences between disciplines, individuals, etc.) and some typical examples of information behaviour (e.g. browsing, berrypicking, powerbrowsing, chaining, skimming, squirreling), as well as discusses some implications for information tools and services. In the end some attention is dedicated to issues of digital scholarship.

KEYWORDS: information behaviour, scholars, digital scholarship.

Introduction

The field of science is often viewed by general population as special. This is due to its complexity and broad spectrum of fields it encompasses. Scientists are often thought of as "nerds, freaks, weirdoes, or evil doers", or "geniuses" (Lipps 1999). To lay people or even to scientists from other fields science appears convoluted, difficult to understand, complex, even unintelligible and for this reason it may appear discouraging or esoteric.

What do scientists/scholars do? They are mostly occupied by three activities: critical thinking, evidential reasoning and judging authority (Lipps 1999). This

means that they constantly review existing information and use it in support of their work. It is also true that "unlike most people, scientists usually love their jobs" (Lipps 1999). If we look at some other characteristics of science, we see that it is a very social activity, that it requires a huge knowledge base, it provides constant need for information, it produces a fair deal of controversy, and, last, but not least, that there are enormous differences between various disciplines.

In the context of our paper, we should ask, how are these activities connected to information, information provision, information behaviour. It is fair to say that science is among most information-intensive fields of human activities. "One of the most important things that researchers do is to find, use and disseminate information" (Cann, Dimitriou and Hooley 2011). Therefore the interest in scholarly information behaviour has always been very much alive in Library and Information Science Community, either from the view of research or the practice.

> "Understanding the nature of information practices and their relation to the production of scholarship is important for both theoretical and applied work in library and information science (LIS). Research on scholarly practices provides a foundation for the development of information systems, services, and tools to support scholarship and science, especially as we strive to manage the escalating stores of digital literature and data for use by current and future researchers." (Palmer and Cragin 2008)

It is also true that the current view, which seems to be emerging from various studies, is that no very sharp distinctions could be made between information behaviours of contemporary researchers and other information users. This is due to a number of reasons, e.g.:

- Information behaviour is governed by general principles, like accessibility, familiarity, circumstances;
- Discipline/domain context is very important and it is very difficult (if not impossible) to make generalizations – researchers from different fields are very different in terms of information behaviour;
- Changes in technology have removed some previously existing differences.

Research paradigms

Case (2008) in his book *Looking for information* describes the long tradition of studying information behaviour and points out that scientists were among the first focuses of these studies. He mentions the year 1902 when C. Eliot wrote about what is needed and can't be found in a library which is the first scientific paper in this domain. He further presents different periods, paradigms, focuses of information behaviour studies and also mentions the differences in research topics, approaches, and directions of studies. Generally, we speak about three research paradigms: system-centred, human-centred (cognitive), social-epistemological. The main focus of the first one are information systems,

the second one focuses on the individuals with their cognitive (and affective) functions, and the third one studies the social context of information creation and use. Case (2008) also speaks about main focus of studies regarding user groups:

- Occupational groups: scientists, engineers, doctors, lawyers, journalists, …
- Social groups: consumers, voters, students, library users, TV viewers, …
- Demographic groups: age, gender, ethnic, race, geographic, …

Case (2008) and also other theoreticians state that research of scientists has always been among primary focuses of Information behaviour studies, and, not surprisingly, also the first. Wilson (2000) gives an example of The Royal Society Scientific Information Conference, in London in 1948. After World War II it was mainly about studies of document use, of system use, in the sixties the research focuses on "serious" information needs which meant "task-oriented studies", as Vakkari (1999) states. The studies focused on well defined groups, and on information use in the shape of information artefacts, information settings. This period was followed in the seventies by expansion to other aspects ("non-task oriented studies") which began to focus on individual's information behaviour, including their feelings, thoughts and other cognitive/affective issues. From nineties onwards we see a lot of focus on every-day life information situations and on individual characteristics. We are going to illustrate this shift by presenting some examples of early and later research in chronological order.

Examples of early research

A) Herbert Menzel: *The information needs of current scientific research* (1964) – Menzel studied requests for information or documents that were actually made by scientists in the course of their activities and called them demand studies instead of preference studies. Therefore the data for these studies comes from actual demands which are assumed to reflect their information needs.

Menzel also investigated types of user studies and accordingly defined information seeking behaviour from three angles:

- When approached from the point of view of the scientist or technologists, these are studies of scientists' *communication behaviour*;
- When approached from the point of view of any communication medium, they are *use studies*;
- When approached from the science communication system, they are *studies in the flow of information* among scientists and technologists.

B) William J. Paisley: *Information needs and uses* (1968) – Paisley tried to set up a conceptual framework for the research of users of scientific information with the goal of setting up guidelines for scientific information systems. His claim

was that information needs and uses depend on numerous systems related to various aspects of the life of an individual scientist/technologist and that propositions can be formed regarding channel selection, amount of seeking, effects on productivity of information quality, quantity, currency, and diversity, the role of motivational and personality factors, etc. Although Paisley did not study scientist as a member of some particular group, he showed that every scientist stands at the centre of many systems that touch every aspect of his/her work. His approach is that scientists as users should be studied in relation to:

1. Legal and economic system
2. Formal information system
3. Personal variables

Paisley set up the model of *seven (almost) concentric circles* (presented below), but unfortunately did not provide the explanations that would specify how the types relate to each other. The above mentioned three aspects de facto present the eighth, ninth and tenth circle in the model.

