Everyday information organization practices in the pursuit of leisure: The information organization, management, and keeping activities of amateur art photographers

LITERATURE REVIEW

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INTRODUCTION

In this review, I discuss some of the literature relevant to my proposed study of how amateur art photographers make decisions about managing the information and artifacts gathered and created in their serious leisure pursuit. This includes examination of the information systems and structures amateur art photographers have developed to support the management of said information and artifacts, how they make sense of the task of managing these, how their current strategies have developed, and whether they have strategies for the long term keeping of their photography-related "stuff."

In the first section, I situate the proposed study in library and information science (LIS) by relating it to other work on information behavior and practice in everyday contexts. Approaching information behavior in the everyday foregrounds special aspects of information behavior that I will identify and attend to in the proposed research. Finally, I use the framework of the Serious Leisure Perspective to define my population based upon their approach to photography as a leisure activity.

Managing the information and artifacts related to the activity of photography is a form of information organization, so the middle sections of the review are concerned with different aspects of the organization of information. The main type of information/artifact created and organized in the activity of photography is the photograph, so I begin by looking at the organization of images. This includes discussion of the attributes used to organize images in cultural institutions, how individual people organize their photos, and how these two approaches are colliding in new venues of online photo sharing. One's collection of photographs and other photography-related information is a personal information collection, so I next cover the literature of personal information management (PIM) and show how my proposed work will extend our knowledge of PIM practice.

Until now, the scope of information organization discussed has mainly been at the individual level; next I examine two broader approaches to the topic: concepts and categories in cognition, and classification theory within LIS. Theories of categorization and classification structures in cognition attempt to explain the cognitive organization of humans in general and do not attend to the individual. They are of interest here because how we think about our collections of information is likely to affect how we manage those collections. Also, we use information structures, systems, and artifacts to extend our cognitive abilities. While not directly related to the questions asked in the proposed study, these topics are often referenced in the LIS literature on information organization, providing focus for analysis and ideas for new questions to explore.

I finish the review of information organization by examining the general LIS literature on information organization via classification. This section begins with how we define the processes of categorization and classification, and how our ideas on these activities have followed the same general trend as theories of cognitive categorization. The scope of the topic is then narrowed from the idea of universal classification, moving first to disciplines and domains, and then to smaller groups who coalesce around work. Finally I return to the topic of the individual by looking at how some information organization systems and tools have been informed by the information organization behavior of individuals.

After this exploration of the topic of information organization from a variety of viewpoints, I return to my overall questions:

- From the amateur digital photographer's point of view, what information and artifacts does s/he find, create, keep, and organize or manage?
- What structures or systems has s/he created to manage them?
- Has s/he made changes to these systems and structures over the course of an amateur digital photography career? If so, how did s/he decide it was time for a change and how did s/he navigate the decisions involved in implementing that change?
- Does s/he have strategies for the long-term keeping of photography related information and artifacts? If so, how has s/he arrived at them? If not, why?

The last section of the review is about the Sense-Making Methodology. This approach is firmly dedicated to examining phenomena from the individual's point of view, and understanding how s/he makes sense of stopped-situations in order to move through them. It has informed my questions and my ideas for designing a study to explore them. Finally, I will explain the parallels I see between the Sense-making model and the activities of PIM. This may provide a new way for thinking about PIM and suggest that Sense-Making may be useful in a more balanced approach to studying information behavior that does not solely focus on seeking and use.

SITUATING THE PROPOSED STUDY

This section takes several steps to conceptually situate the proposed study. First, I show how the study fits into and extends other literature on information behavior and practice in LIS. Then, I examine some conceptualizations of and approaches to everyday life from LIS and other disciplines. These may help to guide the design of the proposed research and the analysis of data collected. Finally, I introduce and critique the Serious Leisure Perspective before using it to identify and describe the population of interest in my work.

INFORMATION BEHAVIOR AND PRACTICE

Information behavior is information seeking

Research into human information behavior (HIB) has primarily examined the activities of information seeking and information use (Spink and Cole 2006b). Most studies of information use have conceptualized the topic as "potential use" (Vakkari 1997): or the information sources or channels people *use* to obtain information (because those sources potentially contain the desired information) (Savolainen 2006). Where one goes to find information is an aspect of information seeking. Most information use studies take the latter approach to conceptualize "use" (Vakkari 1997). Since most HIB studies consider information behavior to consist of seeking and use, the result is that almost all HIB research is limited to only one aspect of information behavior: seeking.

Many information seeking and use studies take a narrow conception of information seeking as a goal-directed, problem-solving activity involving the kinds of questions that can be posed to an information system. Ross (1999, 785) points out that this is unsurprising given that the design of formal information systems and services is a main goal of LIS. A growing number of studies make different assumptions about information seeking and instead focus on concepts like information encountering (Erdelez 1997; Marshall and Bly 2005),[1] incidental information acquisition (Williamson 1998b), and serendipity (Foster and Ford 2003).

In an era of information overload (Eppler and Mengis 2004), the predominant focus on directed information seeking is problematic. Finding information is usually no longer a challenge. Sources chosen and strategies for navigating through the glut are still of interest, but the larger challenges have become:

- choosing a comprehensible amount of the most relevant information (Talja 2002);
- assessing the quality of found information;
- making sense of all of the information at hand; and
- keeping track of information so that one has it when one needs it.

These activities are explicitly stated or implied in many definitions of information literacy (Virkus 2003). Thus, the interests of LIS should extend to all types of information behaviors.

Information behavior is (not) all in your head

A "real use" approach to conceptualizing information use is infrequent compared to the "potential use" approach described above (Savolainen 2006). "Real use" is the cognitive transformation associated with information (Vakkari 1997), or the incorporation of information into a person's existing knowledge base (Spink and Cole 2006b). If use is understood solely as an internal process of cognition, we are limited to cognitive approaches, and an entire range of information behavior is ignored.

The incorporation of information into a person's existing knowledge base has a strong cognitive component, but our knowledge bases and cognition extend beyond the internal workings of our mind (Clark and Chalmers 1998). Kirsh and Maglio (1994) discuss epistemic actions, or the physical, external actions we take to improve the ease, speed, or reliability of our mental computation. Some types of information use can be seen as epistemic action. Sensemaking as discussed in (Russell et al. 1993) involves creating representations in order to make information useable. These representations are often external.

[1] Marshall and Bly investigate the use of encountered information, in the sense of what people physically do with it.

Wilson recognized that information use can have a physical component, such as marking important parts of a text (2000, 50), but this type of information use is much more varied and complex than making marks while reading. We create external artifacts and representations (information objects) in physical space to extend our memories and our cognition (Gruen 1996) (Jones and Nemeth) (Neumann 1999a) (Kirsh 1995) (Larkin and Simon 1987). The artifacts we create and use as cognitive and memory "prostheses" (Lamming et al. 1994) include many types of systems and structures. A few examples include mind maps (Buzan 2006), calendars (Payne 1993), directory structures (Jones et al. 2005b), notes (Hartley 2002), to-do lists (Taylor and Swan 2005), spreadsheets (Russell, Jeffries, and Irani 2008), and general information scraps (Bernstein et al. submitted).

Several models of information behavior have included some form of information creation using found information, but none have treated the topic in any depth. Kuhlthau's "presentation" includes preparing to present or otherwise use information. This may include organizing strategies such as making an outline to assist in arriving at a personal synthesis of a topic (1991, 368). Hektor identified "dressing" as an everyday information activity in which an individual consciously or unconsciously externalizes the product of the internal cognitive act of framing information. This is an extremely broadly conceived activity which includes all encoding of information for communication and sharing with others, as well as "to keep in a photo album, a diary or any other private repository" (2001, 86-87). Godbold (2006) included "creating information" in her proposed extensions of several well known models of information behaviors.

By taking into account such artifacts and the creation and use of information objects and space in supporting our knowledge and our cognitive functions, we move beyond purely cognitive phenomena. Extending the definition of information use in this way leads directly to a broader conceptualization of information behavior.

Information organization is information behavior

Human information organization behavior (HIOB) joins information seeking and information use a third kind of human information behavior (Spink and Cole 2006b)[2]. Information organization behavior in this context has been defined as "analyzing and classifying materials into defined categories, e.g., the Dewey Decimal Classification System" (Spink and Cole 2006b, p. 25).[3] This definition is discussed further:

> While the example they give is a document organization system, their definition lends itself to creating a cognitive framework for HIOB. Few studies have examined human's information-organizing behavior in relation to other information behaviors (Spink, Park, and Cole 2006, 141).

[2] See also their Integrated Human Information Behavior framework (Spink and Cole 2006a, 232).

[3] Let us for now ignore the fact that Spink and associates consistently cite an article on the Universal Decimal Classification in their definition utilizing the Dewey Decimal Classification as an example. The recognition that HIOB exists and should be included in models of HIB is excellent, though not unprecedented.

Use of this definition to create a cognitive framework for HIOB is problematic on at least two fronts--one within LIS and one in cognitive psychology. First, Elin Jacob has clarified the difference between classes and categories as things, and classification and categorization as cognitive processes (1991; 2004). Conflation of these terms muddies the discussion of these activities. Second, researchers cognitive psychology have agreed for quite some time that the human cognitive architecture is not made up of well-defined categories like “classes” (Rosch and Mervis 1975; Smith and Medin 1981; Lakoff 1987).

This definition and expansion also lead me to wonder what HIOB is intended to encompass if few studies have been conducted on this sort of behavior. There is a large literature on the topic mentioned in the definition: classification theory and subject analysis. The ever-growing PIM literature is concerned with what people do with information they have sought, encountered, or need to re-find (i.e. "other information behaviors"). A healthy percentage of the literature on computer supported cooperative work (CSCW) explores how people share and organize information and information objects in order to get work done. Portions of all of these topics are covered later in this review.

Spink and Cole (2006a, 236) state that Cole and Leide (2006) have begun the work on human information organization behavior (HIOB). Indeed this article appears to be unique in the LIS literature. The end goal appears to be to use metaphor to translate the organization scheme of an information system into the cognitive organization of a novice user. Metaphor is one way humans cognitively organize concepts (Lakoff and Johnson 1980), however this does not apply to all concepts. The paper in question reports on interviews intended to elicit metaphorical representations of scholars' research topics and problems. The subjects appeared to be confused by researcher requests and found it difficult to respond to the researchers' instructions to describe their own research topics metaphorically. Given the intent to elicit the cognitive structures of domain experts with the end goal of creating an information system (or a layer thereof) that is more human-like, the study seems less a foray into a new research area than a failed attempt at knowledge elicitation (Hoffman et al. 1995), another well-explored area in artificial intelligence, cognitive science, and psychology.

Regardless of problems with Spink and associates' definition of HIOB and questions of exactly what the scope of HIOB is if it is currently unstudied, it is heartening to see a number of studies and a general model of HIB including organization behavior. I identified only one other inclusion of information organization in a general framework for HIB in a seemingly obscure faceted classification of information interactions created by Cool and Belkin (2002). Here, "Organize" is included as a type of behavior in the Information Behaviors facet. Only a few studies have explicitly included any sort of information organization as an aspect of more specific types of information behavior. Barry (1997b) included organizing information in her model of information behavior in research activity. Meho and Tibbo (2003) added the category "information managing" to their model of information seeking behavior. Hartel (2006) includes the gathering, organization, and production of information used by serious gourmet cooks as part of their overall information activities.

Issues with human information organization behavior

Information organization behavior and information use behavior are in truth inextricable.[4] Incorporating information into one's knowledge base (using it) involves categorization, cognitively, if not externally. Sensemaking (as per Russell), a way of making information usable, is an iterative process of organizing information into representations and adjusting representations to fit the information (Russell et al. 1993). Kwasnik (1989a) showed that an information object's use or intended use heavily influenced how that information object would be classified in the workplace. Information organization behavior as it manifests in PIM is also very much about individual information needs--past, present, and those anticipated to exist in the future (Bruce 2005). It is also about information seeking--finding, re-finding, and reminding (Jones 2008a). In PIM, people are not only seeking and using information objects. Through their use of their PIM structures and systems, they are actively and iteratively constructing those systems in their daily lives.

Using the term "behavior" to describe the sort of phenomena generally included in information behavior research is not without problems. Savolainen (2007) analyzes the use of the terms information behavior and information practice as umbrella concepts. While his analysis is limited to information seeking studies, his conclusions also apply to the broader use of the terms. One issue is squaring the largely invisible, internally cognitive concerns of information behavior researchers with the use of the term behavior. In psychology, a behavioral approach is focused on what can be observed from the outside. Internal, introspective cognitive processes are not observable. This means they are subjective, private and unverifiable, and prone to error and distortion; therefore they are not worth considering in science (Zuriff 1985). Tirassa, Carassa and Geminiani write that "behavior is in the (representational) observer's eye only, not in the organism observed: what organisms do is not to behave, but to interact with their subjectively defined environment" (2000, 20). As described above, some information behavior research has focused on observable questions such as which sources people use and some actions that take place in the steps of information seeking; however, a preponderance of information models are concerned with an internal process.

For some, the increasingly broad scope of definitions of information behavior[5] is problematic (Savolainen 2007). What use is the term if it describes everything? My response would be: what use is the term if it refers to a concept much narrower than the term implies? Even the broadest of concepts needs an associated term. Defining the overall term broadly allows us to identify all of the more specific types of information behavior and how they relate to each other instead of taking an unbalanced and blinkered view of the topic.

