The participant perspective on metadata

1 Introduction

This literature review takes as its foundation the IL framework and the metadata skills and concepts identified in the previous literature reviews. It surveys existing information seeking theories with a critical eye towards how the types of tasks and environments that were identified in the first two reviews relate to these theories and ultimately looks specifically at two complementary theories behind the interaction between individuals and online community environments, namely social constructionism and the extended mind theory in order to discuss the impact of the online environment on individual learning. The discussion of users and their interaction with electronic documents focuses on the implications of decisions surrounding how metadata is used to support information objects and systems in use environments. It approaches metadata from two perspectives: metadata models, in which a theoretical construct supports an information object/structure, and metadata encoding, in which a specific implementation of metadata supports an information object/structure. The review concludes by questioning the state of metadata research surrounding a socio-constructionist view of metadata and information objects and asks how the views of information literacy support participants' needs with regards to metadata.

2 Defining the user

2.1 Foundation of user-centered information research

The growth of user-centered information theory with Dervin and Nilan's article (1986b) helped shift the profession from a focus on the document to a focus on intended use. The shift

coincided with developments in technology which has had significant impacts on creating converging pressures between information organization and use applications. As Dervin's work continued (1998, 1999; Dervin, Reinhard, & Shen, 2006) the focus has evolved from being centered on the rather static idea of the user to the concepts of communication and discourse surrounding the interaction between individuals, social groups, and information. As can be seen in the Library of Congress (LOC) (Library of Congress Working Group on the Future of Bibliographic Control, 2008) working group report, a discussion about the utility of bibliographic records quickly leads to large questions about the role of metadata and librarians in the world of information and knowledge management.

As information science research has evolved from a 'system' orientation to a 'user' orientation to now a 'discourse' orientation, technological tools have evolved to help support these new conceptions of documents, users, and the context of their interaction. These technological developments allowed an increase in both the amount of information produced, and its availability, complicating the process of information retrieval, a trend noted by Bush (1945, p. 1) which is regularly repeated in information science literature today. Taylor's comments also pointed towards this change, stating that libraries must change from "passive warehouses to dynamic communication centers" (1968, p. 179). In their work on creation and use of digital information, Van Oostendorp, Breure, and Dillon (2005) echo this sentiment claiming that access to information "has become a necessary condition for participating in economic, cultural, and societal processes, both for individuals and for organizations" (p. 1).

The view of the user as active information seeker reacting against a system is grounded in foundational views of information science theory. Taylor's theory of information needs which includes visceral, conscious, formalized, and compromise states (1968, p. 182) is widely regarded as a beginning point for discussing user-perspectives. Successive models of the user and their information interaction include Belkin's anomalous states of knowledge (ASK) in

which users address the gap between their concept of a problem and their voicing of that problem (1980), Dervin and Nilan's Sense-Making model of information seeking (1986b). Dervin and Nilan echo Belkin's call for user-centered information seeking models in their 1986 ARIST article. "These calls point to the lack of user orientations as a major…stumbling block to more efficient and effective service" (p. 7). They go on to describe a three component model involving a user in context (the situation), a body of information (the use), and a gap between the user and the information they seek. As with Belkin, the Sense-Making approach recognizes iterative process of information seeking.

2.2 Process based models

While early models of information seeking focused on linear or circular models, the next phase of information seeking models began examining information seeking as an exploratory and non-linear process. Bates' (1989) theory of berrypicking emphasizes the user's tendency to retrieve only selected relevant documents from each attempt at interaction. "In other words, the query is satisfied not by a single final retrieved set, but a series of selections of individual references and bits of information at each stage of the ever-modifying search" (p. 3). Bates goes on to emphasize that not only does the focus of the query change but also the type of query employed. She lists several search options: footnote chasing, citation searching, journal run, area scanning, and subject searches (p. 7) and suggests that users will switch between these types of searches during the information seeking process.

Toms (2002) builds on the berrypicking model in her 2002 article on information interaction. She points to a shift from viewing people as "general-purpose computational systems" to viewing them as "adaptive and adapted organisms whose whole computational mechanisms are specialized and contextualized" (p. 856) and echoes Bates' emphasis on browsing. "When a cue is noted, the user stops to examine the text, and may or may not extract and integrate the

information. The user may recycle in multiple, nonlinear ways through category selection, cues, and extraction" (Toms, 2002, p. 857). She moves past previous models in suggesting that users do not have to have specific goals prior to initiating an information interaction. Her suggestion, that information has become so ingrained in daily life that it is an invisible and required component to existence, has continued to be emphasized in recent works including Morville's book *Ambient Findability* (2005). Morville discusses the ramifications of ubiquitous information in his chapter on "Graffiti theory" in which he suggests that "all information that flows through our senses continuously and unconsciously shapes our memories, beliefs, predictions, decisions, and behaviors" (2005, p. 169). Erdelez (1999) asserts that a major issue with previous seeking models is that they assume that information seeking is only an active task. Her assertion that information seeking can be satisfied by accidental or incidental encountering of information (1999; 2004) also gets to the idea of the user as a holistic being comprised of "actions, feelings, and thoughts"(1999).