Model (Paisley 1968)

1. The scientist within his culture
   - The largest circle
   - The culture (tradition and ambient spirit) that determines the scientist's community
2. The scientist within a political system
   - i.e. in some period in US more scientists hired by the military establishment than by food-research agencies
   - or, scientific nationalism – foreign research being ignored
3. The scientist within a membership group
   - The scientist locates himself within professional membership system
4. The scientist within a reference group
   - Similar specialization, training
5. The scientist within an invisible college
   - Subsystem of 4 (reference group)
   - Group of scientist who share information directly
6. The scientist within a formal organisation
   - Policies within employing organisation open or block channels of information
7. The scientist within a work team

- Subsystem of 6
- The most important, vibrant sharing of information

8. The scientist within his own head
    - The system of motivation, intelligence, creativity, cognitive structure

9. As explained above, three additional depersonalised systems cut across:
    - *The scientist within legal/economic system* (i.e. copyright issues)
    - *The scientist within a formal information system* (i.e. libraries)
    - *The scientist within the frame of personal variables* (cognitive structure, motivation, etc.)

Example of later research

Judith Palmer: *Scientists and information* (1991a; 1991b) – Palmer studied agricultural scientists with an attempt to form a model of 'Information styles' thus focusing on more individual characteristics, the combination of which consequently forms an approach of a person towards dealing with information. The fact that the study included personal characteristics to reveal differences in information behaviour indicates that this is a study of a later date. In her study Palmer identified five groups of information seekers:

- 'non-seekers', for whom information access was not a priority;
- 'lone, wide rangers', preferring to work alone, reading and scanning widely, and relying on serendipitous information discovery:
- 'unsettled, self-conscious seekers', concerned about missing important information;
- 'confident collectors', amassing their own information collections, rather than routinely searching for information;
- 'hunters', with regular information-gathering routines, and a focus on currently relevant information.

According to Palmer, six types of information habits can be observed, based on appearance, body language, and intonation in response to questions:

- 'information overlord', operating an extensive and controlled information environment;
- 'information entrepreneur', creates an information-rich environment, using many sources and strategies;
- 'information hunter', organised and predictable information gatherer, in narrowly focused areas;

- 'information pragmatist', occasional gatherer of information, only when need arises;
- 'information plodder', rarely seeking information, relying on his/her own knowledge or personal contacts;
- 'information derelict', seeming to neither need nor use information.

Key information concepts in scholarly context

We are going to have a look at some of the basic concepts which proved to be relevant in the context of information behaviour: information, information need, relevance, pertinence, aboutness, salience, information overload, context, and some types of information behaviour, such as browsing, scanning, serendipity, berrypicking. However, we will not pay attention to these in general, instead, we will look at them in a scholarly context. In addition, we will try to get an overview of scholarly disciplinary differences as observed in studies in previous decades and today.

Basic information concepts

Information and information need: We already said that science is a very information-intensive field. This means that scientists are regular users of information and that their information needs are in the focus of many information providers. As an illustration we can say that scientific publishers are among largest information providers in the world, which is a clear indication of the scope of scientific information needs. There is, however, always a question of the discrepancies between information needs and information wants or demands. These are observed also in scientific environment. Scientists (like all other users) may ask or search for something which they do not really need.

Relevance, pertinence, salience: As Case (2008) points out, the term relevance can have very different meanings. In general, it denotes something which has a close, logical relation to a topic, thought, comment, question. Usually it is viewed as something of interest, something worth our attention. However, in the area of LIS the term is reserved to denote topical connection, i.e. *aboutness*, *topicality*, and is usually used in connection to results of a search or query which, by definition, is a consequence of an information need. A document is relevant to a particular information need, if it is judged to be on the appropriate topic, more specifically, if it contains the right terms. There exist standard measures: recall and precision.

As it turned out, relevance, in the meaning explained above, is often not what users want. They mostly look for that kind of relevance, which is based on their intentions and their state of knowledge, not only on logical matching of terms in queries and documents. This is users' subjective view on what they consider

relevant – and most often they use other words, such as *useful*. Thus we are speaking about pertinence – situational or psychological relevance, which is usefulness regarding a particular information need. The difference between relevance and pertinence is nicely illustrated by Belkin and Vickery (1985): "Relevance assigns an answer to a question, pertinence assigns an answer to an information need."

A third aspect, *salience*, is connected to the fact that we are more prone to notice things which stand out, are bright, lively, unusual, extreme, intensive, sudden, etc. Salient information is faster and more easily remembered. The problem is that salient information is not necessarily relevant or pertinent. It is also vice-versa: potentially relevant/pertinent sources can be non-salient and can stay unnoticed. Scientific environment is strongly focused on things, topics, etc., which have more potential to be noticed, be it because of the high rated journal of publication, scientific prize given to a scientist, prominent place of work, etc.

As an example of a study dealing with the concepts of relevance, pertinence and salience in scholarly context we can give Tenopir et al.: *Perceived Value of Scholarly Articles* (2011). The study revealed that when judging which literature to use, the scientists consider as most important criteria: article topic, online accessibility, source of article. Article profiles which were rated highest were: article written by a top-tier author, in a top peer-reviewed journal, available online at no personal cost to the reader; or article written by a top-tier author, in a peer-reviewed journal not in the top tier, available online at no personal cost to the reader

Browsing, scanning, serendipity: Information seeking is not always an intentional, conscious activity. It can happen that relevant, pertinent information is found with little effort, unintentionally or even without active seeking. One of the oldest and most often mentioned concepts is browsing which was extensively studied by Marcia Bates:

> „Browsing is the activity of engaging in a series of glimpses, each of which may or may not lead to closer examination of a (physical or represented) object, which examination may or may not lead to (physical and/or conceptual) acquisition of the object" (Bates 2007).