[4] Of course, this is true of information use and information seeking as well. In PIM, a person re-finds in his own information collection, which he has organized (or not) himself; here information organization and information seeking are intertwined.

[5] These definitions are too numerous to analyze here, but Spink and Cole's (2006b) framework is just one example. Savolainen (2007) is a good starting point for exploring the many ways information behavior has been defined.

Savolainen's (2007) main concern is the general lack of attention given to defining the terms we use in LIS. This indicates a lack of concern with or exploration of the discourse(s) of our discipline. Different concepts are laden with different assumptions from which spring different viewpoints influencing our interpretation of phenomena. Researchers must be reflexive in order to identify their own assumptions and compensate for their own biases.

Information practices: a better fit

Savolainen (2007) also traces the development of the information practices approach, which may be viewed as a response to the need to find an alternative to the dominant and limited concept of information behavior. The two approaches are differentiated in the following way:

> …within the discourse on information behavior, the "dealing with information" is primarily seen to be triggered by needs and motives, while the discourse on information practice accentuates the continuity and habitualization of activities affected and shaped by social and cultural factors (126)

Another important distinction between information practice and information behavior is that definitions of information practice have, in general, been more inclusive. Information organization is not a new addition to the overall view of information practices. Taylor (1986) described the need for a model of information practices including organizing, storing, manipulating, and evaluating. McKenzie (2002, 38) states that information practice is a broader term than information behavior because it includes the greater range of activities identified in her work; "list-making plans and strategies" were used by women pregnant with twins as part of active seeking in information encounters (2003, 33). Talja and Hansen (2006) include interpreting and indexing ("giving names to pieces of information for the purpose or retrieval and re-use") as information practices because they "are part of the routine accomplishment of work tasks and everyday life" (125).

Next I explore the concept of everyday life. The main goal is to express how I see PIM and, by extension my proposed study, as concerned with the everyday and as fitting in the larger literature of LIS. I will also return to this distinction between information behavior and information practice, showing why my proposed work takes the latter approach.

EVERYDAY LIFE

Interest in information behavior outside the workplace first sparked in the 1970s, but grew dim after a few large-scale surveys were conducted. With the increased use of qualitative methods in the 1980s, interest in non-work information behavior resurfaced and has continued to grow, but the number of studies in this vein is still far outnumbered by research on information in various work contexts. Savolainen introduced the phrase everyday life information seeking (ELIS) to describe this area of research in 1995, and the name has since been applied to a growing body of research, previously known by such terms as "non-work information seeking" and "citizen information seeking" (Savolainen 1995).

Everyday life information seeking (ELIS)

ELIS is defined as "the acquisition of various informational (both cognitive and expressive) elements which people employ to orient themselves in daily life or to solve problems not directly connected with the performance of occupational tasks" (Savolainen 1995, p. 266-7). In addition, Savolainen (2004) later specified that ELIS was also unconcerned with these topics in the performance of full time study.[6]

The literature on information behaviors in everyday life and in context continues to grow, much of it citing Savolainen's initial ELIS study, using its terminology of "everyday life," and referring to ELIS as a research area; however, there seem to be tenuous relationships between many of these studies and the original.

In the original study, Savolainen (1995) posits that the underlying rules of everyday life and being ("habitus") as practically evinced in "way of life" and different styles of mastery of life influence people's default strategies for seeking information in everyday life. The word "default" is important here because other context greatly influences actions taken in individual information seeking instances such as the directed seeking of information in order to solve a problem. The study also looked at patterns of passive monitoring for orienting information that are so habitual and ingrained in people's lives they might not be recognized as information seeking or strategies at all. The latter kind of information seeking is an example of way of life, while the former is invoked when one's sense of mastery of life is threatened.

The study compared the information seeking practices of people from the working and middle classes because differences in styles of mastery of life were expected to be more marked across class lines. Style of mastery of life was found to be related to information seeking habits for both orienting and practical information. As expected, the relationship was stronger for orienting information as it is associated with way of life as usual, characterized by a mastery of life. Findings about the relationship between style of mastery of life and class indicates only a high level outline of ELIS practices and that one cannot make assumptions about an individual's information practice based on class. The paper ends by calling for the refinement of the ELIS research framework through more work on analyzing styles of mastery of life, identification of relationships between these and situational factors in instances of practical information seeking in problem situations, and the identification of other factors which may be more fruitful for analyzing differences in information behavior.

Other studies citing ELIS have not systematically followed Savolainen's lead of exploring the hypothesis that way of life in the everyday and style of mastery of life are directly related to information seeking practices. Instead, most of these studies explore and describe information seeking by groups of people in different contexts. Some of the studies go beyond information seeking to consider broader information behaviors and practices. These studies seemed to be linked to the 1995 ELIS study in two main ways. The first is in the use of the term everyday to describe information behaviors and practices. The other is by focusing attention on information seeking in problem situations.

[6] In the discussion of ELIS below, my usage of the term "work" includes occupational tasks and tasks involved in full-time study.

Hartel's (2007) analysis of the literature associated with ELIS found that studies fall into three thematic categories. The first is holistic, in which information seeking is examined across a broad swath of everyday life. The phenomena of interest are not bounded by tasks or time. Another is information seeking in the context of particular leisure activities. These two comprise relatively few of the studies: 80% of the ELIS-related studies in her analysis focused on information seeking in either compromised everyday life situations such as illness or crisis, or in the everyday lives of populations seen as marginalized or disadvantaged (Hartel 2007).[7] Here the assumption is that life is a problematic situation (Ross 1999, 784). The imbalance in research is problematic given that by the definition of marginalized, the majority of humanity is not marginalized, and by the definition of everyday, most of everyday life proceeds without crisis. Kari and Hartel (2007) make the case that information is central in many pleasurable, fun, higher areas of life. Reviewing some studies of these areas, they point out that findings about information practice related to the higher things tend to contradict the typical findings of problem-centered information behaviors. This indicates that we likely have a very skewed picture of information practices that needs to be balanced.

Everyday life in ELIS, LIS, and beyond

The discipline of sociology has long been interested in the meaning of the everyday. Bakardjieva (2005, 38) notes that everyday life is an intricate empirical and conceptual construct, and that for such a commonplace phrase, it:

> has had a complex history in social science and has taken on different meanings in different social theories. It would be an excruciating task to follow all the lines of reasoning drawn through and around everyday life and attempt to resolve the debates still raging.

It is far beyond the scope of this review to take on that excruciating task, but a few common threads that seem to inform conceptualization of everyday life in LIS will be noted.

By defining ELIS instead of everyday life, Savolainen (1995) technically avoided defining everyday life. The definition of ELIS was meant to emphasize the legitimate nature of non-work contexts of information seeking, not create a dichotomy between work and non-work information seeking, which are related and complementary. Savolainen's use of Bourdieu's notion of habitus and the concept of way of life indicate that his understanding of the meaning of "everyday" is not related to work or non-work context, but is instead tied to ideas of pattern, routine, unwritten rules, an understood order, and habitual ways of being, understanding, and living. This is a sociological understanding of the concept of the everyday. Aside from Savolainen, Paulette Rothbauer (2005) and Kari and Hartel (2007) are among the few researchers in LIS who have directly invoked sociological notions in discussions of the everyday. Elfreda Chatman used these ideas in a different way, which will be discussed below.

[7] This is not a new criticism of information seeking research in general. In particular Dervin's Sense-making methodology has been criticized for representing information need as a gap or problematic situation (Davenport, Higgins, and Sommerville 2000). Dervin's (1976a) taxonomy of everyday information needs is based on the conceptualization of information need as problem. Kuhlthau's (1991) model of information seeking finds prevalent feelings of apprehension, uncertainty, confusion and frustration.

EVERYDAY LIFE: HIGH OR LOW?

Kari and Hartel (2007) place everyday life in the category of "lower thing." They cite Heidegger (1978)[8] as characterizing the everyday as relatively drab, uninteresting, and involuntary basic events that dominate people's behavior. They cite Maffesoli's (1996) description of everyday life as dominated by conformity, rules, rituals, and even unreality in the sense of "theatricality, superficiality, and spectacular effervescence" (70, cited by Kari and Hartel 2007, 1131). Lower things are contrasted with higher things. Higher things are defined as "usually positive human phenomena, experiences, or activities that transcend the daily grind with its rationality and necessities" (1132). While I agree with Kari and Hartel that the way everyday life has been conceptualized in LIS is primarily negative and problematic, I do not agree that it should be categorized as a lower thing.

The current conceptualization of everyday life in LIS is not the only way to view the matter. Perhaps the discipline's negative conceptualization of everyday life is an example of yet another social science domain out of balance. Given the rise of positive psychology and the hope of an LIS research agenda into higher things, perhaps we can hope for a positive everyday life?

We cannot escape the often dull and sometimes unpleasant aspects of everyday life, but we can choose to recognize its coexistent pleasurable and profound aspects (Highmore 2004). Metcalfe and Game (2004) vividly describe a small and simple moment of human connection in everyday life, in which attention to the mundane is the key to a profound experience of awe, love, and the eternal. Crook (1998) reviews approaches to everyday life which foreground spontaneity, playfulness, sensuality, and heterogeneity.

Sztompka (2008) outlines the meaning and anatomy of everyday life, defined as the observable manifestation of social existence, in terms both of what it is not and what it is. Everyday life is *not*:

- confined to the profane as opposed to the sacred. Magical and religious ritual and other symbolic practices happen alongside down to earth routines.
- Confined to a common class of people. Every person has his own everyday life.
- Limited to private life. Some people's everyday lives are more in the public eye than others, but we all live out parts of our everyday lives in view of other.

Everyday life:

- Always occurs in a social context
- Repeats. Everyday life events can be cyclical, rhythmic, or routine. They may happen multiple times a day or once a year.
- Very often assumes a ritual form following un-reflexive, deeply internalized scripts. These include habitual actions and formal occasions for which there is an understood order of doing things. Habitual and routine actions tend to flow un-reflexively

[8] Because I am primarily concerned with how the concept of everyday life has been interpreted in LIS, I did not find it necessarily to consult all of the cited sociological works in these studies. When the original source was not consulted, it will be discussed only in terms of the secondary authors' interpretations.

- Is embodied and located in space and time. The location and duration of an everyday event influence the character of the event.

This echoes Lave (1988, 14):

> In the functionalist view the label "everyday" is heavy with negative connotations emanating from its definition in contrast to scientific thought. Its customary use encompasses the unmarked, unsung category of humble domestic activities and their associated social roles (e.g. housewives, running errands). In the version of practice theory developed here, mundane activities in domestic settings do not delimit the boundaries of some putative "everyday world." Nor does the term denote a division between domestic life and work, domestic and public domains, routine maintenance and productive activity, or manual routines and creative mental work. "Everyday" is not a time of day, a social role, nor a set of activities, particular social occasions, or settings for activity. Instead, the everyday world is just that: what people do in daily weekly, monthly, ordinary cycles of activity.

These conceptualizations of everyday life clearly make room for the many ways in which people populate their everyday lives with the "higher things" of life. They would include religious practice (often routine, but also profound) and celebrations (cyclical and pleasurable). Many people decide to make other types of higher things a regular part of everyday life. Examples include taking on a hobby, deciding to regularly frequent cultural events, beginning a meditation practice, participating in volunteering or practicing "random acts of kindness," entering therapy or other self-development programs, resolving to have regular date nights with a partner/spouse or to liven up one's sex life, taking joy and physical pleasure in one's daily exercise routine, keeping a mindfulness/thankfulness journal to focus oneself on the good in one's life, and so on. The list of higher things that people choose to make room for in their daily lives is endless.

THE PRACTICE OF EVERYDAY LIFE

Rothbauer (2005) presents Certeau's practice of everyday life (de Certeau 1984; de Certeau, Giard, and Mayol 1998) as a theory of information behavior. Another review of Certeau's perspective on everyday life is (de Queiroz 1989). Certeau conceives of the practice of everyday life in the context of an increasingly socially fragmented world based on a productivist economy where increasingly marginalized ordinary people are characterized as consumers or users of culture and products lost in a jungle of functionalist reality. This sounds dark and dour indeed, but I see it as hopeful; his idea of practice of everyday life includes the ways in which individuals navigate through this unsavory world in creative, often subversive ways as meaningful individuals. These ways or practices are called "tactics." Tactics are contrasted with "strategies" which are the recognized, legitimized, expected ways of using and engaging with institutions, establishments, and systems over which ordinary individuals have no control. Tactics are ways of manipulating uncontrolled events to turn them into opportunities, and they comprise the bulk of everyday practice:

> Many everyday practices (talking, reading, moving about, shopping, cooking, etc.) are tactical in character. And so are, more generally, many "ways of operating": victories of the "weak" over the "strong" (whether the strength be that of powerful people or the violence of things or of an imposed order, etc.), clever tricks, knowing how to get away with things, "hunter's cunning," maneuvers, polymorphic simulations, joyful discoveries, poetic as well as warlike (de Certeau 1984, xix).

Certeau's practice of everyday life featuring the ordinary person as an active, creative individual is inherently positive. Kinser (1992, 81) writes that Certeau's view of everyday life "is superbly idealistic: daily activities are neither alienating nor fatuously complicitous with the established order of things, but rather positively stimulating to the individual and for the individual's urban ambiance. The vision is inspiring." Several other foundational theories of everyday life summarized by Bovone (1989), also contrast everyday life with a larger system that is out of individual control.