The research of information seeking within the context of the web has had an impact on information problem solving based literacy models. Several models and studies detail processes such as starting, chaining, browsing, differentiating, monitoring, and extracting (Choo, Deltor, & Turnbull, 1999), initiation, selection, exploration, formulation, collection, and presentation (Kuhlthau, 1991, p. 367) and recognize, define, select, formulate, execute, examine, extract, reflect (Marchionini, 1995, p. 50). Other models take a meta-view of the process approach and define the elements of interaction (problem, setting, task, system, domain) (Marchionini, 1995, p. 48) or define facets of specific types of searching such as exploratory search (lookup tasks, learning, and serendipitous browsing) (Marchionini, 2006, p. 42).

Within the context of information literacy (IL), these process-based approaches map onto discussions of the research process and can be used to inform many of the skills-based elements of IL instruction (identify question, formulate search strategies, determines material availability)

(ACRL, 2006). These models can also be used to inform how specific system elements should be designed or used. Marchionini (2006) for example defines search features which aid in exploratory search including hypertext links, relevance feedback, dynamic query interfaces (sliders, quick limits), and faceted metadata which may impact a user's search experience (p. 44).

2.3 Incorporating cognitive and affective states

In addition to the process-based approach to defining an information user, several models define cognitive and affective states of the user. Kuhlthau (1993b, 1999) in particular maps cognitive and affective states information seeking processes and observes that facets of these states including redundancy, mood, prediction, complexity, and interest (1999) have a significant impact on the user's information experience.

Kuhlthau (1993b) takes a second significant step in relating her concepts of information seeking to the constructivist philosophies of Dewey, Bruner, Kelley, and Vygotsky. She suggests that Dewey's five phases of reflection (suggestion, intellectualization, guiding idea, reasoning, and testing) map onto both the process of information seeking and the cognitive state of the user in the process. She further observes that Kelley's phases recognize the impact of new information and uncertainty on the user and asserts that Bruner (1968), like Dewey (1924) emphasize the importance of interpretation and internalization to the information seeking process (Kuhlthau, 1993b, p. 341) . Kuhlthau continues creating connections between constructivist philosophy and information seeking, arguing that Vygotsky's (1977) 'zone of proximal development' which describes the area of influence around a student's ability to learn independently and their ability to learn with assistance maps onto her concept of 'zone of intervention'(Kuhlthau, 1996).

Expanding on the impact that environment and personal/social contexts has on the information seeking process, Chatman (1996) discusses information seeking from the perspective of

vulnerable populations and the impact that views of social connectivity and power have on an individual's pursuit and acceptance of information. Some of the affective states that Chatman (1999) documents are alienation, hope/hopelessness, and avoidance. Nahl and Tenopir (1996) observe that affective response in information seeking experiments help inform research results. Research in this area has continued to investigate elements of cognitive and affective states that impact information seeking. Nahl (2004) uses a taxonomy of concepts including need, preference, attitude, motivation, expected effort, uncertainty, optimism, satisfaction, and relevance.

Wilson (1997; 2000; Wilson, Ford, Ellis, Foster, & Spink, 2002) discusses the connection between information seeking processes and affective and cognitive states within the context of an information need, and views uncertainty as a measurable element which is reduced through information seeking. Williamson (2006) builds on several of these models to create an ecological theory of information behavior. She begins by discussing complimentary perspectives on info behavior, including Bates's (2002) integrated theory which balances active & passive information seeking and Erdelez's (1999) 'information encountering' theory. Williamson contrasts her 'ecological theory' with those of Dervin (1986b) who focuses on SenseMaking, Kulthau (1993b) who focuses on uncertainty reduction, and Belkin (1980) who focuses on states of knowledge, stating that "while these are appropriate for the study of purposeful information seeking, not all information-related behavior is purposeful" (Williamson, 2006, p. 128). Williamson discusses her research stating that it is grounded in Bates's 2002 integrated theory views this research as being grounded in "a view of nature as personal existence" (Williamson, 2006, p. 130). Williamson's view of the user not as sole individual nor as sole social being but as 'self-created' also includes "biological and social circumstances and constraints."(2006, p. 130). Williamson's ecological theory is intriguing in part because it serves as a bridge between the information seeking theories of Dervin, Belkin, and Bates to the social constructionist theories discussed in the next section. Williamson asserts that 'ecological' elements including "biological

factors, age, ethnicity, stage of disease and affective issues" played a role in the seeking habits of the users on a breast cancer website. She observes that metadata can play a key role in creating information systems that are responsive to the user ecology.

2.4 Users as active participants

Just as the literacy models included technology in their models the above information seeking models often tie technology in. Tom's (2002) berrypicking model is one example of a clear technological influence but many models do not explicitly address technology as a radical change in information seeking. Some more recent work views that the impact of technology on the nature of the document and the impact of widespread search and socially constructed online environments as radically changing the information seeking process. Sundin (2008) for example asserts that information seeking is implicitly a socially based practice and points to Marcum's (2002) observation that the view of information interaction as being separated from a social and domain context remove the essential elements of the interaction.