Bates also investigated another type of information behaviour, which she called berrypicking. It has to do with evolving queries when a searcher starts with one topic and gets 'distracted' by other topics which he/she sees along the search. Therefore, in a berrypicking event a searcher utilizes many different sources and varying searching techniques. "A berrypicking search involves getting a bit of information here, another bit there, just like picking berries in a forest." (Bates 2007). Related to these activities is scanning – "aimless looking at what we have in front of us" (Case 2008). In later research, another concept has emerged, called serendipity (or information encountering, as defined by Sanda Erdelez) which denotes finding information (something interesting) without looking for it, without premeditated, planned, directed activity.

Information overload, avoiding information: Information overload is the state of being exposed to a greater quantity of information than our system can process. The common trait of all responses to too much information, which are also expressed by scholars, is selective exposure to information. People (also scholars) usually choose the following responses, presented by Miller (1960) – all of them have negative consequences:

- Omission
- Error
- Queuing
- Filtering
- Approximation
- Multiple channels
- Escaping

Here are two examples of studies which explicitly speak about researchers dealing with too much information and with problems with encountering additional interesting information:

The paper by Charles Perrow: *On not using libraries,* 1989 (Case 2008) presents the distress of a scientist when faced with the richness of information found in libraries. The abundance of information causes stress and breaks the scientist's concentration. The author says that libraries should hide most of the literature so that one will not become delirious from the want of time and wit to pursue it all.

Chandra Prabha, Lynn Silipigni Connaway, Lawrence Olszewski and Lillie R. Jenkins published a paper *What is enough?* (2007) where they tried to answer the question, how do scientists decide how much information is enough. The results showed that approaches to information sources and strategies, and the amount of time and effort they devote to searching, correspond directly to the perceived importance of their objectives. Among most influential factors causing the end of searching were temporal and financial constraints.

The importance of context

> „Context of information seeking may be described by means of many different parameters such as the time and place of appearance of information need, the time for information seeking, types of participants of the seeking process, for example, their demographic, social, professional, educational and behavioural characteristics, the purpose of information seeking, the concrete task for which this information is looked for, the processes and situations of information seeking, and many others" (Gaslikova, 1999).

Additionally, context can be observed thematically: as a viewpoint, or a point for interpretation of some piece of information. It is a personal, changeable,

complex, and dynamic concept. Due to the fact that both documents and queries have contexts, it is a concept very closely related to information seeking. As Wilson (2000) pointed out, for too long it is an aspect to which too little attention has been paid in efforts of trying to understand what users want:

> "Paradoxically, user studies has been concerned with almost everything apart from the use to which information is put by the... information seeker... The reason for this seems to be a desire to draw policy conclusions... from data on aggregated behaviour rather than a desire to *understand* the user ... The *user* may be found in many... contexts; and *user studies* need to distinguish among these contexts... Any partial view demands rigorous definition of *which* context applies." (Wilson 2000)

Similarly, Nicholas (2000) argued that the key to understanding information needs lies in understanding of problems and situations in which they arise.

As said before (and as the next section will show), science is information-intensive field which heavily depends on the context which in turn dictates the differences in information behaviour of scientists from different disciplines.

Disciplinary differences

Many studies have been done to investigate the differences in information and communication behaviour of scientists from different disciplines. The trend begun in the seventies and continued intensively in the eighties. At that time some large studies (e.g. INFROSS, Line 1971), DISISS (1980) discovered that the area of Social Science differs significantly from Natural Science[1]: social scientists were found to use books and journals, prefer printed to electronic sources, and like informal communication and information channels. Social science was also found to be less concentrated on universality and internationality, since there was less need for foreign (and foreign languages) sources. Similar facts were found for humanities. Later many disciplinary and interdisciplinary studies to some extent confirmed the findings:

- Natural science: researchers prefer articles and preprints (digital), value informal information sources (e.g. conferences, personal contacts), don't like libraries/librarians.
- Social science, humanities: important sources beside articles are books (also printed).
- In terms of technological preferences today there are no more differences, but Natural scientists were earlier to adopt the information and communication technologies in their work. Recently, a thorough review of literature on disciplinary differences regarding information practices was done by Palmer and Cragin (2008).

1 Usually the term Science is used, but we use the term Natural Science to emphasize the opposition between this branch and other scientific disciplines.

Digital scholarship, e-science, e-research

Many areas of science are becoming increasingly reliant on new ways of collaborative, multidisciplinary work. John Taylor defines it as "E-Science is about global collaboration in key areas of science and the next generation of infrastructure that will enable it."[2]. We are talking about "scholarly information infrastructure", more specifically technology, services, practices, and policy that support research in all disciplines (Borgman 2007; 2009; 2010). Another term which is commonly used for the infrastructure which enables this shift, particularly used in Britain is „the Grid". Scholars are increasingly using technologies of Web 2.0 and Web 3.0 to collaborate, communicate, share information, etc. This infrastructure enables forms of scholarship that are information- and data-intensive, distributed, collaborative, and multi-disciplinary. eResearch is a collective term for variants such as eScience, eSocial Science, and eHumanities (Borgman 2007; 2009; 2010). All these changes inevitably bring along changes in scholarly information behaviour, as we will try to show through examples of contemporary studies which follow in the next section.

Some examples of contemporary scholarly information behaviour

In recent years, in spite the fact that a lot of research attention has been paid to other than scientific contexts, some studies have revealed certain changes in scientific information behaviour. These are due to the effects of information and communication technologies, which have, in turn, also influenced the provision of scientific information resources. Among contemporary types of information behaviour are chaining, skimming, navigating, powerbrowsing, squirrelling, cross-checking, and some others. These behaviours will be shown through examples of studies which follow. A number of studies deals with conceptualizations of scholarly activities to reveal common information-related practices (primitives) in all scientific disciplines, as difficult as this may be. Examples of large studies will be:

- Ellis 1989; Ellis, Cox and Hall 1993; Meho and Tibbo 2003
- Unsworth 2000
- Brockman et al. 2002
- University of Minnesota Libraries 2006
- Rowlands at al. 2007; 2008
- Palmer et al. 2009

In the end we will show some implication which these observations have for information providers, such as academic and research libraries.