SOME OTHER CONCEPTUALIZATIONS OF EVERYDAY LIFE

Hancock and Tyler (2004, 624-5) write that everyday life has traditionally existed as an analytical space used as part of broad interpretive approaches to understanding the social world. Citing Garfinkel (1967), Goffman (1959), and Schutz (1967), they characterize the traditional concept of the everyday as concerned with: "the mundane, common place and largely informal actions and interactions of people which provides the backdrop to, or set of resources for, their everyday sense-making activities." In (Schutz and Luckmann 1973), the everyday life-world is the unexamined ground of the natural world view--"the province of reality which the wide-awake and normal adult simply takes for granted in the attitude of common sense." Crook (1998) reviews other common conceptualizations of everyday life as taken-for-granted. Of course, what is taken for granted varies in different cultures, groups, and communities, for it is socially constructed (Berger and Luckmann 1989). While moving through the environments and communities in which we live out our everyday lives (home, work, social group, etc), each of us finds ourselves navigating through different social worlds with their own particular flavors of reality. The idea of the routine, patterned, or at least repeating nature of actions in everyday life seems to be the most common thread across approaches to the concept.

TREATMENT OF EVERYDAY LIFE IN ELIS RELATED STUDIES

Treatment of the concept of everyday life in ELIS related studies varies. One quality of the everyday found in LIS conceptualizations of the term is its patterned, routine, and/or habitual nature. Among serious readers, reading is interwoven into the everyday routines of life (Ross 1999). Our habitual use of digital technology, combined with its ubiquity and frequent invisibility, indicates that it is inextricably embedded in our everyday lives (Beer 2005). Illness is said to interrupt the structures and routines of everyday life and the forms of knowledge that underpin them. If illness is chronic, this interruption becomes a feature of one's everyday life (Baker 1998). The everyday in domestic environments is associated with "routine, patterns, structures" and "households locked into constantly shifting structures…by various social, technological and cultural networks" (Silverstone 1993, 229).

The last two examples above hint at the other understanding of the everyday often found in LIS: the notion of the everyday as a shared and often taken-for-granted understanding of reality, the order of things, and common sense. Davenport (2002) avoided the term "everyday" but defined mundane knowledge management in organizations as "an expression of shared order, articulated in generic activities, ordered by protocols, procedures, documentary genres, and other artifacts." This highlights the patterned, routine nature of this work and the way it constructs a shared common-sense understanding of the work. In (Agosto and Hughes-Hassell 2006), one function of ELIS is exploration that helps teens understand the social and physical worlds in which they live.

It is fairly common to avoid the ambiguous mess of the meaning of the everyday by defining it simply as not-work (Bates 2004a; Meyers, Fisher, and Marcoux 2007). Some do not explain what they mean by everyday at all (Carey, McKechnie, and McKenzie 2001; Mckenzie 2003; Tuominen 2004; Savolainen and Kari 2004). The assumption seems to be that "everyday" is synonymous with not-work.

Savolainen defined ELIS as happening outside of work contexts, but explicitly stated that the everyday and work are inextricable and complementary. This fact is reiterated by Spink and Cole (2001) in their introduction to a special journal issue on ELIS. Given (2002) specifically studied the overlap in work and non-work information needs and behaviors among mature undergraduate students. Likewise Julien and Michels (2004) note that work is an integral part of daily life and include work related information behavior in their intra-individual case study. Finally, some researchers examine everyday routine in the workplace (Jacob 2001). This is also the focus of much work in CSCW; (Davenport 2002) is but one example.

LIFE IN THE ROUND AND EVERYDAY LIFE

Chatman's theory of life in the round (1999) was developed in the domain of LIS and in many ways functions as a theory of everyday life. Chatman drew from a large number of sociological works including (Berger 1963), (Garfinkel 1967), (Berger and Luckmann 1989), (Goffman 1959) and (Unruh 1980). A life can be lived in the round when one lives in a small world. Chatman's explication of the small world sounds much like many descriptions of everyday life. The small world results in a particular worldview including rules about appropriate behavior and sources of knowledge that permits its members to conduct their lives in a routine, expected manner (Chatman 1999; Burnett, Besant, and Chatman 2001), but these rules can also be seen as constraining. Much of the information that holds a small world together "is perceived by members of that world as appropriate, legitimate, and as having a rightful place in the general scheme of things" (Burnett, Besant, and Chatman 2001, 536). A life in the round lived in a small world "acknowledges everyday reality at its most routine" and is usually so predictable that it is "a life taken for granted" (Chatman 1999, 214). One effect of living a life in the round is that people rarely cross the boundaries of their own small world in the conduct of their information behaviors. The way one understands everyday life strongly affects how one seeks and uses information. This very similar to the conclusions of Savolainen's original ELIS study (1995), and so we have come full circle in the discussion of the concept of the everyday within LIS.

CONNECTIONS STILL TO BE MADE

Finally, it is worth noting that only in the late stages of compiling this review did I discover the work of Pierre Bourdieu as a common thread between several of the themes and topics surrounding my proposed study. As mentioned above, Savolainen (1995) uses Bourdieu's notion of habitus as a basis for the ideas of way of life and mastery of life. Bourdieu and Whiteside (1990) discuss photography in terms of habitus and ethos in everyday life. Finally, Kane and Zink (2004) discuss the experience of serious leisure in terms of Bourdieu's conception of "field." The extent of the work I would like to examine and the fact that nearly all of Bourdieu's work held by UNC Libraries is currently held in reserve for an undergraduate class, combined with this late discovery means that I have nothing to add here except that I believe exploring Bourdieu's work may be fruitful for further guiding my thought and analysis on the proposed study.

My current conceptualization of the everyday for this study incorporates the following, but needs further exploration and rigor:

- A shared (or shared-enough to communicate and cooperate) understanding of the order of things and their meaning
- Taking this understanding of order and meaning for granted most of the time
- By carrying out our everyday lives in one or more social contexts, our shared understandings of the order and meaning of things is continually reinforced and reconstructed.
- A focus on the repeating, cyclical, patterned, habitual, and the routine
- A recognition that living in the everyday perhaps paradoxically means breaking with expectation, seizing opportunities, and deciding to do things differently.[9]
- Is inclusive of the high and the low, the profound and the mundane. With intent, profound and profoundly enjoyable experiences can be made part of one's mundane routine, while certain approaches to the mundane can lead to experience of the profound

INFORMATION ORGANIZATION PRACTICES OF EVERYDAY LIFE

Here I want to show how the proposed study fits into both the everyday and the research area of information practice. I think of the proposed study of the information organization and management behaviors of amateur art photographers as a PIM study. I assume the photographers will create and collect photographs (digital and print) and other information objects related to their serious leisure pursuit, and that they will have some level of system(s) and/or structure(s) for managing and organizing these information objects. My interest in PIM is in how people organize and manage their personal information, and I see this subset of PIM as falling under the umbrella of the LIS topic of organization of information. It can be seen both as a sub-category of HIOB and as a form of information practice.

The proposed study fits better into an information practice approach. I return to two statements about this approach mentioned above:

> the discourse on information practice accentuates the continuity and habitualization of activities affected and shaped by social and cultural factors (Savolainen 2007, 126)
>
> Talja and Hansen (2006) include interpreting and indexing ("giving names to pieces of information for the purpose or retrieval and re-use") as information practices because they "are part of the routine accomplishment of work tasks and everyday life" (125).

[9] This is reminiscent of Dervin's view of "reality as both chaotic and ordered, the human as habitual and ever-changing and seeing structures as simultaneously static-seeming and continually constructed. Sense-Making embraces dichotomy and refuses to take sides" (Dervin 2003). The uncanny parallels between some of the ideas of de Certeau and Dervin must be saved for a future paper…

In its interest in activities that are continual, habitualized, or routine, the information practice approach is better suited for investigations of the everyday than the information behavior approach with its focus on problem situations and "practical information seeking."[10]

Infrastructure as unifying concept

I keep returning to the idea of infrastructure to explain my view of how PIM and the everyday are so tightly interlinked. It is not a perfect analogy, but it has been useful for organizing my thinking thus far. {Star 1999 #42773}outlines the properties of infrastructure. Below I will use Star's properties to briefly discuss points of similarity between these topics.[11]

- Infrastructure is embedded into and inside of other structures, social arrangements, and technologies.
    - Everyday life is embedded in the social contexts in which we live. It allows us to do our business, and in the process of doing our business, we construct it.
    - PIM is not typically done for its own sake, but as a part of or support to other tasks. The use of technologies creates a need for PIM practice, and we use technologies to do PIM.
- Infrastructure is transparent, in that is invisibly supports tasks without having to be thought about or reinvented each time it is needed.
    - Everyday life is typically invisible and taken for granted.
    - Once we have PIM habits, we often don't have to think about them any more. The organization of information has in general been construed as hidden work (Neumann 1999b).
- Infrastructure has spatial and/or temporal reach and scope; it does not exist in one-time events.
    - Everyday life is embodied and takes place in time and space. It is made of those events and actions that are repeated.
    - PIM is concerned with objects that exist in space and we use space to organize things. PIM is an activity concerned with and influenced by time. We need reminding or refinding in the future. We need to find things from the past. Time is a common attribute for organizing information. PIM is not done once and finished.
- Infrastructure is learned as a part of membership in a community of practice and is taken for granted. It both shapes and is shaped by conventions of a community of practice.
    - This is part of many definitions of everyday life.
    - As PIM is typically done by an individual for himself, this does not clearly apply. On the other hand, it is reasonable to think one's use of PIM tools or ways of organizing might be at least in part affected by one's social contacts

[10] I use this phrase in the spirit of (Savolainen 1995).

[11] Star notes that whether or not something is infrastructure is relative. For me, electricity is infrastructural, but for an engineer employed at the power company, it is the focus of work. The incredibly "meta" task of discussing the topic of infrastructure itself as a topic is slightly amusing.

- In order to support work in the background, infrastructure connects to other components of infrastructure in standard ways.
    - My everyday life requires infrastructural components such as a shared language, electricity, transportation systems, food supply system, etc.
    - PIM practices are dependent on other components of infrastructure like standard file formats, communication and file transfer protocols, and standard paper sizes.
- Infrastructure is always evolving in the inertia of the existing installed base with its strengths and limitations.
    - We cannot escape our histories. Our current worldview influences what ideas and experiences we accept and reject, controlling our ability to change understanding of everyday life all at once. New points of view or understandings do not necessarily erase old ones.
    - Our decisions on the adoption of new PIM practices and tools are influenced by current practices and tools as well as by the state and size of our overall collection of information organized using current and older tools. Whether we can migrate all of our data, metadata, and information structures without losing anything affects what new strategies we will try.
- Infrastructure becomes visible when it breaks.
    - Everyday life is generally invisible and taken for granted. When everyday life is interrupted or challenged we note its absence.
    - We don't pay much attention to our PIM practices until we can't find something, they become too cumbersome, we need to move our stuff to a new computers, or another aberrant or problematic situation occurs.
- Finally, no one is in charge of infrastructure, changing it from above. It is created in modular increments through routine practice in local spaces.
    - This is part of many definitions of everyday life. Highmore (2004, 316) writes of "the impossibility of finding an origin to routine: the way routine and habit creep up on you, the way you can never locate the moment when an activity became routine."
    - Rarely is a grand, all encompassing PIM design hatched and implemented in an orderly fashion[12]

Our understanding of everyday life can thus be described as infrastructure supporting our living of life. Things that are infrastructural in a context are by their natures part of everyday life in that context. PIM is an infrastructural activity supporting our functioning in an information rich and information demanding world. Thus PIM is an everyday life activity. This is true regardless of whether it is done at home or at work. For this reason, it is appropriate to characterize and approach PIM as an information practice.

[12] Jones (2008a) does mention a few people who go to great lengths to unify all of their personal information, but this happens as a response to the fragmentation of existing practices, or the threat of such.

WHY IS THIS TOPIC IMPORTANT?

My position is that as an everyday, infrastructural information practice, PIM is of central interest to LIS.[13] There are two main reasons for this. First, libraries of all types have in the past decade begun to experience difficulty convincing the public and relevant stakeholders that they provide unique and valuable services. When the general perception is that any information worth having can be found on the Internet, of what use is the library? Miksa (2007) claims that changes in the information environment shifting the location of library use from public space to private space are challenging the most basic aspects of the library. He calls for LIS education to ensure the survival of librarianship by beginning to accommodate a very different view of the library as:

> a personal (i.e., limited and highly controlled) function of individual or small group needs. This will involve altogether new concepts oriented around the selection, acquisition, and organization of information and provision for services for specific end-users--for example, end-user selection, end-user catalogs, and end-user classification--rather than in terms of large conglomerations of users (Miksa 2007, 18).

This vision of the librarian of the future is a person who is informed enough about different kinds of information, the information needs of individuals, and technology to create efficient personal systems for information access and organization for people or for small groups, or, in other words, a private PIM specialist.

This is a radical example, but in truth there has been a shift in libraries toward providing more visible information services (Fourie 2004).[14] Helping people and groups manage their information is not an entirely new role for libraries. Over the years, some academic libraries have identified PIM as an area of instruction, offering workshops or seminars on the topic that met with success (Wanat 1985; Dow 1987; Fiscella and Sack 1994). Partridge and Genoni (1996) identified a gap in the education of researchers regarding strategies for managing personal research information, a specialized form of PIM for those engaged in research (Genoni and Partridge 2000) and provided training.