This perspective, that the information interaction habits have changed dramatically, is often characterized as a generational gap due to the fact that the Net-generation has grown up with technology to the extent that it has changed their cognitive habits. "This research points to the possibility that N-Gen students are literally wired differently from previous generations, their brains shaped by a lifelong immersion in virtual spaces" (Mabrito & Medley, 2008). These models suggest that because students are less familiar with traditional texts such as books and journal articles they appear to lack core information literacy skills. In contrast, Mabrito and Medley (2008) claim that Net-Gen students already possess independent critical thinking skills, exceptional collaboration skills, and are exceedingly familiar with the fluid nature of documents on the web.

As might be expected, these assertions have solicited some response, notably by research which suggests that these perspectives are not looking closely enough at the phenomenon. Rowlands et. al. (2008) performed a cross-study evaluation of previous work on the changes in information interaction with the goal of confirming or debunking concepts about the generation that they call the "Google Generation." Their findings confirmed some perspectives such as the predisposition towards digital objects and the familiarity with technology but also disagreed with other observations such as the expectation that students implicitly understood the nature and context of digital documents. Rowlands et al. (2008) further observed that in contrast to the expectation that students were experts in evaluating digital resources that they lacked essential critical selection and evaluation skills. They further asserted that many of the changes attributed to the Google Generation were also seen in anyone who had adopted the same technological platforms suggesting that while change is occurring in how people search for, select, evaluate, and create information that there is not some special pre-disposition that the most recent generation is experiencing. Rowlands et al. (2008) do discuss two concepts which bear particular relevance to the role of metadata in an individual's information interaction. First, they observe that online information tools are both becoming more complex and serving more advanced needs. They assert that the semantic web and other online tools will play an increasing role in how we interact with information (2008, p. 305). Second, they assert that the current phenomenon of social software has not yet reached the mass appeal that has been attributed to it (2008, p. 297). They cite the 2007 OCLC report which found that very few students are likely to join libraries in social environments online. Despite this observation, they observe that the traditional publishing models and notions of the document are changing quickly.

The shift in users from passive searchers and consumers to creators and classifiers of information is viewed in this review as a key reason to investigate the set of skills and concepts that participants have when interacting in digital environments. This literature review is left asking what models help discuss these changes, particularly with regards to the use of metadata-rich

documents and community created metadata. The following section examines the impact of technology rich information theories such as Clark and Chalmers' extended mind theory (1998) on the information interaction theories reviewed in this section.

2.5 Extended Mind and information interaction

Two trends, first that the advances in digital tools serves new participant needs and second that the impact of social and community trends is difficult to measure, represent a wide range of literature and opinions on the user experience. The information space with which this literature review is concerned is described in the horizon 2009 reports as the "Personal Web" (Educause, 2009, p. 19). The Personal Web as described by this report is composed of aggregated and customized information that is controlled by the user interacting in community-created online environments. Some of the examples posed include using social software aggregation applications such as Swurl (2009b) to aggregate online activity, and online scholarly publishing tools such as Omeka (2009a) which allows the creation of rich online documents using a mixture of metadata standards, narrative, and other digital objects.

These types of tools add additional dynamics to the interaction between users and information in that they require the users of these services to form a conception of the digital documents with which they are interacting and creating. This means that the use of technology goes beyond the point of facilitation and towards the point of enhancing or extending the cognitive work of the participant. Further, because these sites are often defined in a fluid social discourse containing their own language, standards, and conventions it becomes increasingly important to consider what impact working in these environments has on participants. As noted in the IL review, the theory of the extended mind (Clark & Chalmers, 1998) asserts that humans use technology to support and extend cognition. The review of the information seeking processes above including initiation, selection, evaluation, and remembering, corresponds to digital tasks such as

bookmarking, tagging, recommending, reviewing, saving, and collaborating. The use of bibliographic management software to store and categorize resources, the use of bookmarking and social bookmarking sites to store and categorize links, and the use of social digital libraries such as Flickr and YouTube to create media-centric documents are three concrete examples of these types of new tasks.

Clark and Chalmers' work on the extended mind is documented in Jacobs (Jacob, 2001, p. 82) discussion of the role of classification in context. Jacob builds on the idea of embodied cognition in which the cognitive act is grounded in internal and external factors and presents Clark's system of external structures which support the extended mind. Jacob covers two structures that are of interest to this literature review. The first structure is "stigmergic structures" (Clark, 1997; Jacob, 2001). Jacob defines these as "sociocultural, socipolicital, and organsational configurations of responses that institutionalise patterns of behavior" (Jacob, 2001, p. 83). Jacob's traffic light example shows that stigmergic structures are "the residual products of successful problem-solving activities undertaken by the larger sociocultural community" (2001, p. 83). Wright (2007) documents the perspective that literacy served a stigmergic purpose in Europe as the printing press enabled society as a whole to interact with legal agreements, written words, and currency in a way that exceeded individual contributions(p. 108). A recent example of this phenomenon is NPR's election watch project which encouraged people to tag their online posts about the inauguration and their trip with the tags #inaug09 and #dctrip09 (Carvin, 2009). Metadata in community information spaces serves stigmergic roles in that while the details of creation and purpose may not be readily apparent to all users, the ability to recognize and use metadata structures is more commonly understood. The second structure which Jacob (2001) discusses is 'cognitive scaffolding' in which "technology, knowledge structures or methodologies" provide the individual the opportunity to extend their knowledge based on interaction with the scaffolding structure. The concept of scaffolding which grew from Vygotsky's work (Jacob, 2001; Vygotsky, 1977) often employs categorization and classifications