2 John Taylor's definition of e-Science, found at http://www.e-science.clrc.ac.uk/.

Information-seeking patterns (Ellis 1989; Ellis, Cox and Hall 1993; Meho and Tibbo 2003)

We are beginning with this study in spite the fact that it is not so recent; however, it was reviewed and updated in 2003 by Meho and Tibbo. The initial study investigated information behaviours of natural, social and humanist scientists to find out that similarities could be identified between behaviours of scientists from various disciplines. Namely, they identified seven behaviours expressed by all groups, to which Meho and Tibbo added another three, this time looking at social science researchers. The authors state that not all behaviours are present in every information process, but that this depends on the unique circumstances related to individual's activities in a given moment (Ellis 1989). Therefore the authors decided not to speak about stages in the process, rather they speak about elements of the process or strategies used in the process. The identified behaviours are listed below, the last three (separated by a line) stemming from the second study by Meho and Tibbo:

- Starting – activities at the start of information seeking, means used by the seeker to begin the process;
- Chaining – following references, citations, etc. in known materials or further chaining from known citations using citation indexes;
- Browsing – half-directed or half-structured scanning areas of interest;
- Differentiating – filtering material by source and quality to reduce the quantity of acquired information;
- Monitoring – keeping up-to-date by checking sources regularly;
- Extracting – systematically working through a source to selectively identify relevant information;
- Verifying – checking the accuracy of the information found;
- Ending – concluding steps, final connecting of 'threads'.

- Accessing – getting to identified and located information in a required way, depending on the nature of the information source;
- Networking – communicating and maintaining a close relationship with a broad range of people such as friends, colleagues, intellectuals working on similar topics, members of ethnic organizations, officials, booksellers;
- Information managing – filing, archiving, and organizing the collected information.

Although the authors in the initial study did not indicate any sequence of behaviours, nor did they claim that all can be found in one information-seeking process, Wilson (1999) did just that, as his diagram shows (Figure 1). Namely,

he claimed that order can be set for at least some of the behaviours: beginning comes first, ending last. Checking is one step before ending, it is preceded by extracting, before which comes differentiating between found information. Browsing, chaining, monitoring are equal information searching activities and are as such placed at the same level, directly following beginning and preceding differentiating. The last three behaviours, being found to be more characteristic for social scientists, were placed by Meho and Tibbo in a new model, also of a process nature (Figure 2).

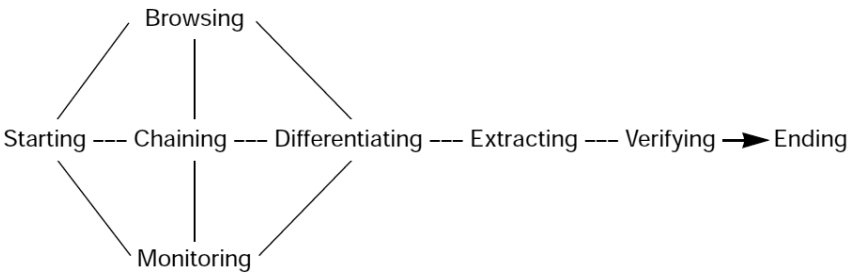

Figure 1: Process version of the behavioural model (Wilson 1999)

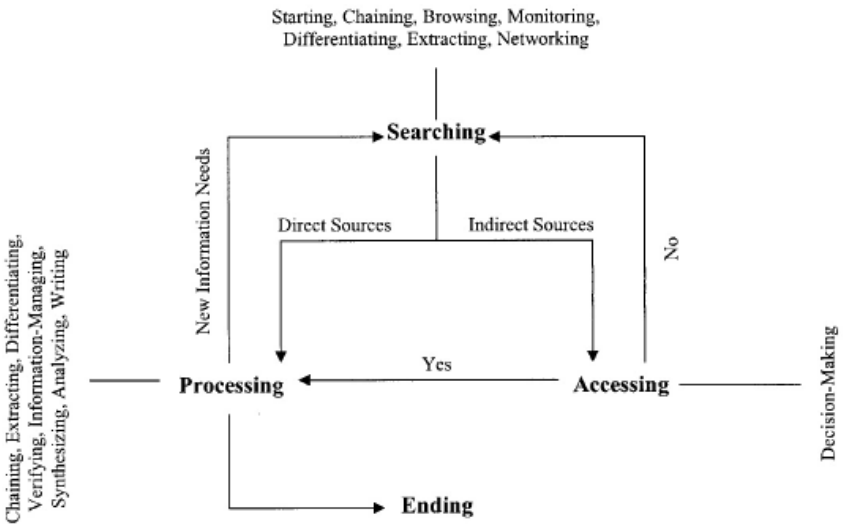

Figure 2: Stages in the information-seeking behaviour of academic social scientists (Meho and Tibbo 2003)

Scholarly primitives (Unsworth 2000)

Although this study dealt only with the Humanities, it is nevertheless worth mentioning, since the model served as an inspiration and a starting point for some information behaviour studies which also included other disciplines. Thus

Unsworth's model proved its worth well beyond humanities area. The author's intention was "to suggest a list of functions (recursive functions) that could be the basis for a manageable but also useful tool-building enterprise in humanities computing" (Unsworth 2000). He identified the following types of behaviour (similarly to our previous example he states that he does not assume them to be in any particular order):

- Discovering (also called selecting) – not only the selection of objects for comparison, but also, and equally importantly, the selection of regions of interest within the objects selected;
- Annotating (also called linking) – to create operative associations between, among, and within digital objects ,either in the classic form of annotation, or in the more abstract sense;
- Comparing – comparison of several (sometimes many) objects of analysis, whether those objects are texts, images, films, or any other species of human production;
- Referring – to direct to something of relevance or to bring attention to something relevant such as a source or another interesting object[3] – here Unsworth emphasizes the importance of the stability of references;
- Sampling – closely related to "selecting", sampling is the result of selection according to a set criterion;
- Illustrating – presenting an idea or a concept using an example of something already known to the audience[3];
- Representing – describing an object in words, depict in graphic manner, possibly in different versions[3].