More recently there has been a shift from reporting upon instruction programs about PIM to calling for a shift in the understanding of the role of the library and librarians which includes PIM services (Newton-Smith 2000; Savenije and Grygierczyk 2001). Sullivan (2004) makes the case for the role of academic librarians in assisting university researchers in the use of information support tools to more effectively handle the increasing flow of information. Citing the heavy use and prevalence of personal information collections among scholars, McGeachin claims that librarians should conduct research on how such collections are managed and makes a strong case for the library role in helping:

[13] PIM seems to have been more openly embraced as a research area outside of LIS, mainly by computer science and human computer interaction.

[14] Selection, collection, and organization of information are perennial library services, but they happen behind the scenes, and are therefore invisible, leading to the age old question, "Why do you need a master's degree to check out books to people?!"

> Librarians can be knowledgeable in the use of bibliographic citation management and personal information management applications and offer instruction to customers in one-on-one consultations, group classes, and by Web-based tutorials. Since the acquisition, classification, storage, and retrieval of information are at the heart of library science, librarians are a very appropriate group to advise scholars on how to manage their personal information collections (McGeachin 2004, 135).

This trend is not only happening in academic libraries. The public library's role is seen as shifting from "solely providing access to knowledge to acting as a platform for the storage and dissemination of local community knowledge within the global context created by twenty-first century digital technologies (Chowdhury, Poulter, and McMenemy 2006, 454). The need for providing some method or guidance for the organization of this local community knowledge is implied.

Second, in recent years there has been an overall increase in interest in and the importance of ordinary people and everyday life. This has been seen in LIS and other academic disciplines such as history, sociology, and cultural studies. The value of personal information collections for Institutions such as libraries and archives show greater interest in the fate of the personal collections of ordinary people, previously valued mainly for their creators' personal and family use (Beagrie 2005).

The "twenty-first century digital technologies" mentioned above have driven an explosion of digital content creation. People's personal collections now exist in multiple locations in multiple formats. The PIM implications of this will be discussed in the section on PIM fragmentation. The realization that digital information is both essential and fragile, requiring the active care and management of data to facilitate its current use and ensure future accessibility, resulted in the identification of digital curation as a necessary activity for long term stewardship of digital information (Rusbridge et al. 2005). While digital curation activity has been primarily focused on scientific data and digital libraries, Beagrie (2006) explores the need for this sort of care and management for personal collections. While digital curation of personal information is not synonymous with PIM, it seems reasonable to expect that effective PIM practices will simplify the tasks involved in digital curation (Paradigm 2008, sec. 3). However, as Marshall's (Marshall 2007) exploratory research shows, the long-term management of personal information is a highly problematic area. Helping people learn to manage their personal information for the long term may be a useful service, not only for library users, but for librarians, digital curators, and archivists interested in preserving such materials in their collections.

EVERYDAY INFORMATION ORGANIZATION PRACTICE IN AN EVERYDAY PURSUIT

I have now situated my proposed study of the everyday PIM information organization practices of amateur art photographers squarely within the LIS discipline and literature. I have explained why studies of personal information organization practices are highly relevant to the concerns of LIS. To provide further background for the proposed study, the remainder of this review primarily examines, from a few perspectives, the various ways people organize information. This includes the purely cognitive organization of knowledge or concepts, as well as the personal information management of many forms of information including photographs. I also examine to a lesser extent information organization behavior in organizations--this is of great interest to researchers in computer supported cooperative work--and in institutions like libraries that exist to gather, organize, and provide information to some population.

First, however, it is necessary to identify and describe the population I intend to study: amateur art photographers. For this purpose, I use the SLP. These are people who have committed to bringing the practice of art photography into their everyday lives as a serious, though non-professional pursuit. As I will demonstrate below, amateur art photographers are a distinct group of amateur photographers; to my knowledge their information practices have been studied.

The Serious Leisure Perspective

Since Jenna Hartel introduced Robert Stebbins' Serious Leisure Perspective in her work on hobbyist cooks (Hartel 2003), there has been a small but growing number of researchers in LIS using the Perspective to situate groups of people and their activities. These will be discussed after a review of the Perspective.

The simplest definition of the Serious Leisure perspective is that it is a theoretic typology of the whole of leisure. In development since 1982, it is rooted in theory derived from data gathered from nearly 30 years of sociological research into specific leisure populations. The Perspective provides a structure for identifying any activity as a specific type of leisure, related to other activities and types of leisure in various ways. Situating studies of diverse groups within a common framework, will, over time provide for the accretion of knowledge that is currently lacking in ELIS research.

Using the Serious Leisure Perspective as a lens through which to look at digital photography and its practitioners also provides a way to distinguish between different types of digital photographers, identify which types are of interest in the proposed research, and possibly compare the information practices of different types of photographers in the proposed research or follow-up work. It will also allow for the findings of the proposed research to be compared to other studies on different activities that happen to be the same type of leisure as digital photography.

Finally, though the importance of studying information practices outside the work context is no longer a debated point, the Serious Leisure Perspective has identified many important personal and social functions or participation in certain types of leisure. Urban (2007, p. 39) recently observed that "serious leisure participants look very much like the lifelong learners identified by the Institute of Museum and Library Services (IMLS) and other funding agencies as communities of interest." This observation was also explored in some depth by Jones and Symon (Jones and Symon 2001). To any who may still think of everyday and leisure to be frivolous pursuits, the potential fundability of this research may lend a greater sense of import to the topic.

An overview of the Perspective

The Serious Leisure Perspective breaks all of leisure down into three main types: serious leisure, casual leisure, and project-based leisure. Before the Perspective is explained, it should be noted that within it activities are categorized or given as examples of different types of leisure, but what the categories are truly describing is a particular mode of engaging in that activity. For example, we can say that watching movies is a casual leisure activity. Watching movies is indeed typically a casual leisure pursuit, but it can be categorized as another form of leisure given a different context or approach to the activity. Systematically becoming an expert on Japanese film by watching and studying the movies over years of one's life would constitute a serious leisure pursuit, while watching a few French films set in Paris to get oneself in the right frame of mind for an upcoming Parisian vacation might be closer to project-based leisure. Not all activities can cross these leisure type boundaries, but many can, including digital photography. The ways in which it crosses boundaries will be discussed after a general introduction and description of the Perspective.

WHAT IS LEISURE?

Before delving into the Serious Leisure Perspective's typology of leisure, it is first necessary to understand what is included in leisure sphere. Attempts to define leisure have primarily been experientially grounded. They are based on how people perceive their own uses of time and activities. Three factors have dominated in the research on what is perceived as leisure. They are: work relatedness, freedom, and motivation. That which is most clearly leisure has been defined as low in work relation, high in freedom, and intrinsically motivated (Iso-Ahola 1979). These factors are not without their critics, and a simpler kind of definition has emerged.

Low work relation as a defining characteristic of leisure is problematic because some leisure activities are work related. One reason is that leisure activity is sometimes undertaken with colleagues, or is made available through the workplace.[15] Another is that some people who truly enjoy their work and/or the types of activities involved in it may choose leisure activities similar to their work. In tracing the history of hobbies in America, Gelber (1999) argues in Chapter 1 that certain leisure activities have been popular and encouraged in America because they are often work-like in their activities, have value that mirrors those of the workplace, and do not conflict with the Protestant work ethic. He also discusses the post-World War II surge in hobbyist attempts at turning their leisure activities into paying occupations.

The issue of remuneration is somewhat related to work relation as a determiner of leisure. Gelber (1999) and Stebbins (2007, p.6) both note that it is common for people make money in the pursuit of their leisure activities. In this case, the reason these activities remain in the sphere of leisure is that people are not dependent on the activities to make a living, and their motivation for taking part in an activity is not to make money. In summary, the earning of money in the pursuit of a leisure activity does not disqualify that activity as leisure. If a person would engage in the activity in the absence of any earnings, and if they do not rely on the earnings as a source of their living, the activity is still leisure.

[15] See cases like the office giving employees tickets to a sporting event, or the once ubiquitous arcade games and ping pong tables in Internet boom startups. Also, consider the last line in the "Requirements" section of each of the current software engineer job openings at an Internet startup company in Seattle: Ping pong, Paintball or Barbequing experience a definite plus (LiveMocha 2007).

Freedom as a defining characteristic of leisure refers to how freely a leisure activity is chosen by an individual. If a person has no choice in whether to participate in an activity, that activity is unlikely to be experienced as leisure. Stebbins (2002) summarizes a shift away from free choice as a characteristic of leisure. There is a growing recognition that everyone is constrained by societal and cultural expectations, laws, availability of funds or the lack thereof, education, and individual abilities. People choose leisure activities out of the options that the above factors make available to them, but this is not truly free choice.

What remains is motivation. Leisure is seen as intrinsically motivated, i.e., it is pursued out of a personal desire or drive, not because of external demand or expectation. This idea is the linchpin of Stebbins' most current definition of leisure as it is approached in the Serious Leisure Perspective:

> …uncoerced activity engaged in during free time, which people want to do and, in either a satisfying or a fulfilling way (or both), use their abilities and resources to succeed at this. "Free time" is time away from unpleasant obligation, with pleasant obligation being treated here as essentially leisure since *homo otiosus*, leisure man, feels no significant coercion to enact the activity in question (2007, p. 4).

So, leisure is one way a person can choose to spend free time. Leisure of any type may entail obligations, but these must be pleasant obligations. In casual leisure, a viewer is obligated to make it to the theater at a certain time to watch a movie. In serious leisure, a musician may be obligated to attend practice, but this is seen as an enjoyable opportunity to engage in the leisure activity instead of as an unpleasant obligation. At base, leisure remains a highly subjective construct. As Stebbins (1982, p. 254) wrote at the birth of the Serious Leisure Perspective: "leisure is activity defined as such by people engaging in it."

SERIOUS LEISURE

The first of the types of leisure to be examined in the development of the Serious Leisure Perspective was serious leisure. The concept was developed in response to a problem in leisure and leisure studies. Stebbins (1980) summarized research indicating that a majority of leisure time was spent in leisure activities returning the evanescent benefits of hedonistic gratification. He noted that there were other types of leisure with more durable benefits. Durable benefits are defined as the outcomes of such activities. The eight types of durable benefits available from leisure have been identified as: (1) self-actualization; (2) self-enrichment; (3) self-expression; (4) regeneration or renewal of self; (5) feelings of accomplishment; (6) enhancement of self-image; (7) social interaction and belongingness; and (8) lasting physical products of the activity (Stebbins 2007). In 1980, leisure activities with durable benefits were understudied; Stebbins highlighted the need to develop concepts and a vocabulary for discussion these activities so that research on them could proceed.

Earlier, Stebbins (1977) developed initial sociological definitions of the amateur, referring to all forms of amateur pursuits as semileisure. These pursuits, done outside of the work context, nonetheless had some work-like characteristics. Such activities did not fit comfortably with the general concept of leisure as the least determined of an person's time. This explained the lack or research on these activities. However, these work-like characteristics were seen as why these activities held durable benefits for their participants. This is not as illogical or contradictory as it may at first seem. Paradoxically, highly enjoyable flow states have been found to occur more than three times as often in work than in leisure, yet people wish to be at leisure when they are at work (Csikszentmihalyi and LeFevre 1989).

In 1982 Stebbins introduced the concept of serious leisure to describe these types of leisure having durable benefits. The new serious leisure concept incorporated his earlier conceptual work on amateurs and hobbyists (Stebbins 1980) and added career volunteering to the framework. These are the three types of serious leisure. Six qualities distinguish serious leisure from other forms of leisure. First, serious leisure is characterized by people having leisure careers in their chosen pursuits. A leisure career spans is a long-term endeavor, possessing an arc of increasing skill, knowledge, and/or experience over time. The acquisition and use of skill, knowledge, and/or experience over time can at times be challenging. It requires significant personal effort (the second quality) and perseverance when things do not go well, are frustrating, or are generally unpleasant (the third). A fourth quality is the social world (Unruh 1980) and unique ethos that forms around each instance of serious leisure. Fifth, due to the nature of the other five qualities people involved in serious leisure pursuits tend to strongly identify with those pursuits. Finally, in addition to the combination of enjoyment and fulfillment found in other forms of leisure, serious leisure results in the eight durable benefits listed above. (Stebbins 2007, p.11-13).

Durable benefits are the outcomes of involvement in a leisure pursuit, but a fine distinction is made between these beneficial outcomes of the activity and the rewards that motivate people to engage in the activity. Some durable benefits are also rewards. These include personal enrichment, self-actualization, self-expression, self-image, and regeneration of oneself after work. Some rewards are social (associating with other participants and being part of a social world, a sense of accomplishing something together, and a sense of being needed and contributing to a group); however, most of the rewards of serious leisure are personal. In addition to the rewards that are also durable benefits, personal rewards include self-gratification (pleasure) and financial return.

Such rewards offset the costs of serious leisure. Stebbins (2007, p. 14-15) reports that each serious leisure pursuit he has studied has had its own specific constellation of costs or negative aspects, but that participants report that any costs are heavily outweighed by the rewards that the activity brings. One general cost of serious leisure is time. To be serious about a pursuit requires a substantial time commitment, which means taking time away from other activities and responsibilities including work and maintaining relationships with others. Stebbins reports on participants whose prioritization of their chosen pursuit precipitated talk of divorce (1992, p. 108-111). Another general (and literal) cost of serious leisure is money. As a leisure career progresses, a devotee often consistently wants to upgrade any relevant equipment, acquire more specific equipment, amass more information[16], and/or get more training. Enjoyment of a serious leisure activity and the pursuit of its rewards may at times create a sense of uncontrollability around the activity and how much time and/or money is allotted to it. When a serious leisure pursuit becomes uncontrollable, all costs increase, but the rewards are still high enough to continue to drive the participant to continue. A social cost, exacerbated by the above personal costs, can be the social marginalization of the devotee outside the social world of his pursuit (2007, p. 17).