systems to create supporting structures for the learner. As noted in education and information literature, metadata services scaffolding purposes by helping students see new relationships in unfamiliar domains (Zeng & Smith, 2003) and by helping users of online systems recognize content and functionality (Churches, 2008). These two examples support the extended mind theory by discussing tools and systems in the real world which have implications on personal knowledge. Just as Wright (2007) and Vygotsky (1977) point to the role of social structures in influencing their theories, Jacob (2001) asserts that encoded social structures support extended mind behavior. As will be noted in the next paragraph, the debate between cognition as defined with a focus on the individual and constructionism which focuses on social and dialectic structures has the ability to confuse an otherwise common thread through the discussion of the cognitive roots in organization theory. These three concepts, that individuals use technology to create enduring structures embedded with social context, that scaffolding structures are used to provide cues to this context, and that the role of social influence on these structures is of primary importance in these systems provide a framework for investigating the role of these structures. In the current digital environment, these structures are often supported with metadata and other information organization elements. Likewise, the concept of social constructionism (Holland, 2006; Tuominen, Talja, & Savolainen, 2003) which focuses on the dialog between individuals through information resources describes another example of technology-enhanced information seeking/interaction. Concrete examples of the types of discourse that exist in a social constructionist view include social-publishing tools such as blogs and wikis which view the document less as a fixed resource and more as a forum for discussion. Social constructionism places an information interaction within the context of social, political, and historical context and emphasizes the impact of the interaction between individuals and the language that is used in their information environments (Holland, 2006, p. 93).

While a comparison of EM and social constructionist theory delves too far into cognitive and behavioral theory than is warranted in this literature review, these two theories have a large body

of theory behind them. In fact, Ingwersen (1992) spends considerable time differentiating between cognition, which he defines as the investigation of human mental behavior, and cognitivism which he defines as the perspective that computers can serve as non-metaphorical models of human thought (Ingwersen, 1992, p. 21). Holland (2006) too pays attention to the close distinctions being made in this field and explicitly cites EM as a bridge between cognitivism in which his emphasis is on the internal/individual influence and social constructionism in which emphasis on social/external influence. In discussing the concept of extended cognition, Holland proposes that technology tools can be used to extend cognitive work by allowing the brain to break up complex problems, represent them using external symbols and systems, and process them as simpler problems (Holland, 2006, p. 94). Examples of this include the use of mathematical symbols to represent and break down complex problems, the use of categorization systems to find patterns, and the use of structured information systems to track relationships between objects. Clark and Chalmers (1998) discuss this as "situated cognition" in which the work of the mind is located not only in an individual's interior state but also an external state which involves external environmental factors including social, political, technological factors (p. 11). Holland asserts that the social constructionist view claims that language is itself an external cognitive tool which is used to enhance cognition. As another example, Bosse et al. (2005) discuss the process of representation as a core example of extended cognition in which complex concepts are represented in simple shared symbols. This notion is seen in community created representations such as Twitter, Blog, YouTube postings and classifications including #inaug09, #dctrip09 that create systems which bridges multiple individuals to create a shared information environment. These bridged information systems in turn are positioned to enhance cognitive tasks such as perceiving, remembering, connecting, and understanding.

3 Information Literacy and cognition

Information theory covers a wide range of information related behavior. Despite the wide array of research performed both in information seeking theory and in learning theory, there has been little work comparing the two. Of note in this area are the information seeking models of Belkin (Belkin, 1980), Taylor (1968), Dervin and Nilan (1986b) and Kuhlthau (1993a) to the education models of Bloom (1956), Bandura (1977), Bruner (1968), and Vygotsky (1977). Taylor's model of needs (visceral, conscious, formalized, conscious) helps inform the ideas of both Belkin and Dervin who discuss the gap between an individual's learning need and the information he/she seeks. Kuhlthau (1993a) presents a process model which is composed of six stages: Initiation, Selection, Exploration, Formulation, Collection, and Presentation and brings in the idea of 'uncertainty' and the resulting affective issues related to the information seeking and learning process. Several of these models are directly compared in Figure 1. This figure is an comparative chart of information seeking and learning models structured around Kuhlthau's stages.