Therefore the study aimed to identify behaviours and information practices, which are expressed by all scholars (hence the term 'primitives' which also found its way into other models), in order to provide a foundation for the design of digital information tools and technologies to support scientific work. This means that in each of these behaviours researchers perform certain information activities.

Information nature of scholarly work (Brockman et al. 2002)

The ambition of this study, as stated by the authors, was to emphasize the differences in information work in the humanities vis-à-vis other disciplines[4]. For this reason the authors devised a broadly based conceptual framework

3 The explanation of this primitive is not based on Unsworth's own words, but inferred from his work by the author of this paper.

4 We should note that not much attention is dedicated to other disciplines.

of the information nature of scholarly work in the humanities, accounting for processes of:

- Reading – for various purposes and in different depths (background, comprehensive, and continual reading), and in different media; a sub-activity here is *chaining to enable reading* – using bibliographic listings to find relevant reading materials;
- Collaborative networking – maintenance of collegial networks for correspondence and collaboration;
- Researching and searching – collection of information by means of use of a variety of sources (e.g. information collections, primary materials, access tools), complemented by a variety of searching skills and strategies;
- Ways of writing – interpretation and structuring of the gathered information to construct meaning and shape texts.

In each of these phases the authors look at which types of information are involved, how do scientists get to it, what do they do with it, etc., and make direct links to the technologies which are used by scientists. The study, although concentrating on the humanities, thus provides a good insight into a contemporary scientific work from the perspective of information.

Scholarly information activities (University of Minnesota Libraries 2006)

Another study, this time done explicitly by academic librarians to gain more insight into the behaviour of their users, aimed at defining appropriate infrastructures and services at the Minnesota University Libraries. The study focused on the humanities and social sciences and investigated three components: use of information resources, infrastructure services, and research behaviours, in order to get a closer look at how researchers acquire, create, manage and use information and knowledge. Of course, the ambition was to find out how to facilitate these (or how to facilitate them better) through library services.

Using Unsworth's model and adopting the same term, they organised 'scholarly primitives' into four groups:

- Discover: all kinds of searching, whether serendipitous or structured, that lead to finding and identifying resources, materials, and forms of assistance relevant to scholarship;
- Gather: acquisition and organization of diverse resources;
- Create: activities scholars undertake once they have identified and acquired resources for their research: analyzing and synthesizing materials, information, and ideas; annotating research materials; writing; working collaboratively; preparing grant applications and teaching materials; and reviewing and rating resources for scholarly use;

- Share: all aspects of dissemination: participating in conferences and scholarly meetings; publishing; teaching; sharing data, ideas, resources, drafts, and completed works.

These four scholarly information activities also represent stages of the research process, but are not always discrete steps in practice. We can therefore say that this study explicitly concentrates on information behaviours performed during various types (or phases) of scientific work. For each of the four primitives the authors provided its relationships to common tasks or behaviours, support requirements from data, and potential tools and services which were considered most useful. A visualization of these four components is also provided.

Information behaviour of the researcher of the future (Rowlands et al. 2007; 2008)

This two-part study looked at 'Google generation' who are normally not considered researchers due to a simple fact of being too young. But, the authors disprove this fact by warning that these people are also the future generation of researchers and that they will bring along some very different types of information behaviour. For this reason, the authors looked in one part of the study at people who are already researchers, but are at the beginning of their careers (Rowlands and Fieldhouse 2007), and in the other part at youngsters who belong to the so-called *Google generation* (Williams and Rowlands 2007). In the context of this text the first part is interesting. It identified some very distinct, and quite new patterns in today's researchers' information behaviour:

- Skimming: looking at one to two pages at a time;
- Navigating: looking around at what is available, i.e. checking 'the electronic sweet shop';
- Power browsing: reading abstracts and titles, even indexing terms, rather than full text;
- Squirrelling: downloading material to 'read' later;
- Cross-checking: collecting information from different sites.

In fact this is one of the first studies which investigated the patterns of behaviour which are expressed by scientists of various disciplines and from various parts of the world, and also to try to give names to the new patterns of behaviour. It showed how stressed for time and how engulfed in the vast amount of information researchers are, how poorly equipped many are to work with the ever emerging new information and communication tools, how reluctantly many embrace new forms of communication and collaboration, and how these conditions force them into individual coping strategies which are not always successful.

Scholarly information practices (Palmer et al. 2009)

This was another study aiming at discovering what information infrastructure would suit best to scientists of various disciplines. It did not use empirical research, instead it investigated a vast body of available interdisciplinary and disciplinary studies of scholarly information behaviour. It was commissioned by OCLC and also expanded on Unsworth's model. The study identified five broader 'core scholarly activities': searching, collecting, reading, writing, collaborating. These were further refined to sixteen granular *scholarly primitives*:

- Searching
    - Direct searching
    - Chaining
    - Browsing
    - Probing
    - Accessing
- Collecting
    - Gathering
    - Organizing
- Reading
    - Scanning
    - Assessing
    - Rereading
- Writing
    - Assembling
    - Co-authoring
    - Disseminating
- Collaborating
    - Coordinating
    - Networking
    - Consulting

Of these granular primitives six were found to be particularly common in the Humanities (browsing, collecting, re-reading, assembling, consulting and notetaking) while five were equally applicable to all disciplines (chaining, accessing, assessing, disseminating and networking).