[16] One survey found that amateur scientists are far more likely to gain access to books and magazines by purchasing them than by getting them from a library (Dolence and Gilmour 2006).

The terminology used to describe serious leisure in the sociology of leisure is by necessity precise and technical. A focus on the existence of the costs of serious leisure and perseverance through difficulties is necessary in describing serious leisure because these differentiate it from other forms of leisure. In all of the seriousness it is easy to lose track of the notion of leisure as something that is generally pleasurable. Studies of serious leisure stress that, "…the adjective serious is distinguished from humourless, and offered without any sense of moral judgement" (Crouch 1993, p. 19). Stebbins sums it up best:

> …the senses to be stressed of the adjective "serious" are earnestness, sincerity, importance, and carefulness, rather than gravity, solemnity, joylessness, distress, and anxiety. Though items in the second list occasionally describe serious leisure events, they are not characteristic of them, and they fail to nullify or, in many cases, even dilute the overall pleasure participants gain from them (Stebbins 1982, p. 258).

TYPES OF SERIOUS LEISURE

As mentioned above, the three types of serious leisure are volunteering, pursuit of hobbies, and amateurism. These three types are clearly described with many examples of how different activities fall into the types in (Stebbins 1998), while current research on the three is synthesized in (Stebbins 2007). Basic descriptions of the three types follow below to enable discussion of digital photography as a serious leisure pursuit.

VOLUNTEERING

Stebbins defines volunteering as:

> Uncoerced help offered either formally or informally with no, or at most, token pay and done for the benefit of both other people (beyond the volunteer's family) and the volunteer (Stebbins 2007, p. 9).

Among the serious leisure types, it is only in volunteering that self-interest that characterizes serious leisure is joined by altruism as a motivation, though the dynamic between the two motivations is not yet understood. Another way volunteering is different from the other types is that the activities of the volunteer are directed by another--an employee in charge of managing volunteers, or another volunteer with more experience. Amateurism and hobbies are self-directed. Volunteering can be done as casual leisure, for instance passing out flyers at an event. It can also be done as project-based leisure. One example is going on a trip to help build houses for the poor. But as a serious leisure pursuit, volunteering is undertaken as a career over time. Career volunteering entails acquiring certain skills, knowledge, and/or training requiring time and effort (Stebbins 1992). (Stebbins 1998) presents a description of 17 different types of serious leisure volunteering (p. 72-80). While digital photography may be undertaken in the course of a volunteer activity--for instance, documenting the construction of a house on a volunteer trip--it is not entered into by itself on a volunteer basis. Therefore, we will leave the topic of volunteering behind and discuss the other types of serious leisure.

AMATEURISM

The distinctive quality of amateurs is that they are engaged in activities that other people do professionally as an occupation. Setting up the definition of the amateur as requiring a professional counterpart means that we have to be able to define who the professionals are. In early work on conceptualizing amateurism, Stebbins argued for a complex macrosociological definition of the professional based on type of service or product provided, authority, cultural tradition, standards, a sense of identity with colleagues, and training or certification requirements for admission to the profession (Stebbins 1977). However, he has recently stated that the intricacies of sociologically defining professionalism should be left to the sociology of work instead of the sociology of leisure; in the Serious Leisure Perspective, professionals are to now be defined as "someone who is dependent on the income from an activity that other people pursue with little or no remuneration as leisure" (Stebbins 2007, p. 6). This has implications for the placement of activities within the Perspective because as many activities move toward professionalization, people begin making a living off of them long before they develop the hallmarks of the macrosociological definition of professional.

From the beginning, amateurs have been defined as playing a part in a Professional-Amateur-Public (P-A-P) dynamic. Both amateurs and professionals serve publics, sometimes the same publics. Amateurs are also part of the public of the professionals. Indeed, because they seriously developing their knowledge and skills toward the goal of professional-level standards and insist on excellence, they become a critical part of the professional's public. Amateurs are also able to move fields forward intellectually in ways that professionals cannot (Stebbins 1982). Haley (Haley 1976) discussed amateurs in a broader sense than that of the Serious Leisure Perspective, but one suggestion remains in line with this claim of the P-A-P: amateurs are allowed to guess, and professionals are expected to prove the amateurs wrong, if indeed the amateurs are wrong. Professionals who guess, however, are in trouble. Yoder's (1997) study of the amateur activity of bass fishing introduced another actor, and potentially complicating factor, into the P-A-P: the commodity agent. Commodity agents are "groups and individuals involved in the production, facilitation, and exchange of activity related commodities" (p. 415). Some serious leisure activities are more commodified than others; in these there is at least the perception that a great deal of specialized equipment is required. The role of commodity agent in some activities may be filled by both amateurs and professionals (see the amateur who makes equipment to sell to other amateurs, and the professional whose image and/or expertise is used to market products to amateurs). This finding introduces another layer into the P-A-P dynamic (Stebbins 2007, p. 7).

In contrast with general parlance, the term "amateur" does not indicate shabby or unprofessional work in the Serious Leisure Perspective. The opposite is true. Amateurs know enough to require excellence from professionals because they themselves are striving for professional levels of excellence at their chosen activity. As activities become professionalized and one can make a living at them, levels of standards and expectations begin to rise. In such a case, a practitioner of such activity can decide to take on the activity as a full time profession. Participants who do not become professionalized will not be able to do the activity full time. They may get discouraged by the difficulty of keeping up with rising standards in their limited leisure time, either becoming dabblers or ceasing the activity. Or, they may find a fulfilling and (mostly) pleasurable experience in challenging themselves to meet high standards as part of an amateur leisure career.

HOBBIES

Hobbies are much like amateur pursuits in that they involve a leisure career with all the difficulties and rewards that entails. They require commitment and perseverance and provide durable benefits to participants. Hobbyists find publics in their family, friends, and other hobbyists. The main difference is that hobby pursuits have no professional counterpart. Though in some cases there may be commercial equivalents to hobby activities, these hobbies do not constitute a work role for other individuals (Stebbins 1980). This is why participation in some sports (e.g. mountain climbing (Stebbins 2005a) or long-distance running(Yair 1990)) is categorized as a hobby, whereas serious participation in other sports with professional leagues (e.g. tournament bass fishing (Yoder 1997) or basketball) are considered amateur pursuits.

Collecting is probably the most common form of hobby, and is the most studied (see (Olmsted 1991) for a review of research and (Gelber 1999) for a history of hobbies in America centered on collecting as the most common type of hobby). Serious collectors gain deep knowledge of the history, context, manufacture, and properties of the collected items. They are not be confused with casual accumulators who may have collections of items, but have not engaged in learning about the collected objects, or obsessive hoarders (Olmsted 1991). Other types of hobbies include makers and tinkerers, activity participants, players of sports and games, and liberal arts hobbies. This last group is of particular interest in LIS because it indicates the existence of hobbies defined by their "search for broad knowledge of an area of human life and the search for this knowledge for its own sake" (Stebbins 1994, p. 175). Essentially these hobbies are based on information seeking and synthesis.

PROJECT-BASED LEISURE

Project based leisure is defined as:

> …a short-term, moderately complicated, either one-shot or occasional, though infrequent, creative undertaking carried out in free time. It requires considerable planning, effort, and sometimes skill or knowledge, but for all that is neither serious leisure nor intended to develop into such (Stebbins 2005b, p. 2).

In effort and skill involved, project-based leisure can be similar to serious leisure. Also, they types of activities undertaken in projects are often pursued by others as serious leisure. The main difference is that projects do not require long-term commitment and so do not constitute a leisure career. For people who have no time or inclination to begin a serious leisure career, project-based leisure pursuits can provide a sense of fulfillment not gained from purely casual leisure. Because of the relatively short duration of a project, a real social world does not spring up around it. However, project-based leisure can build community by bringing people together with a common goal and carrying off community events and projects. Some examples of project-based leisure include a genealogical project,[17] volunteering for a sporting event, planning a party, and making preparations for a holiday. As is suggested in these examples, project-based leisure is often motivated by an event. Stebbins identifies two types of project-based leisure: one-shot and occasional.

[17] Yakel (Yakel 2004), however, notes that genealogy and family history do not have clear end goals. There is always more information that can be searched for and integrated into the larger narrative of a family.

CASUAL LEISURE

Casual leisure is defined as "immediately, intrinsically rewarding, relatively short-lived pleasurable activity requiring little or no special training to enjoy it" (Stebbins 1997, p. 18). It includes play, relaxation, passive entertainment, active entertainment, sociable conversation, sensory stimulation, casual volunteering, and pleasurable aerobic activity (Stebbins 2007, p. 39). Though it does not offer the durable benefits of a leisure career, casual leisure is not denigrated in the Serious Leisure Perspective and is required for an "optimal leisure lifestyle," defined as:

> …the deeply satisfying pursuit during free time of one or more substantial, absorbing forms of serious leisure, complemented by a judicious amount of casual leisure (Stebbins 2007, p. 42).

Like serious leisure, casual leisure comes with a set of costs and lasting benefits. These benefits include the sparking of creativity and discovery, learning through edutainment or infotainment, re-generation or re-creation of self outside of work time, the development and maintenance of interpersonal relationships, and a sense of well-being and quality of life. Costs vary by activity but in general include boredom due to lack of challenge, absence of a distinctive leisure identity, and limited contribution to self and community (Stebbins 2001).

Reviewing the Serious Leisure Perspective

At its base, the Serious Leisure Perspective is a classification scheme. Life and human activity are messy, tending to resist classification. For this reason, there are some basic problems with the Perspective, which I will discuss below. However, this is not to say that the Perspective will not be useful for the proposed research and future LIS research on information practices in everyday leisure.

PROBLEMS

The value of the concepts of serious, casual, and project-based leisure is clear for communicating about approaches to leisure activities, but the clarity and usefulness of the Perspective seems to break down at the closer levels of classification. In particular, the distinction between amateur and hobbyist is problematic. Stebbins places photography in the amateur category because professional photographers exist (Stebbins 1998). On the surface, this seems clear enough, but I will tease out how complicated the real situation is below.

Hartel (1994) studied information practices and spaces in gourmet cooking, which is classed in the Serious Leisure Perspective as a hobby (Stebbins 1998)[18]. Serious leisure gourmet cooks clearly have professional counterparts, including actors who are also commodity agents. Chef Emeril Lagasse's empire of fine dining establishments, television shows, kitchen equipment, and foods is just one example. Professional chefs create cookbooks, television shows, and websites that amateur gourmet chefs consume. The institutions that train people for entrance into the culinary profession are open to people who do not intend to become chefs or cooks. The gourmet techniques that hobbyist gourmet chefs work to acquire are pioneered and practiced by professional cooks--they set the standards. Amateur gourmet chefs sometimes eat at gourmet restaurants where the food is prepared by professional chefs and cooks. If the crème brulée is not up to snuff, they will notice. In her study, Hartel explicitly differentiates the hobby of gourmet cook from the professional catering or culinary arts.

Raising and breeding animals and gardening are also classed as hobbies in the Serious Leisure Perspective. Professional gardeners are employed in the private sector and by institutions. There are also professional landscapers and garden designers. As for raising and breeding animals, breeding racehorses is big business. In American Kennel Club activities and competitions, both amateurs and professionals are present and striving to meet professional standards (Baldwin and Norris 1999).

What this means for the theoretic relationship between amateurs, professionals, and hobbyists has not been sufficiently addressed and Stebbins admits this leaves the relationship in "conceptual limbo"(Stebbins 2007, p. 26).

One explanation may be that prior to the Perspective's shift in definition from sociological to economic, those employed in these activities did not meet the complex criteria of the professional category. Stebbins also allows for the fact that activities become professionalized over time and may move from hobby to amateur pursuit. However, the classifications reported here were published in 1998 and cooking, gardening, and breeding animals have been done professionally since long before then. Also, in particular, the professional culinary arts seem to fully meet the sociological definition of professional presented in earlier work on the Perspective (Stebbins 1992). That the Perspective does not explain why these activities should be hobbies instead of amateur pursuits shows that lines between the two categories have not been drawn clearly enough. The theoretic relationship between amateurs, professionals, and hobbyists has not been sufficiently addressed and Stebbins admits this leaves the relationship in "conceptual limbo"(Stebbins 2007, p. 26).

A slightly different issue is raised by the fact that people have the ingenuity and creativity to turn almost anything into a career. Robert J. Lang is a former physicist who folds origami full-time. He has also designed folding mechanisms for use in designing heart implants and rockets (Orlean 2007). Yet origami is a paper craft, so it is classed as a hobby in the Serious Leisure Perspective. This issue is perhaps quibbling, for as Stebbins points out:

[18] There is one varying characterization in an earlier paper: "Likewise, amateur cooks are continually adding to the technical knowledge they need to prepare their meals well" (Stebbins 1994, p. 175).