Comparison of Cognitive Stages in Information Seeking

Kuhlthau's Stages	Bloom's Taxonomy	Belkin	Taylor	Dervin	Audet's Inquiry Cycle
Initiation	All Stages	Conceptual State, fueled by beliefs, intent, knowledge	Visceral	Situation	Ask a question
Selection	Knowledge Comprehension Application		Conscious	Gap Bridging	Plan Development
Exploration	Knowledge Comprehension Application			Gap Bridging	Gather Resources
Formulation	Comprehension Application Analysis Synthesis	Conceptual state of obtained knowledge	Formalized	Gap Bridging	Draw Conclusions
Collection	Comprehension Application Analysis Synthesis			Gap Bridging	Draw Conclusions
Presentation	Analysis Synthesis Evaluation	User's updated view of world	Compromised	Use	Reflection

Figure 1 Comparison of cognitive states in information seeking

Information literacy standards including the Big 6 which includes the steps of task definition, information seeking, location and access, use of information, synthesis, and evaluation ("What is the Big6?," 2006) and the ACRL (2006) standards which include know, access, evaluate, use, and ethics) map easily onto Figure 1, particularly with regards to Kuhlthau's and Audet's models. Bruce (2004, p. 6) includes Doyle's attributes of information literacy in which an information literate person: Recognizes that accurate and complete information is the basis for intelligent decision making. Table 1 includes a complete listing of Bruce's information literacy elements.

Table 1 Bruce's information literacy elements

Information Literacy elements

Recognizes the need for information
Formulates questions based on information needs
Identifies potential sources of information
Develops successful search strategies
Accesses sources of information
Evaluates information
Organizes information
Integrates new information into an existing body of knowledge
Uses information in critical thinking and problem solving

While all of these standards emphasize evaluation and use, only Bruce includes components of information management which she calls information control. Both Bruce and Doyle present models that include concepts of organization. The lack of the inclusion of organization components in most standards may indicate a gap between the expectation that users will seek to contextualize their learning experience and their failure to contextualize the information they found. In her article on methodologies for integrating information seeking with learning models, Wolf (2003) discusses the concept of 'Information Problem Solving' (IPS) which includes information seeking within the context of a directed learning environment. Each of these models and their applications focus on bringing the student to a state where they are both engaged in the information seeking/learning process and aware of their position and possible actions in that environment.

Wolf (2003) claims that students have difficulty getting to this state, stating that "many students use a strategy when required, but fail to use it when the requirement is removed". Bruce also comments on the relationship between information seeking and learning, saying "while effective information use arguably underpins enquiry learning, problem based learning, action learning and various other student centered modes, an effective information literacy education requires explicit attention to information processes; as well as the careful crafting of real world information practices, and meaningful reflection, into curricula" (Bruce, 2004, p. 5). While

Taylor, Belkin, Dervin, and Kuhlthau focus on individual information seeking experiences, the work of Chatham, Vygotsky, and Dewey discuss information seeking in group environments. Vygotsky observed that "the internalization of socially rooted and historically developed activities is the distinguishing feature of human psychology" (1977, p. 57). Likewise, Chatman's (1999) concept of life in the round describes an information world that is "composed of normal language, worldview, and codes. Life lived in the round is the process that permits social meaning to happen" (p. 212). Concern for the social aspects of knowledge organization is echoed by Hemming (2006), Montiel-Overall (2005), and Grant (2005). In addition, Srinivasan and Huang (2005) claim that the explicit recognition of the social component of knowledge building in collaborative digital libraries has direct results in use and satisfaction with the digital libraries. Andersen and Skouvig (2006) say that "Knowledge organization cannot legitimize itself by referring to the principles, standards, or techniques of its internal workings. We must understand knowledge organization as situated in society and as a human activity" (Andersen & Skouvig, 2006, p. 318). Erickson (2006) observes that, in group information management (GIM) situations, the shared information "produces tensions between the ends for which it is shared and the not-necessarily desirable symbolic inferences it may support," (Erickson, 2006, p. 7) and that group dynamics are an evolving process.

3.1 Extended mind and the process of literacy

The discussion of extended mind brings to the forefront the concept that becoming literate in an area is a process of learning both the conceptual and symbolic systems which are used to represent that field. The idea that this process coincides with the process of forming deeper internal understanding of the elements of the field can be framed in Bloom's (1956) stages of apply, analyze, evaluate, and create. Thus, while in-depth domain knowledge facilitates the recognition of systems of encoding and classification in a given field, a lack of familiarity with

those representation systems can also be either a barrier to effective work or an enabling system to aid understanding. For example it would not be possible to have in-depth domain knowledge in software development without understanding programming languages. Nor would it be possible to understand mathematics without understanding the meaning of mathematic symbols. Likewise, being able to recognize and use a classification system, or generalize an encoding system for use in a different context can aid understanding in unfamiliar contexts. The implication of this approach for information seeking theory is that the procession through stages of an IPS situation are tied to the creation and use of external information objects which can include resource abstracts, summary narrative, or a database of citations. Likewise Bloom's (1956) levels of learning can be tied to the use or generation or use of specific information objects.

Just as Holland (2006) suggests that language is one of the most ingrained examples of cognitive supporting systems, this literature review suggests that the role of document structure in a digital environment is a key element of the interaction between an internal cognitive state and the extended information world. As was discussed in the literature reviews on information literacy and information organization, the changing nature of the document and of the nature of information use and creation in electronic environments are creating new roles for these interactions. In the following section, this review will look at the various roles that metadata plays in the creation and use of information in digital environments and the impact that those interactions have on the participants.