In addition, four "cross-cutting primitives" were found: monitoring, notetaking, translating, data practices. These, as the authors explain, were observed separately, since they "naturally straddle or cut across two or more information work activities", i.e. they can be found in more than one of the above five groups.

Some implications for information tools and services

One of the questions, perhaps the most important one, is, what did all these studies reveal as basic for information services and information infrastructure for the area of science? Firstly, it is obvious that it is difficult, if not impossible, to find common traits of all disciplines regarding information behaviour. Perhaps humanities and social sciences share some features of information behaviour, and are as such the subject of quite a number of studies (Meho and Tibbo 2003, Unsworth 2000, Brockman et al. 2002, University of Minnesota Libraries 2006). Other areas seem to be very distinct. As Rowlands and Fieldhouse (2007) point out:

> „Much of the current thinking about the digital transition lacks sensitivity to some really deep-rooted domain differences: the idea that all disciplines are moving towards a common end point, symbolised by the physics community, is not tenable. Specialties, or disciplines, are a more useful, more natural unit of analysis for studies of scholarly communication than studies at the institution or journal level. Greater sensitivity to disciplinary variation is needed in the design of user behaviour studies. A theoretical perspective which begins to explain some of the scholarly communication preferences of different user groups is beginning to emerge but it remains a high level concept and one which is difficult to operationalise effectively in practice, either in terms of designing research studies or digital libraries." (Rowlands and Fieldhouse 2007, 33)

If we can speak about similarities, these can be observed as two aspects of trying to cope: with vast amount of information, and with the novelties of information and communication technologies. As stated in the report by University of Minnesota libraries (2006, 55), research is an 'environment in which dual (paper and digital) practices abound, and disorder is the norm'.

Secondly, it has become apparent that today's scientists require specific information tools and that many of the traditional library services no longer suit their needs. The digital tools have widened access to information, so on the one hand researchers are reading more primary journal materials from a wider range of sources, however, reading has become more superficial, as they mostly power-read or scan texts for relevant information, as well as read separates instead of journals (Rowlands and Fieldhouse 2007). Electronic journals have diminished the use of printed ones and are affecting the production of printed journals very negatively. Digital materials also offer cost- and time-saving through enhancing scientific productivity. However, researchers still read print materials, however, the access is in most cases digital (i.e. they print digital texts to read them). This, in turn, requires them to possess more sophisticated searching skills. For

those who do not (since many have not had any formal training), it means that they need to develop "a range of coping strategies to navigate digital libraries" (Rowlands and Fieldhouse 2007), which again calls for greater user friendliness of the tools. It is becoming apparent that convenience and digital visibility are crucial in the new information landscape (Rowlands and Fieldhouse 2007). Observations made by Marron and Smith (2008), are:

- Digital innovations are taking place in all disciplines.
- Digital publishing is shaped powerfully by the traditions of scholarly culture.
- Some of the largest resources with greatest impact have been in existence a long while.
- Many digital publications are small niche resources.
- Innovations relating to multimedia and Web 2.0 content and functionality are encouraging the emergence of new types of publications.
- Establishing credibility of digital resources (particularly those in open-access) is not easy, but is of critical importance.
- Achieving sustainability – especially for those resources with an open access mandate – is a universal challenge.

What implications can this have for libraries and library services to scholars? Marron and Smith (2008) define their task as "dauntingly broad". Vilar et al. (2012) state that in order to keep their status, libraries need to rethink their perception of the end-users, as well as re-evaluate (and consequently reorganize and/or update) the services which they offer to researchers. The formal resources will still retain much of their value and importance, however, they will be increasingly affected by information and communication technologies and new patterns of scientific publishing (e.g. open access, e-archives, repositories). Some library services are already less important – hence the decline of library visits and of use of library paper materials. As Rowlands and Fieldhouse (2007) point out, mediated library services are declining rapidly in favour of user self-service, to the point of near extinction in many cases. Additionally, some services provided through libraries, such as provision of e-journals to researchers' desktops, are not felt by them as library services. Another service much appreciated by researchers is provision of collaborative information environments, preferably customizable according to discipline and academic status (graduate student, faculty), deeply collaborative, and rich with opportunities for end-user contribution and sharing. One of other possible results of changing information behaviour is also an adaptation of an academic library space from a book storage space to a social space. Academic libraries are being redesigned to incorporate new hybrid learning spaces serve a far broader purpose than simply accommodating information (Bryant, Matthews and Walton 2009). Vilar et al. (2012) have also argued that another thing to do is that librarians have to leave the library building and start working in the research environment to become more aware of its characteristics. This was also noted by

Marron and Smith (2008): "Learning about these many niche resources is only possible through an ongoing dialogue with those scholars who create and use them." The librarians should also put some more thought into the fact that library use is considered complicated (Haglund and Ollsen 2008). The value of some other services, however, for example discovery tools such as OPACs (with access to full-text) and Web of Science, and access to e-journals, will likely increase, provided that more care is taken of usefulness of data as well as user friendliness and functionality of information tools. There are other interesting issues which librarians might consider taking up: setting up e-archives and repositories (Bailey 2005), tackle issues of long-term preservation of new digital works (Marron and Smith 2008), approach data curation (Witt 2009), become open access publishers (Adema and Schmidt 2010). The 25 future scenarios suggested by the project Academic libraries of the future (2011) give us a good insight into what certain decisions could mean for the future of academic libraries. Also, the "2010 Top 10 trends in academic libraries" by ALA/ACRL (2010) tells us about the impact of technology, development of new library services, and new skills required for academic librarians.

References

DISISS. 1980. *Design of information systems in the social services: towards the improvement of Social Science information systems: overview of research carried out 1971-1975*. Bath: University Library.