> …enactment of the core activity by the professionals in a particular field, to influence amateurs there, must be sufficiently visible to those amateurs. If the amateurs, in general, have no idea of the prowess of their professional counterparts, the latter become irrelevant as role models, and the leisure side of the activity remains at a hobbyist level (Stebbins 2007, p. 6)

My friend who does origami with his son on the weekends is not likely aware of Robert J. Lang or the high-level standards of the serious competitions addressed in the above-cited article. In fact, my friend pursues origami as a *casual* leisure pursuit, not a hobby. He does not do keep up with research on new designs or collect different types of paper. He is not committed to improvement; it is a fun way to pass time with his son. Lang's approach to origami is not leisure at all, but his work.

This underscores the caveat I made at the beginning of my discussion of the Serious Leisure Perspective. It should be thought of as a classification of *approaches* to an activity, not as a taxonomy of activities. However, in Stebbins' own work and that of other researchers using the Perspective this distinction is not typically made--it is generally the activities that are presented as being categorized. Jones (Jones 2006) suggests a shift from defining serious leisure in terms of specific activities defined as amateur, hobbyist, or volunteer to a definition based on social identity. Defining serious leisure as "any leisure activity that is able to provide the participant with a valued social identity" foregrounds the fact that any leisure activity can be approached with various levels of seriousness.

Finally, like any classification scheme, the Serious Leisure Perspective has some issues of bias. Parker (2006) claims that serious leisure is a middle-class phenomenon. Serious leisure is also a very Western, capitalist perspective (Gelber 1999). Very little is known about the existence of serious leisure in other cultures and studying leisure outside our own culture requires different approaches (Stebbins 2005c). Serious leisure may also be a more predominantly male phenomenon (Raisborough 1999). Raisborough (Raisborough 2006; Raisborough 2007) suggests that the demands of participation in serious leisure require women, but not men, to distance themselves from normative gender expectations. The self-interest required of a successful serious leisure career is typically frowned upon in women, who are expected to be caretakers of others. These and other studies indicate gendered work roles and gender stereotypes extend into serious leisure, especially in volunteer pursuits (Bartram 2001; Rotolo and Wilson 2007).

Lawrence (Lawrence 2006) calls attention to the ghettoization of some kinds of leisure activities into the categories tolerable and intolerable deviant serious leisure. Particularly problematic is the categorization of religious beliefs non-dominant in Western culture as leisure. Judeo-Christian religious practice is not included in the SLP, yet in 2007 (66), Stebbins uncritically cites a very dated article on the occult revival as popular culture (Truzzi 1972) to support his categorization of deviant belief systems. Here, witchcraft and Satanism are combined into witchcraft-Satanism, though many practitioners of modern witchcraft consider their practice to be religious[19] and do not include Satan in their cosmology (Adler 1997). "Eastern religious thought," which qualifies as a dominant in a global culture, is also included as a deviant belief system.[20].

[19] As does the US Military (U.S. Department of the Army 2001).

[20] For comparison, the other categories in Truzzi's paper are astrology; parapsychology and extrasensory perception; and a "waste-basket" category containing such things as Nostradamus, sea serpents, snowmen, werewolves, vampires, and unidentified flying objects.

USEFULNESS

The concepts of serious, casual, and project-based leisure introduced in the Perspective provide a useful framework for thinking about leisure activities and different approaches to them when designing studies, selecting participants, and reporting the work. Attention to this would allow studies of information practices in specific leisure activities to be compared and contrasted in meaningful ways, addressing in part some of the criticism that research of this nature tends to accrete rather than build upon itself. For instance in (Miller and Edwards 2007), the researchers discover in the course of the study that they have stumbled across two distinct groups of Flickr users with widely varying practices. They name the groups Snaprs and Kodak Culture participants. In the context of the Serious Leisure Perspective, this is not surprising and there are names for these two groups, respectively: serious amateur and casual photographers. Not using a shared framework for describing different approaches to leisure activities leads to confusion and inability to compare findings. For example, can we compare Snaprs to the serious amateur photographers using Flickr presented in (Cox, Clough, and Marlow 2008)? It seems likely, but is unclear because of differences in the way participants were chosen and described.

The names for the categories serious, casual, and project-based leisure were derived by Stebbins from his conversations with leisure participants about their pursuits. Though most people do not go through life categorizing their leisure pursuits, Stebbins found that his participants recognized casual leisure, contrasting it with what they did as "serious" leisure (Stebbins 2007, p. 121). Asking people to characterize their leisure is what the Perspective is based on. This approach has been used by other researchers as well. Lawrence (2006, p. 80) asked Star Trek fans whether their fandom was leisure or not. If they considered it leisure, they were asked to class their fandom as non-serious, casual leisure or serious leisure. The newly developed Serious Leisure Inventory Measure (SLIM) (Gould et al. 2008) could be a useful tool for measuring the seriousness with which participants pursue the activity of interest. The SLIM is a survey instrument based upon the six qualities of serious leisure identified by Stebbins and confirmed in many studies using the Perspective. The SLIM operationalizes these qualities and attempts to quantify the concept of serious leisure. The measure has just been introduced and use in various leisure populations is needed to determine its validity across the leisure spectrum; however the beginning of the development of measures is one indication of the maturity of the Serious Leisure Perspective.

Hartel (1994, p. 26-31) analyzes the treatment and coverage in the leisure literature of information phenomena in hobbies. She finds that there is no consistent or rigorous approach to information in the studies she examined. Information activities are largely reported only to illustrate other aspects of the hobby, though there is enough coverage to indicate that rich information phenomena take place in hobbies. Multiple information sources are consulted, including people. Some hobbies generate their own literature and genres.[21] Finally the liberal arts hobbies identified by Stebbins are based upon the acquisition of information and learning (Shields 1994). This indicates a gap in knowledge about leisure domains that LIS research is in a unique position to fill.

[21] Excellent examples of this sort of leisure activity researched primarily in education and literacies research, are role-playing games and fan fiction (Kustritz 2003; Thomas 2007).

Digital photography as serious leisure

My interest in the proposed research and in this review is people who do photography using a digital camera. While digital photos may be printed, they exist first as digital files which must be managed in some way. Little is known about how individuals interested in photography as a serious leisure pursuit manage their digital photos, especially in the context of long term plans. For this reason I formally specify "digital photography" as the topic. This does not, however, indicate a lack of interest in other types of photography a person might engage in or how they manage photographic prints or any other non-digital information associated with the activity. Where these exist, they will be taken into account as part of the photography-related personal information collection.

First, it is not my intention to present a history of photography, but several historical facets come to bear on teasing out how photography fits into the framework of the Serious Leisure Perspective. My knowledge of the facts of the general history of photography has been derived from (Marien 2006), (Peres 2007), and the works of Don Slater (1991; 1995).

It is undeniable that digital photography is nudging traditional film photography into obscurity. In 2003, the sale of digital cameras surpassed the sale of film cameras in the United States (Lipkin 2005, p. 8). In 2003, the Kodak Corporation announced it would cease the production of slide projectors. This was followed in 2004 by the news that Kodak would no longer make paper for black and white photography (Marien 2006, p. 491). A report on the professional photo market in 2005 estimates that while over half of professional photographers still use film cameras for some shots, 70% of all professional photos are taken with digital cameras. The report projects that by 2010, 90% of photos will be digital and the number of photographers using film cameras will fall to 40% (InfoTrends 2006). In late 2007, the New York Times reported that for the past four years the sale of film dropped at a rate of 25 to 30 percent each year (Hafner 2007).

Opinions differ on what the rise of digital photography means for photography. Some make a clear distinction between photography and digital photography, insisting that digital photography is not actually photography, but a form of imaging. Ostrow (Ostrow 2007, p. 187) refers to digital photography as "the photographic effect," the doppelganger of photography. Some see digital photography as a technological threat to "real" photography's continuation (Batchen 2001, p. 129). Others are less purist and more sanguine. Early on, Manovich (Manovich 2003) identified digital photography as paradoxically breaking with older modes of visual representation while simultaneously enforcing them. Marien (2006, p. 398-410) summarizes measured responses to the threat of the digital, using numerous examples of how some "new" anxieties about the possibility of manipulation and the results of over-popularizing the medium have been present throughout the history of photography. Lipkin (2005, p. 25) sees digital photography as just another of many technological developments in how images are produced, albeit a drastic one. He describes the profound changes to photography that are occurring due to the fundamental difference between traditional and digital photographs. The first involves manipulating objects, while the second involves manipulating information (2005, p. 13). This fundamentally changes each step of the image making and distribution process, but somehow digital photography seems to be a familiar process: one is still making images by capturing light.

The research that will be reported on non-professional photographers (and almost any work on photography that does not emanate from the world of art theory and criticism) does not tend to make any great distinction between digital and film photography. The focus is on the activity of making images. That the default end product is in a different form tends to influence the act of photography mainly by lowering the cost of making multiple photographs. The effects of this will be discussed in the section on how people manage their photo collections, but in brief they are a broadening of subject matter and an increase in the number of photographs taken. Though the differences in cost-per-image and affordances between formats influences behavior, most people do not attend to their theoretical, conceptual, or mechanical differences. Neither will this review or proposed research introduce a conceptual or theoretical distinction between the two. My interests in differences between digital and film photographs lies in how the format affects what people do (or don't do) with their photos.

PROFESSIONAL PHOTOGRAPHERS

Given an understanding of the Serious Leisure Perspective, it initially appears obvious that photography should be classed as an amateur activity because there are professional photographers. This is where Stebbins has categorized the activity (1998, chap. 2). This classification task becomes more complicated when one begins to take apart the activity of photography. There are at least three distinct photographic professions and at least another three modes of photography as leisure that do not match up with the three professional types. This underscores once again the importance of conceptually steering away from categorizing activities into serious leisure categories. Instead, different approaches to any leisure activity may be categorized as different types of serious leisure.

The ability to confidently identify amateur[22] art photographers rests upon a clear understanding of the amateur's professional counterpart(s). Two works helped me crystallize the relationships between the different types of leisure and professional photography. The first is Barbara Rosenblum's comparative ethnography of three main types of professional photography. In all, she was immersed in various aspects of photography as a participant-observer for about four years in the early 1970s. The result is an in-depth social-behavioral description of the three different photography worlds, and the impact of each world on its associated photographic style (Rosenblum 1978). The second is Howard Becker's *Art Worlds* (1982), which uses the example of photography to illustrate how change happens in art worlds. Both books address the definition of a professional in the arts and the social worlds that exist around various art and photographic pursuits. This research is dated, but given my personal knowledge of the different photographic professions[23], the core of each description still rings true. While particulars and technology have changed, the core values of the professions and the fact that they inhabit distinct social worlds remain the same.

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[22] A note on terminology: as will be discussed later, the term "amateur" is used loosely in the literature on art. In this review the term will refer to the Serious Leisure Perspective sense of the word unless the term appears in quotes.

[23] I considered and researched careers in photography and the fine arts as an undergraduate in an arts program. This included getting to know professional artists and photographers, working in a gallery, frequenting museum and gallery events, considering MFA programs, and reading on the subject. Obviously I ultimately decided that the fine arts were too insecure a prospect and advertising photography was too boring and tedious--the commercial studio in which I spent some time did a lot of shots for chicken-feed advertisements.

Rosenblum (Rosenblum 1978) studied three photographic professions: newspaper photography, advertising photography, and fine art photography. My interest is in the latter, so it will suffice to say the standards of newspaper photography are based in the values of journalism, while the style and content of the photos are constrained by journalistic conventions, technologies of reproduction in the newspaper, and editors. Likewise, the standards of advertising photography are based in marketing and sales. The style and content are constrained by product, client, budget, audience, and art directors.

Rosenblum admits that professional art photographers are a difficult group to define (Rosenblum 1978, p. 10). Art photography is not a typical occupational category; people do not get hired at jobs to be fine artists (1978, p. 87). Art photography is a job that people create for themselves. Rosenblum and Becker (1982, p. 93) both discuss the difficulty of earning a living (or a substantial part of a living) as a fine artist. Professional art photographers may have other jobs such as teaching, commercial photography, or jobs unrelated to art that may command more of their time than art and pay substantially more money. In such a case it may appear the art photographer is a non-professional, depending on interpretation of the economic definition of professional.

There are other qualities that are hallmarks of professionalism in art. In addition to making *some* money from their art, Rosenblum's definition of professional art photographer requires that an individual publicly take on the role of a professional photographer--acquiring the attitudes, behaviors, and vocabularies of the profession and "learning to see" like a photographer (Rosenblum 1978, p. 19). Becker also notes the need for an art professional to be fluent in the conventions of his or her medium (1982, p. 34), and to have access to the knowledge available only at the inner circle of the art world (1982, p. 63) which is only available to those who actively participate in that world (1982, p. 95). Further, Becker states that ultimately it is the market which sorts the professional artists from the non-professionals (1982, p. 16). In the same vein, Rosenblum's criteria for identifying professional art photographers included having had shows in galleries or museums (1978, p. 10). Even if a small percentage of income is derived from her art, the professional art photographer is working hard to increase that percentage. Her goal is to make a living from her art, becoming and remaining a central player in the social world of art, which also includes critics, collectors, connoisseurs, artists, museums, and galleries (1978, p. 87).

This is to be contrasted with the amateur art photographer, who is serious about her photography leisure career, is aware of the standards, conventions, values, and language of the professional art photography world, moves at least peripherally in that world, and who may even sell a print from time to time. The difference is that the amateur will have a work career that she will not describe as "what she does on the side." Her photography will clearly be a leisure activity and she will typically want to keep it that way.