4 Metadata, the document, and authorship

Metadata serves a variety of roles in digital documents. These roles include resource organization, discovery, and management, personal information management, and discovery of

new information. Despite a widely regarded use in search and retrieval, research has not agreed on the utility of metadata in this area. Studies show that full-text indexing provides sufficient retrieval at lower indexing costs (Hawking & Zobel, 2007; Hemminger, Saelim, Sullivan, & Vision, 2007). Other research also shows significant value in the use of metadata to evaluate, and use documents (Liddy, 2005; Reamv, 2004; Yee, Swearingen, Li, & Hearst, 2003). Despite this debate there is ample evidence of the growth of metadata in electronic documents. The concept and use of metadata has expanded greatly in recent years and is increasingly used in common information environments as opposed for 'back-end' system work.

The previous section of this review discussed the impact of the changing user roles with regards to information seeking and use. Put in terms of an active user or holistic user, this means that the creation and categorization of information needs to be considered as an integral part of the information seeking process. Evidence of this perspective is found in the literature. Liddy (2005), for example, found that users recognized multiple uses of metadata including retrieval, summary/representation, and easy browsing. Likewise, Brand, Daly, and Meyers (2003, p. 6) indicate emphasize actionability, and persistence as two primary uses of metadata and claim that metadata use in electronic systems is on the rise. A review of metadata actions grounded in the work of Liddy (2005), Brand, Daly, and Meyers (2003) , and Gilliand (2000) can be used to group and type common actions. Greenberg et. al. (2001) found that primary authors were both adequate creators of metadata and personally invested in metadata that they created. Greenberg (2003) has also created a taxonomy of creators which includes Professional, technical, author, community/enthusiast metadata creators. These types include metadata creation, searching, harvesting, interpretation, migration, and presentation each of which can include automatic and manual processes.

Given the shift from more static, authority centric organization systems to more user-centric dynamic systems it is worth investigating how the previously well-defined roles of cataloger and

information consumer have blurred. The developments in categorization systems mentioned in the previous sections illustrate how these polarized views of 'cataloger' and 'user' are dissolving. The emergence of social software networks and iterative categorization tools are enabling a side shift in viewing how information is processed and is encouraging new research on the cognitive processes of classification. This section reviews the roles of users and catalogers through a discussion of the organization positions of collaborative classification versus expert classification systems.

4.1 Participant views on collaborative description

The recent development of folksonomy categorization approaches has created a response in classification literature. Folksonomies, also known as collaborative tagging systems, are based on a decentralized view of categorization that emphasizes contextual user input over single point cataloger input. Folksonomies are important both because they emphasize the value of participant created description and because they combine the use of pre-coordinate indexing with post-coordinate use in a categorization loop that leads both to refinements and subject expansions. Mathes' (2004) paper on folksonomies cites the comments of flickr co-creator Stewart Butterfield who claims that folksonomies offered 90% of the value of structured taxonomies but without the overhead (2004, p. 13). Observations regarding the validity of this claim are one of the core debates in the discussed in this area. Macgregor and McCullough (2006) list a number of arguments in favor of folksonomies over traditional classification systems including the difficulty of using established bibliographic control, inflexibility of established systems, and the lack of established controlled vocabularies focused on digital library use. They cite Greenberg's (2004) work on automatic metadata generation and suggest that partial automation may bring controlled vocabularies to Web-based indexes but that for the time being, collaborative tagging is emerging as a movement to fill in the gap (2006, p. 3)

In a posting on his own Web site, Shirky (2006) asserts that traditional classification systems fail to accommodate the changing needs of information categorization. While he notes that some authority produced classification such as the Periodic Table of Elements adequately fills descriptive needs and enables new discovery, Shirky points to the shortcomings of the LCSH and DDC systems focusing on their geographic and cultural biases that have created large blocks of poorly cataloged resources (2006). Shirky goes on to point out that with the separation of the resource locator (URI / Call Number) from the resource description, new ways of linking have been made possible that provide more useful structures than rigid hierarchies. He manages to get to one of the core arguments for folksonomies, that better description is achieved when a user describes a resource with specific contextual phrases, avoiding the "Signal Loss" that is inherent in traditional categorization schemes (2006, p. 15). He further claims that this style of tagging allows for rich post-coordinate retrieval and clustering of documents based on real user needs rather than having been determined by an authority at a single point (p. 16). Initial studies by Shirky (2006), Guy and Tonkin (2006), and others summarized in Macgregor and McCullough's article (2006) are beginning to show that while collaborative tagging appears to discard controlled vocabularies and ontological relationships, that order and utility can be derived from analyzing the usage patterns of large bodies of users. Shirky (2006) found that users collectively migrated to new tags as concepts changed and that people tend to code in their area of expertise. Guy and Tonkin (2006) conducted similar reviews of tags on sites like del.icio.us and flickr. The found that while users could learn some "tag literacy" concepts, that the collective use of tags for description was more dominant than single use tags and that the tags often had shared social meaning (p. 3).