Information behaviour of the researcher of the future – Executive summary. 2008. Accessed March 2013. www.jisc.ac.uk/media/documents/programmes/reppres/gg_final_keynote_11012008.pdf

Academic libraries of the future. Futures thinking for academic librarians. 2011. Accessed March 2013. http://www.futurelibraries.info/content/page/academic-libraries-future-2.

Adema, J., and Schmidt, B. 2010. From Service Providers to Content Producers: New Opportunities For Libraries in Collaborative Open Access Book Publishing. *New Review of Academic Librarianship* 16 (1), 28-43.

ALA/ACRL Research Planning and Review Committee: 2010 top ten trends in academic libraries. 2010. Accessed March 2013. http://crln.acrl.org/content/71/6/286.full.pdf+html.

Anderson, T. D. 2005. Relevance as process: judgements in the context of scholarly research. *Information Research* 10 (2), paper 226. Accessed March 2013. http://InformationR.net/ir/10-2/paper226.html.

Bailey, C. V. 2005. The role of reference librarians in institutional repositories. *Reference Services Review* 33 (3), 259-267.

Bates, M. J. 1989. The design of browsing and berrypicking techniques for the online search interface. *Online Review* 13 (5), 407-424.

Bates, M. J. 2007. What is browsing – really? A model drawing from behavioural science research. *Information Research* 12 (4), paper 330. Accessed March 2013. http://InformationR.net/ir/12-4/paper330.html.

Borgman, C. L. 2007. *Scholarship in the Digital Age: Information, Infrastructure, and the Internet*. Cambridge, MA: MIT Press.

Borgman, C. L. 2009. Scholarship in the Digital Age: Blurring the Boundaries between the Sciences and the Humanities (Keynote Talk). *Digital Humanities Conference. College Park, MD. Jun. 2009*. Accessed March 2013. http://works.bepress.com/borgman/216.

Borgman, C. L. 2010. The Digital Future is Now: A Call to Action for the Humanities. *Digital Humanities Quarterly* 3 (4). Accessed March 2013. http://works.bepress.com/borgman/233.

Brockman, W. S., Neumann, L., Palmer, C. L. and Tidline. T. J. 2002. *Scholarly Work in the Humanities and the Evolving Information Environment*. Washington: Digital Library Federation and the Council on Library and Information Resources. Accessed March 2013. http://www.diglib.org/pubs/dlf095/index.htm.

Bryant, J., Matthews, G. and Walton, G. 2009. Academic libraries and social and learning space: A case study of Loughborough University Library, UK. *Journal of Librarianship and Information Science* 41 (1), 7-18.

Cann, A., Dimitriou, K. And Hooley, T. *Social Media: A Guide for Researchers*. London: Research Information Network. Accessed March 2013. http://derby.openrepository.com/derby/bitstream/10545/196715/6/social%20media%20guide%20for%20screen.pdf.

Case, D. O. 2008. *Looking for information: A survey of research on information seeking, needs & behavior*. Philadelphia: ASIST. Chapter 11.

Ellis, D. 1989. A behavioural approach to information retrieval design. *Journal of Documentation* 59 (3), 318-338.

Ellis, D. 1993. Modeling the information seeking patterns of academic researchers: the grounded theory approach. *Library Quarterly* 63 (4), 469-486.

Ellis, D., Cox, C. and Hall, K. 1993. A comparison of the information seeking patterns of researchers in the physical and social sciences. *Journal of Documentation* 49 (4), 356-369.

Fisher, K. E. and Julien, H. 2009. Information behaviour. *Annual Review of Information Science and Technology* 43 (1), 1-73.

Foster, I. and Kesselman, C.. ed. 1999. *The Grid: Blueprint for a New Computing Infrappucture*. Los Altos, CA: Morgan Kaufmann.

Gaslikova, I. 1999. Information Seeking in Context and the development of information systems. *Information Research* 5 (1), paper 67. Accessed March 2013. http://informationr.net/ir/5-1/paper67.html.

Haglund, L. and Olsson, P. 2008. The Impact on University Libraries of Changes in Information Behavior Among Academic Researchers: A Multiple Case Study. *The Journal of Academic Librarianship* 34 (1), 52-59.

Hey, T. and Trefethen, A. E. 2002. The UK e-Science Core Programme and the Grid. *Future Generation Computer Systems* 18, 1017-1031. Accessed March 2013. http://eprints.soton.ac.uk/257644/1/UKeScienceCoreProg.pdf.

Kuhlthau, C. C. 2004. *Seeking Meaning: A Process Approach to Library and Information Services*. 2nd edition. Westport, CT: Libraries Unlimited.

Kuhlthau, C. C. 1991. Inside the search process: information seeking from the user's perspective. *Journal of the American Society for Information Science* 42, 361-371.

Kuhlthau, C. C. 1993. *Seeking meaning: a process approach to library and information services*. Norwood, N. J.: Ablex.

Line, M. 1971. The information needs of social scientists: an overview of INFROSS. *Aslib Proceedings* 23 (8), 412-434.

Lipps, J. H. 1999. This is science! In *Evolution: Investigating the Evidence. Paleontological Society Special Publication, vol. 9*, edited by Scotchmoor, J. and Springer, D. A., 3-16. Accessed March 2013. http://www.ucmp.berkeley.edu/people/jlipps/science.html.

Maron, N. and Smith, K. K. 2008. *Current Models of Digital Scholarly Communication: Results of an Investigation Conducted by Ithaka Strategic Services for the Association of Research Libraries*. Accessed March 2013. http://www.arl.org/bm~doc/current-models-report.pdf.