Rosenblum discusses the primary role that art schools play in the socialization and professionalization of art photographers. Photography departments in art schools have relationships with important art world gatekeepers, and it is by impressing their teachers that promising photographers will garner introductions to gallery owners, curators, and administrators who may be able to offer a teaching job to support their art career (1978, p. 38-40). Of photography schools, Becker notes that they turn out thousands of graduates who do not become professional art photographers, but who form an educated audience to whom the professionals can address their work, and who, by attending lectures, taking classes and workshops, and buying photographic books, provide an economic base for the field of fine art photography (1982, p. 53). These sound like the amateur public described by Stebbins in the Serious Leisure Perspective.

Art schools spend a lot of time teaching students how to think about and communicate about their own art and that of others. Much emphasis is placed on determining what qualifies as a fine art photograph and what does not (1978, p. 35-36). This may be of particular importance in art photography because it is such a young art form. The invention of photography was made public on August 19, 1839 (Marien 2006, p. 1). The medium gained some acceptance as a minor art form around the beginning of the 20th century, but it did not graduate to fine art until the 1960s (Ostrow 2007). There has been an international art market for fine art photography for only about 30 years (Kaplan 2007). Becker outlines photography's troubled history as art and the attempts art photographers have made to distance themselves from camera club amateurs and commercial photographers (1982, p. 339-350).

THE INVENTION OF PROFESSIONAL FINE ART PHOTOGRAPHY

The inventors (or discoverers) of the first photographic image making techniques were scientists, not artists. Soon after its debut, the potential of photography was thought to be as an aid to archeological research and restoration, and as an instrument that would assist scientists in studying the properties of light (Marien 2006, p. 19). The inventors of photography stressed that photographic techniques generated images "impressed by Nature's hand" and not dependent upon the talent of effort of the camera operator (Marien 2006, p. 23). This attitude is still present in the common claim that "anyone can take a photo," yet at the time the photographic process was considerably more involved than "point and click." By the 1840s photography was referred to as an art-science --a blend of a science and a craft-- because the photographer needed to know chemistry, calculate exposure, and measure light, yet also creatively experiment with technique and equipment (Marien 2006, p. 26). The first professional photographers had by then established themselves. They mainly created studio portraits, but photography was already moving into the streets to record events, and even further afield to document war and expeditions.

As photography became more well known, amateurs began to take up the activity. They formed clubs and salons in which members met to view photos, exchange knowledge, and participate in contests. Amateur photography was then a primarily male pursuit,[24] but a surprising number of middle and upper class women did become amateur photographers (Moeller 1992). The priority of these amateur photographers was primarily technical proficiency--the ability to capture a photographic image that accurately represented nature. Though some of these amateurs thought of themselves as artists, their creativity typically extended only to experimentation with photographic printing techniques and materials (Glauber 2007). Becker characterizes these amateur photography clubs as interested in the craftsmanship of photography--the practical use (accurate recording) created with virtuoso skill, adhering to strict conventions of beauty (1982, p. 340, 258). If art is created in this environment, it exhibits academicism, which "consists of an increasing concern with how things are done with the skill the artist or performer exhibits, as opposed to what is done, the ideas and emotions the works embody or express" (Becker 1982, p. 289). This tradition of camera club is still in existence. These are the amateur photographers studied by Grinter (2005) and Schwartz (1986).

[24] It still is in certain flavors of the activity (Slater 1995).

Garner suggests that, given the levels of sophistication and education of the people who could afford the time and financial costs of early amateur photography, it was inevitable that some would decide they wanted to make photographs that looked like fine art (2007, p. 188). But before 1902, the concept of photography as fine art did not yet exist. Enter Alfred Stieglitz. A member of the conventional New York Camera Club, Stieglitz grew weary of the conventional style, and in a move toward the artistic, developed "pictorialism," a soft-focused style that attempted to represent a painterly view of the world, radically breaking with camera club convention. Stieglitz' vision was not shared by his camera club peers, so he broke with the club and set out to promote photography as fine art.

Of creating new art worlds, Becker writes:

> When an innovation develops a network of people who can cooperate nationwide, perhaps even internationally, all that is left to do to create an art world is to convince the rest of the world that what is being done is art, and deserves the rights and privileges associated with that status (1982, p. 339).

The rest of the world was not convinced.[25] Stieglitz moved ahead, taking action that fulfilled Becker's three further criteria for the creation of a new art world (1982, p. 339). Stieglitz' break with the New York Camera Club and organization of the fine arts oriented Photo-Secession in 1902 began to distance art photography from craft photography. In 1903, Stieglitz began publishing the art photography journal Camera Work. The journal was an instrument through which an aesthetic code and language developed, enabling art photography to be discussed, judged, and critiqued. Finally, Stieglitz opened a gallery that displayed fine art photography, and eventually other types of fine art as he became a social connector between photographers, painters, and sculptors. In this way, art photography was linked with previous art forms in a way that validated photography as art.

Since then, photography has increasingly won acceptance as fine art, and has even been called "the art form of the century" (Kaplan 2007, p. 470) in spite of fine art photography's continual aesthetic oscillation between craft-like values and artistic values. Fine art has even periodically embraced the aesthetic of "folk," "vernacular," or "snapshot" photography (Edwards 2004; Scott 2007).

OTHER PHOTOGRAPHIES, OTHER PHOTOGRAPHERS

I present the preceding art history digression to lend authority and context to my claim that there are at least two types of serious amateur photographers in operation today: camera club amateurs and art photo amateurs. Before examining this claim in more detail, I must make one more brief digression on other non-professional modes of photography that will be referenced below.

[25] In fact, the rest of the world was still not convinced when the market for fine art photography was in its infancy in the 1970s. Kaplan writes that, "Excoriated and ridiculed in the 1970s, a burgeoning community of photographers, dealers, curators, and collectors were undeterred. They struggled to counteract the critical perception that, since photography relied on a mechanical instrument (the camera), it was not an authentic art form" (2007, p. 470)

Conducting research on non-professional modes of photography is complicated by the language used to describe different types of leisure photography within and across disciplines. In the art and photography literatures "amateur" is used to describe both home-mode and camera club photography. The home mode is additionally referred to as *folk photography* or *vernacular photography* in the arts literature, while in sociology it is sometimes called *snapshooter photography* or *family photography*. In most LIS related research it has been called either *family photography*, *consumer photography*, or simply *photography*. Some sources in art and sociology refer to camera club photography as *hobby photography*. In some research this group of photographers are referred to as *camera buffs* instead of photographers. The non-professional art photographer is barely mentioned in any literature and has no associated term aside from the vague *enthusiast*.

Home mode photography

Home-mode photography is the most discussed and researched mode of photography outside of the arts literature. In 1981, Jacobs pointed out that the most interesting questions and discussions regarding home-mode photography had come from sociology and psychology instead of art; in recent years, however, the topic has become increasingly discussed in the literature of the arts, and shows of home-mode photographs have even been exhibited in museums and galleries (Spence and Holland 1991; Batchen 2004; Zuromskis 2006; Levine, Snyder, and Douglas F. Cooley Memorial Art Gallery 2006; Ritchin 2007).

Richard Chalfen introduced the notion of the home mode of pictorial communication—a pattern of interpersonal and small group communication centered around the home and focused on pictorial materials (1987p. 8). He further explains that "Kodak culture" is that which one has to learn, know, or do in order to participate appropriately in the home mode of photographic communication (1987p. 10). These are unwritten and often unexamined rules of the home mode that govern when we take photos, how we take photos, and the subjects of our photos. One might conceive as the home mode as the everyday mode of photography. Home mode photographers take pictures as records, for fun, and sometimes to satisfy personal obligations. Home mode photographs serve as documentation, capture and preserve memories[26], and act as catalysts for storytelling (Chalfen 1987, p. 119-142). The roles and constraints of home mode photography have been further critiqued by Bourdieu (1990).

In that the rules of Kodak culture and home mode communication are passed informally and often unconsciously through community, home mode photography meets Becker's (1982) definition of a folk art. In terms of leisure, the doing of home mode photography functions mainly to document leisure activities, not as an independent leisure activity. The capturing of the requisite snapshots in a situation may be thought of as an extremely brief form of project-based leisure, for it is usually an agreeable obligation. Stebbins (2005b, p. 7-8) gives the creation of a family slide show as an example of project based leisure. Likewise, the creation of a photo album would fall into this category. Going through photographs, reliving memories, and telling stories would count as instances of casual leisure.

[26] The efficacy of the photograph for preserving memory is debated by Batchen (2004)

Photoblogging

Photoblogging is another mode of photography that I cannot currently categorize as amateur photography, though there are many similarities between the two. I mention it here because it is mentioned in the literature and might in some cases be a complementary leisure activity to one's amateur photography career. Photoblogging is very different from the home mode in several ways. First, the notion of putting one's home mode photos up for the public to see is anathema in the Kodak culture (Miller and Edwards 2007). One of the defining characteristics of the home mode is its very specific audience (Chalfen 1987). Next, photoblogging is concerned with taking very large numbers of photographs. The subjects of these photos are usually everyday, mundane objects and activities (Cohen 2005a). The notion of photographing one's lunch or one's shoes at the bus stop is foreign to the home mode.

Photoblogging is also distinct from amateur art or camera club photography in several ways. Photobloggers are not concerned with capturing photographs with craft-like technical skill. Nor do they speak about expressing ideas or emotions in their photographs. Cohen (2005a) reports that they become frustrated when asked to explain their reasons for and processes of making photographs. They speak of going by their instinct and photographing with no prior intention. They do not aspire to create art; the goal is to capture the everyday as they see it (Cohen 2005a): in fact, photobloggers actively resist being labeled as "photographers" (Cohen 2005b). Photobloggers are not amateurs because there is no professional counterpart to the way in which they approach photography. The closest would probably be documentary photography, but in the sparse available literature, photobloggers do not identify with the language, conventions, or values of that particular social world.

This does not imply that amateur photographers cannot maintain blogs on which they post their photographs. The Flickr photostream is a photoblog which, as will be shown below, is used by all types of photographers. Photoblogging as it is described by Cohen appears to be a specialized approach to an activity shared by many casual and serious leisure photographers. Photoblogging could be typically pursued as a hobby, but the research on the activity is too sparse to tell.

AMATEUR ART PHOTOGRAPHERS

That fine art photography was born by divorcing itself from camera club photography implies that the amateurs inhabiting the world of fine art photography will be distinct from those in the world of camera club photography. In the SLP, it is expected that amateur fine art photographers will strive for standards set by professional fine art photographers and orient themselves in that social world. A comparison of the stark differences in the values and social worlds of professional fine art photography and camera club photography in the early 1980s (Schwartz 1986) is summarized in Table 1.

Table 1: Characteristics of camera club amateurs and fine art photographers identified in (Schwartz 1986)

Camera club photography	Fine art photography
Presented as	
Populist	Elite
Models of competent work	
Studio portraiture, nature and travel photography as in National Geographic	Varies greatly, dependent on "school" and intent
Relationship with other art media	
Deny artist identity. Distance themselves from what they see as a lack of skill and aesthetic discrimination in fine art photography.	Interrelated. Many see themselves simply as artists who happen to work in the medium of photography. Some work in multiple media. They are inspired by art in general.
Social world	
Camera club networks, Photographic Society of America	Art world
Relationship with history	
Photos consistently patterned off of earlier work, so style changes little. Still predominantly pictorialist and postpictorialist.	Valued as scholarly pursuit. Makes no mention of non-art modes of photography. Used to evaluate new work for originality, and to inspire informed "revivals" of styles
Aesthetic criteria	
Narrow. Conventional beauty. Conventionally interesting. Good technical quality defined as sharp focus, clear exposure, composition.	Constantly in flux, demonstration of awareness of current styles. Includes the mundane and the conventionally unattractive.
Goals, Ideas of Success	
Aspire to same achievements as predecessors	Improve upon the works of admired predecessors. Become known for original vision.
Critical language	
Straightforward. Modeled on camera club competition judging. Centered on liking or disliking and technical criteria like composition, focus, and exposure.	Specialized, complex. Based on metaphors of seeing, vision, psychology, and emotions.
Role of image	
Represent reality. Demonstrate photographer's competence and skill in articulating camera club tradition.	Convey ideas. Serve as metaphor for the artist's experience.
Requirements of viewer	
Appreciate beauty, recognize skill of photographer.	Active interpretation or discovery. Have emotional response.
Priorities	
Technical aspects of capturing pictures	Conceptualization of pictures.
Interest in innovation	
Technological innovation. New equipment or devices to improve quality of photos.	New and original techniques to avoid seeming imitative.
Relationship of self to work	
Expresses camera club conventions. Little emotional investment. Identity of maker unimportant--images judged anonymously.	Personal, self expression. Identity of maker is important to image.
Benefits experienced	
Sense of achievement	Sense of enrichment and self-gratification

Grinter's (2005) description of the strict conventions of amateur camera clubs and how they changed with the introduction of digital photography indicates that the basic culture of the camera club has not changed dramatically since Schwartz conducted her research. Camera club and art amateur photographers should not be conflated in research on photo practices, and my interest is in the latter group. Recently, the split between types of amateurs has been remarked upon by other researchers:

> Yet looking at the dominant discourses current in amateur photography, the technophile strand promoted in magazines is often resisted by others that are dominated by the language of art and personal expression and which are technophobic. Precisely how this discourse is maintained institutionally is unclear from existing literature (Cox, Clough, and Marlow 2008).