Guy and Tonkin (2006) also found that users were creating local hierarchies and taxonomies using "tag bundles" and comment that they noticed a split between the use of tags to describe "collective collections" and "personal collections" (p. 12). Macgregor and McCullough noted the research of Golder and Huberman (2006) who found that while there was diversity in tag use

among users that the "data also suggested that there existed some measure of regularity in the tags being assigned by users" (2006, p. 5). They also included the comments from Sinha (2005) from her posting called "A cognitive analysis of tagging." Sinha asserted that collaborative tagging and subsequent use involve lower cognitive loads on users because "tagging eliminates decision" in that they are simply recording their description, not applying an external system to what they think the item is (2005, p. 3). Sinha proceeded to observe that tagging enables "immediate self and social feedback" (p. 3). Each of the surveyed articles recognized different uses for more formal classification techniques in relation to collaborative tagging. Guy and Tonkin (2006, p. 12) recommended improvement of tagging systems both through user education and automated processing. Shirky (2006) emphasizes the ability of organized classification systems to provide strong structures for print or highly classifiable systems but also offers strong arguments against the normalization of folksonomy systems. Macgregor and McCullough (2006) conclude their research review by discussing the continued development of traditional classification along with collaborative tagging systems. They review research directed at developing corporate taxonomies and work towards integrating digital libraries, and assert that a hybrid system could allow the structure and interoperability capacity of traditional classification systems to work with the dynamism and openness of folksonomy classification systems (2006, p. 6). The implications of these findings are that the creation of representation and classification systems through tagging and metadata assignment in these environments is serving the roles that were described using the extended mind theory. As these processes have become more popular that they are emerging as a central skill and concept for certain types of literacy.

4.2 Participant views on metadata and authorship

The historical basis of controlled structures in resource description stems from the work of Aistotle, Callimachus, and Linneaus (Weinberger, 2007). In the digital realm, highly structured

data tends to be imposed in classification tools such as taxonomies, schemas, and controlled vocabularies but is also finding root in the generation of metadata. The definition of metadata has been discussed extensively and includes 'data about data' and "structured data that facilitate functions associated with a resource" (Crystal & Greenberg, 2005, p. 177). While metadata models can be used for both highly structured and unstructured data storage, the research being done involving the creation of metadata models tends to involve structured systems. Lagoze (2001) has published several papers describing metadata models including the ABC model which he distinguishes from traditional metadata standards. He views the ABC model as "a basic model and ontology that provides the notational basis for developing domain, role, or community specific ontologies" (Lagoze & Hunter, 2001, p. 1). The ABC model builds on the concept that digital objects need more than just descriptive data. "Traditional bibliographic cataloging has generally assumed that the objects being described and therefore their attributes are more or less stable. Time and object transition has generally been relegated to 'second class' status. This has made traditional resource-based cataloging inadequate in a number of contexts"(p. 2) . Lagoze and Hunter respond to the question of cost of applying such an in-depth model by citing William Arms' (2000) work on the cost of digital libraries. Arms' primary claim is that automation is cheap but lacks depth and sophistication. In his conclusion, he equates the information access on the Internet to the "Model T Ford" (p. 8), asserting that more sophisticated metadata models can solve more sophisticated information problems. Lagoze also views the ABC model as too technical to be understood by the "standard user or creator of metadata." Instead, he claims that "it is intended as a conceptual foundation with two communities in mind"(p. 2). This perspective that the user should be separated from the organization of the information is in direct contrast to the folksonomy based views of the previous section.

Complex metadata structures have been shown to support learning in digital environments. Smith and Zeng (2003, p. 2) devised a structured model for organizing scientific concepts into a single unified metadata structure for classroom use. They assert that this type of metadata

system domain based learning which asks how a subject fits in the overall schema, case-based learning which presents the participant with specific problems, and scaffolded learning which adjusts the content to fit student learning level (p. 3). They refer to this metadata model as "Strongly Structured Models (SSM)." As they implement their SSM systems they include multiple classification tools including thesauri, semantic networks, faceted classification, and taxonomies. Like Lagoze, Smith and Zeng recognize the limitations of specific implementations of metadata models in their inability to cross domains to categorize new knowledge. Zeng and Smith also cite Kwasnik's (1999) article which argues that each classification scheme has its own strengths and limitations. Unlike Lagoze, Smith and Zeng do not allow for a consideration of more loosely structured metadata models on the basis of cost. Although the mention that the creation of a 'concept' requires .5 – 1.5 hours of expert time, their arguments for the benefit to the user earlier in the article clearly outweigh this cost.

In these cases, metadata is used to create complex documents which serve advanced purposes. While it is unreasonable to expect the average information consumer to become proficient in the creation of these documents it is worth considering the role that these documents play in enabling the gaining of knowledge in these participants. The example of RSS that was put forward in the information organization review points to the idea that while the technical elements of RSS are well beyond the average user, the ability to recognize, use, harvest, and re-mix RSS documents are skills which are becomingly increasingly important. The comparison of these two organization system provides a way to discuss two important uses of metadata in electronic environments. The first method (folksonomy) uses metadata to provide a community building and cognition supporting mechanism where participants make sense of their surroundings and encode it for sharing with others. The second method (strongly structured metadata models/documents) provide more advanced participants with a way of representing the complex knowledge of a field and, when recognized and used by a larger population, provides the ability to learn from these documents. While there are a number of issues surrounding both

of these approaches (sustainability, durability, cost), these arguments do appear to focus on the impact on the users' information interaction.