Meho, L. I. and Tibbo, H. R. 2003. Modeling the information-seeking behavior of social scientists: Ellis' study revisited. *Journal of the American Society for Information Science and Technology* 54, 570-587.

Menzel, H. 1966. Information Needs and Uses in Science and Technology. *Annual Review of Information Science and Technology* 1, 41-69.

Nicholas, D. 2001. *Assessing information needs*. 2nd edition, London: Aslib.

Paisley, W. J. 1968. Information Needs and Uses. *Annual Review of Information Science and Technology* 3, 1-30.

Palmer, C. L. and Cragin, M. H. 2008. Scholarship and disciplinary practices. *Annual Review of Information Science and Technology* 42 (1), 163-212.

Palmer, C. L., Teffeau, L. C. and Pirmann, C. M. 2009. *Scholarly Information Practices in the Online Environment: Themes from the Literature and Implications*

for Library Service Development. Accessed March 2013. www.oclc.org/research/publications/library/2009/2009-02.pdf.

Palmer, J. 1991a. Scientists and information. 1. Using cluster analysis to identify information style. *Journal of Documentation* 47 (2), 105-129.

Palmer, J. 1991b. Scientists and information. 2. Personal factors in information behaviour. *Journal of Documentation* 47 (3), 254-275.

Prabha C., Silipigni C. L., Olszewski L. and Jenkins, L. R. 2007. What is enough? Satisficing information needs. *Journal of Documentation* 63 (1), 74-89.

Project Academic libraries of the future. 2011. Accessed March 2013. http://www.futurelibraries.info/content/page/academic-libraries-future-2.

Rowlands, I. and Fieldhouse, M. 2007. *Information behaviour of the researcher of the future, Work Package I: Trends in Scholarly Information Behaviour*. Accessed March 2013. www.jisc.ac.uk/media/documents/programmes/reppres/ggworkpackagei.pdf.

Tenopir, C., Allard S., Bates B., Levine K. J., King D. W., Birch B., Mays R. and Caldwell C. 2011. Perceived Value of Scholarly Articles. *Learned Publishing* 24, 123-132.

University of Minnesota Libraries. 2006. *A multi-dimensional framework for academic support: final report*. Minneapolis: University of Minnesota Libraries. Accessed March 2013. http://conservancy.umn.edu/bitppeam/5540/1/UMN_Multi-dimensional_Framework_Final_Report.pdf.

Unsworth, J. 2000. Scholarly primitives: What methods do humanities researchers have in common, and how might our tools reflect this? *Symposium on Humanities Computing: Formal Methods, Experimental Practice. King's College, London*. Accessed March 2013. http://www3.isrl.illinois.edu/~unsworth//Kings.5-00/primitives.html.

Vakkari, P. 1999. Task complexity, problem structure and information actions: integrating studies of information seeking and information retrieval. *Information Processing & Management* 35 (6), 819-837.

Vilar, B., Pisanski J. and Južnič P. 2012. Are librarians familiar with information seeking behaviour of teachers and researchers in their respective institutions? In *Libraries in the Digital Age (LIDA) Proceedings*. Accessed March 2013. http://ozk.unizd.hr/proceedings/index.php/lida2012/article/download/51/25.

Williams, P. and Rowlands, I. 2007. *Information behaviour of the researcher of the future, Work Package II: The Literature on Young People and their Information Behaviour.* Accessed March 2013. www.jisc.ac.uk/media/documents/programmes/reppres/ggworkpackageii.pdf.

Wilson, T. D. 2000. Recent trends in user studies: action research and qualitative methods. *Information Research* **5** (3), paper 76. Accessed March 2013. http://informationr.net/ir/5-3/paper76.html.

Witt, M. 2009. Institutional Repositories and Research Data Curation in a Distributed Environment. *Library Trends* 57 (2), 191-201.

Sažetak

Informacijsko ponašanje znanstvenika

Posljednjih godina svjedočimo intenzivnim polemikama o promjenama u znanstvenoj praksi uzrokovanim povećanom dostupnošću digitalnih izvora i alata što je potaknulo očigledan i brzi razvoj drugačijeg informacijskog ponašanja znanstvenika, te se postavlja pitanje koje informacijske izvore znanstvenici koriste, kako i kada. Nedavna istraživanja informacijskog ponašanja znanstvenika pokazuju značajne promjene u načinima na koje istraživači komuniciraju, objavljuju radove, surađuju, traže informacije i koriste ih. Istraživanja opisuju prethodno nepoznate uzorke informacijskog ponašanja znanstvenika (eng. *skimming, navigating, power browsing, squirrelling, cross-checking*) koji imaju (ili bi trebali imati) velik učinak na razvoj informacijskih alata i informacijskih usluga za znanstvenike. Rad se bavi ključnim informacijskim konceptima u znanstvenom kontekstu (npr. informacijom, informacijskom potrebom, relevantnošću, korisnošću s obzirom na primjerenost stvarnoj informacijskoj potrebi, informacijskim preopterećenjem, izbjegavanjem informacija), nekim općim karakteristikama informacijskog ponašanja u području znanstvenih informacija (npr. razlikama između znanstvenika i drugih korisnika informacija, razlikama među disciplinama, pojedincima itd.), nekim tipičnim primjerima informacijskog ponašanja (npr. pregledavanjem, berrypickingom, čitanjem samo osnovnih informacija a ne punog teksta, praćenjem referencija uz vraćanje u inicijalni izvor informacija, letimičnim pregledavanjem, preuzimanjem materijala za kasnije čitanje), te se raspravlja o nekim implikacijama navedenog na alate i usluge. Na kraju rada pažnja se pridaje problematici vezanoj za znanost i istraživanje u digitalnom okruženju.

KLJUČNE RIJEČI: informacijsko ponašanje, znanstvenici, znanost i istraživanje u digitalnom okruženju.