There is considerable debate in the information organization arena about the appropriate use of folksonomies and what impact they have on an information interaction. Those who focus more on user-centered organization and contribution assert that the power of community generated context trumps the authority based models. In his book *Ambient Findability*, Morville (2005) states "Forget about ontologies and taxonomies. Folksonomies are the future. As David Weinberger puts it, 'The old way creates a tree. The new rakes leaves together'"(2005, p. 139). He echoes the opposing viewpoint a few sentences later in saying "But when it comes to findability, their inability to handle equivalence, hierarchy, and other semantic relationships causes them to fail miserably at any significant scale" (p. 139). As noted in the literature, folksonomy systems allow user centered description and feedback interactions while also building a collaborative consensus of aboutness. Many authors expressed concern regarding the scalability of folksonomies however, and although arguments can be made that 'authority controlled' values eventually bubble up from the semantically rich, syntactically diverse content, there is no literature demonstrating the success of this type of processing. In contrast, the highly structured metadata models described by Lagoze and Zeng and Chan create interoperability at the expense of immediate user-focused input and feedback and create documents which serve more complex information roles. Both Lagoze and Zeng and Chan's arguments are based on the assumption that well categorized data enables more intelligent and productive user interactions.

The discussion of the impact of metadata and digital documents in literacy runs the risk of straying too far afield of the purpose of this work. This review is in essence exploring the relationship between metadata structures and participant's conception of them. It is for this reason that the perceived level of expertise of the user is so important to this work. In both highly structured contexts, for example Erikkson's (2007) semantic documents, and highly social

contexts (Borland, 2007), the author/reader/tagger interacts with the document in a specific context which includes elements of literacy, information need, and participant perspective. Several of the influential factors of this interaction include the participant's ability to deconstruct the information and metadata models in the document, the ability to construct or apply new information within a given model, and the ability to recognize the ramifications of interacting with the document in a given context.

5 Conclusion

This review investigated theories of information seeking, interaction, and learning with an eye towards how those theories discussed the interaction between a participant and the information they consume and create. It looked at metadata from both the perspective of its creation in environments and use in complex environments and suggested that these two examples are appropriate to use in investigating the role of metadata in the information seeking and interaction theory.

The review suggested that the two complementary theories of extended mind and social constructivism bring to light the key roles of metadata in these interactions and help explain the motivations that individuals have in creating and using metadata. These roles include serving as a stigmergic structure to allow communities to structure their thoughts and beliefs, allowing the parceling of cognitive work through representation of complex concepts, and serving as a bridge between human cognition and computer data processing. This review also examined the components/definition and the context of metadata use, particularly within the context of social and learning environments and suggested that metadata creation and use could be described in terms of the processes of information seeking models and the knowledge levels of Blooms taxonomy. While the review found considerable research into the nature of specific types of

metadata, it failed to find strong definitions about how participants conceptualize metadata models in these information environments and little research which examined their motivations in creating and using metadata-rich documents. The idea of metadata-literacy focuses squarely on this issue and attempts to answer two questions. First the metadata-literacy review identifies elements of literacy which are influenced by metadata creation and use. Second it examines the perceived impact of metadata on everyday information interactions.

This literature review was based on the assertion that this interaction can be discussed within the context of a model influenced by information literacy and information organization principle. In fact, the position that metadata is a bridge between the document and the user is the central assertion of this review. This review further suggested that just as a user requires knowledge of mathematical symbology and logic in order to make use of the cognition-extending technology which supports mathematical thought, they also generally require knowledge of metadata and information organization concepts and structures such as representation, abstraction, categorization, and encoding to make use of cognition-extending technologies. For example, the ability to understand the purpose/use of a RSS feed is directly tied to the recognition of structural/semantically encoded metadata in that feed. Further, this literature review asserted that the extent to which a user understands a body of knowledge is tied to their understanding of the metadata and encoding systems surrounding that body of knowledge. Understanding HTML for example is not really possible without having a vague conception of the HTML document object model (DOM). Likewise, understanding programming languages is as much about being able to decipher documents as it is about understanding the concepts of logic.

These two concepts, that metadata literacy enables the use of cognition supporting technology and that metadata literacy enables the learning of domain-specific knowledge can be explored in a number of ways. Given the large body of work already amassed on information literacy, it makes sense to frame the skills, concepts, and contextual knowledge required within this

framework. This framework addresses both the individual and social participant perspectives that are appropriate in digital documents. The IL framework, through the use of Bloom's Taxonomy also allows an investigation of the impact of metadata by mapping metadata literacies with the increase in levels of knowledge.

By using the IL framework, the metadata literacy review can ask "how can we qualify/quantify the structures required to effectively learn about metadata and how does this impact a personas ability to understand a concept or domain of knowledge?"

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