As the above quote claims, there is little information about differing approaches to amateur photography. I could find little mention of amateur fine art photographers in the pre-2006 literature. The preponderance of items retrieved when searching for terms and phrases related to amateur photography were irrelevant. They were either referring to camera club amateurs[27] or were using the term "amateur" to describe general consumer/home mode photography (Jacobs 1981).

Mentions of amateur art photographers were generally oblique implications that such creatures exist, given the existing split between photography as art and photography as craft. Schwartz (1986, note 14) indicates the presence of two different types of amateur by mentioning that "Art photographers distinguish between unorganized photo enthusiasts, who may move beyond publicly accessible picture taking to "art," and camera club amateurs." In her study of camera club members, Grinter (2005, p. 183) states that the amateurs she studied do not occupy the worlds of fine art, journalism, fashion, or consumer photography, which could be read as an implication that there are amateurs who do occupy such roles.

Outside the realm of photography, two studies report on distinct craft/art divides in amateur painting. Becker reports on amateur women painters who are keen to distance themselves from amateur "picture painters" working in a craft-based mode divorced from the social art world around fine art painting (1982, p. 98). Aibel (1984) studied the role of group membership as social communication in two organized groups of amateur painters in a rural county in Pennsylvania. Each group firmly rejected the activities and products of the other group. One group was oriented toward the art world, modernism, and travelling to larger cities to participate in art world events. The other was more traditional and focused on painting conventional art that fit in with the mores of the community.

[27] There are many historical accounts of camera clubs and well known camera club participants. See (Harthardottir 1999) (Wilsher 1981; Mensel 1991; Glauber 2007). Descriptions of these overall match descriptions of current camera clubs by Grinter (2005) and Schwartz (1986).

Four recent studies discuss amateur art photographers, or people who sound very much like they might fall into that category. These studies are connected by the fact that they all focus on use of the online tool Flickr (Yahoo! 2008b). Further, in all of these studies, participation in Flickr was related to the increase in seriousness with which people pursued photography.[28] In the following section, I will first briefly summarize the four studies. Then I will discuss their descriptions of the photography activities of each group of participants in terms of the characteristics and durable benefits of serious leisure as described by Stebbins (2007) and summarized above.

First, Davies (2006) examines Flickr as a dynamic, multimodal environment for learning and teaching. Her participants, self-selected by answering a questionnaire, are not characterized as amateur art photographers in the study. Several elements of her description suggest that some of her participants may take their photography seriously as an art activity. Second, Miller and Edwards (2007) report that they found a group of participants (Snaprs) whose photo practices on Flickr differed greatly from the rest of the participants whose photo practices were in line with the previous research on home mode photographers. Though the Serious Leisure Perspective is not used in the study, Snaprs demonstrate characteristics that imply they might be serious art photographers. Third, part of Jean Burgess' dissertation work on the cultural citizenship implications of ways of using new media to articulate vernacular creativity is a case study of another group of Flickr users who, while not characterized in the Serious Leisure Perspective, appear to be amateur art photographers (2007). Finally, Cox et al. (2008) state that they examined the use of Flickr in the context of serious leisure photography. This study conceptualized participants in terms of the Serious Leisure Perspective and included in the interview schedule several questions that attempted to get the participants to characterize the place of photography in their lives, it did not directly ask participants how seriously they take this leisure activity.

SERIOUS LEISURE CAREERS

Participants in all four studies tell stories suggesting serious leisure careers in photography. Burgess (2007) and Cox et al. (2008) report a common progression among participants from being snapshooters in the home mode to being "better," more advanced photographers with their own personal styles. Several in the Cox study had or were seeking formal photography training. Most of the participants in the aforementioned studies and all of the Snaprs (Miller and Edwards 2007) owned advanced equipment such as digital single lens reflex (SLR) cameras and multiple lenses. The need for professional equipment is often driven by a desire to meet professional standards; this is a sign of an amateur career. Snaprs also reported interest in improving technique and wanted to take "arty" photos. Davies (2006; 2006, p. 229) remarks on one participant's "growing expertise and confidence over a period of time" and her awareness of her learning process.

In addition, the photography careers of the people in these studies are inextricably bound up with their Flickr activity. Burgess (2007, p.189) explains the relationship in this way:

> people become increasingly interested in 'better photography' as they become more deeply engaged with the various layers of possible participation; and a growing interest in photography drives a deeper engagement with the Flickr network.

[28] This should not be interpreted as a suggestion that all Flickr users become more serious about their photography. The samples in these studies are not random, and tend to be made up of unusually active Flickr users.

Cox et al. (2008) report predictable changes in Flickr use patterns as an amateur photography career progresses. These include a shift of audience away from family and friends to a wider audience including the general public and other people with a serious interest in photography; increasing sophistication of evaluation criteria for photographs; and increasing frequency of Flickr activity. Miller and Edwards (2007) did not ask about change in Flickr use over time, but their Snaprs' Flickr use patterns match the patterns of the amateur photographers in the Cox study.

SIGNIFICANT EFFORT AND PERSEVERANCE

Increasing one's photography skills involves expending much time and effort on the activity. There is much to learn about technology, technique, aesthetics, the theory of photography, and "how to see." This requires reading, experimenting with taking many photographs, carefully examining one's own photos and those of others, and often discussing these issues with other photographers. These activities are reported in all of the Flickr studies. The participants may put significant effort into teaching themselves how to be better photographers, studying websites, participating heavily in Flickr groups, and reviewing books on photography. Difficulties demanding perseverance are only reported in one study, but difficulties, confusions, and frustrations are a natural part of gaining and perfecting any skill. Only Burgess directly reports on this. One of her participants ran into problems when he upgraded from a point and shoot camera to an SLR; the settings seemed too difficult to figure out, even with the manual. This participant persevered by signing up for a formal photography course (Burgess 2007, p.163). Cox et al. (2008) mention that as participants advance in their careers they "*need to discipline themselves* to be creative, interesting, to have fun and be supportive of others in the Flickr community" [emphasis mine]. This indicates some level of effort, commitment, and perseverance.

PARTICIPATION IN A SOCIAL WORLD AND IDENTIFICATION WITH SERIOUS LEISURE PURSUIT

There is evidence that there are multiple levels of social worlds that participants become a part of as amateur art photographers on Flickr. First, Flickr participants may be active in Flickr groups. Three of these studies (Davies (2006) excepted) recruited participants through Flickr groups. Burgess claims that each Flickr group is a community of practice, defined as an emergent culture that results from interaction between the members of the more abstract ‘designed’ community--Flickr as a whole (Burgess 2007, p. 127). Each is built on a common base architecture (the Flickr application), but each has its own content, purposes, scope and aesthetics determined over time by the activities of the group members (Burgess 2007, p. 176). The main argument of the Davies (2006) study is that participants in different Flickr groups learn specific "ways of seeing" appropriate for participation in those groups. "Learning to see" in an appropriate is one of the important socialization requirements for identification as a professional art photographer and is stressed in art school (Rosenblum 1978). Its presence here and in the rest of this section indicates that these amateur art photographers do share values and vocabularies with the world of professional art photography.

Cox et al. (2008) discuss Flickr overall as a place with its own historically and culturally constructed social order. Though individual use of Flickr varies widely, and individual Flickr groups have their own cultures and conventions, some general expectations of site-wide behavior are learned with active participation. Some of these codes of behavior have moral qualities such as whether to respond to comments left on one's photos, how to comment on others' photos, how to respond when added as a contact, and whether to assign tags to others' photos. Additionally, participants learn how to manipulate the system through strategic uploading, description, and commenting in order to maximize views of, and comments on, their images.

Finally, all but the Davies study mentioned that participants have some awareness of, and even participation in, the professional art world. Burgess explores this in the most depth. Likewise, Burgess is the only study to report on participants strongly identifying as art photographers:

> …most Flickr users are not 'professional' photographers, nor are they 'artists' in the sense of fully occupying those identities. However, the participants I interviewed for this project do represent themselves as creative practitioners, or even self-taught artists, and some harbour significant ambitions for their photographic work (2007, p. 168).

Flickr groups focused on artistic photography "discuss, deliberate and negotiate photographic aesthetics by participating in conversations that are mirrored in the art world" . Participants interested in art photography made judgments about what constitutes good photography in ways that fit with expert discourses of photography as art .

Rosenblum (1978) and Becker (1982) discuss the priority of the "idea" in professional art photography. Professionals are able to speak about the motives and meanings behind their photographs. Professional art photography also values creativity, the development of an artistic "way of seeing," originality, and its own history. These characteristics are echoed in some of Burgess' participants' explanations of their photography. One participant "represented his practice in ways that differentiate it from vernacular photography, instead reproducing the discourses of art photography, where creativity is constituted via a balance between technical problem-solving and aesthetic innovation (or 'something different')" . Another explained how Flickr participation exposed him to the history of art photography, enabling him to participate in aesthetic debates . Yet another "privileged the development of an 'eye', or 'seeing things differently', actively resisting the principles of 'good photography'" as it is practiced in amateur camera clubs and professional photographic societies . This echoes Becker's (1982) discussion of how professional art photographers must know the conventions demanded by the art world, so that they can strategically break them to express their unique vision and creativity, without rebelling so much as to become "mavericks." Cox et al. (2008) describe their participants as seeing distinct boundaries between different types of photography, including at least two who maintain multiple Flicker accounts to keep their art photography (presented publicly under their real names) separate from their personal snapshots. Miller and Edwards (2007) also report on the artistic orientation of their Snaprs. One clearly states, "Most of the photos I post to Flickr are for the purpose of art. They're not for information sharing." .

DURABLE BENEFITS

These studies provide some evidence that amateur art photographers gain durable benefits from their photography leisure career. Some of the durable benefits named by Stebbins are not clearly defined, and these benefits were not the foci of any of the studies under discussion, so this analysis is based on what happens to be mentioned in passing. The most obvious durable benefit resulting from photography is the photographs: **lasting physical products of the activity.** Cox et al. (2008) note that participation in Flickr increases one's "scope for individual creativity, releasing the individual to explore their own identity in a way not possible in the narrow world of the photo club, for example." This self-exploration can result in another durable benefit: **self-actualization**. The acceptance of individual creativity also encourages a wide range of **self-expression** and self-representation. One participant in the Cox study described logging onto Flickr as "a release" while working on a computer all day, suggesting the benefit of **regeneration or renewal of self**. Davies (2006) describes participants receiving the durable benefits of **feelings of accomplishment** ("I feel proud of myself for this shot) and **enhancement of self-image** (acknowledgement of one's own expertise). One of Burgess' participants was offered a gallery show based on the work he shared on Flickr. The show was well-attended and he even sold some works (2007, p. 174). One would assume that he gained a sense of accomplishment and an enhanced self-image as an exhibited, selling artist. **Self-enrichment** naturally occurs in the process of gaining knowledge and skills in a leisure career.

The final durable benefit is **social interaction and belongingness**, which is mentioned in all four studies. In Davies (2006) the reference is implicit: learning to see in a particular way defined by a group and participating in that group is described as a social learning experience and will engender a sense of belonging. The other studies discuss the social aspect of Flickr more directly. One participant in the Cox study saw meeting people as a central pleasure of using Flickr. Social interaction such as sharing information and expertise, getting feedback on photos, and participating in groups were also important uses of Flickr (2008). Participants in two studies not only engaged in social interaction and group membership online, but also attended local offline meet-ups and group photo outings organized in Flickr (Miller and Edwards 2007; Burgess 2007).

The above discussion and analysis shows that an under-studied population of amateur art photographers exists. Perhaps they always have, but Flickr has suddenly made them much more visible than every before. Amateur art photographers are differentiated from camera club amateurs by their individuality, creativity, and lack of adherence to convention and tradition. It is then reasonable to expect that their approach to their photographs and other information may be different. Amateur art photographers are differentiated from home-mode snapshooters by the seriousness with which they approach their photography. It is also reasonable to expect that the current knowledge we have of the photowork practices of these home-mode snapshooters will not apply to amateur art photographers. To my knowledge, there is no existing research on the photography-related information practices of amateur art photographers, aside from how they organize and tag their images for public consumption on Flickr. The proposed research will fill that gap.

ORGANIZATION OF IMAGES

Returning to the focus of this review and the proposed research, the question is how amateur digital photographers make decisions about their methods of managing the artifacts and information surrounding their hobby, and how they go about and make sense of changing the structures used to organize these materials. It is assumed that the preponderance of the materials surrounding the hobby of amateur digital photography will consist of images—in print or digital formats. Therefore, an understanding of some special issues and topics regarding the organization of images is in order.

The first part of this section provides an overview of image organization for retrieval, focusing on conceptual indexing of images. Research in this area has focused on the issues of what will here be called institutional collections: how to best provide access to large image collections with heterogeneous user populations. Some of the findings may apply to other kinds of image collections, including personal collections. The second part of this section covers the research on how individual people organize their own collections of images for personal use. It identifies a gap in knowledge on this topic that the proposed research aims to fill.

ORGANIZATION OF IMAGES IN INSTITUTIONAL COLLECTIONS

Organization of images is here used as a shorthand phrase to refer to a number of activities related to providing intellectual access to images in collections. These include the manual description of images using natural language (annotation) or controlled language (indexing), the automatic generation of image descriptions (automatic annotation, face recognition, automatic classification, etc), the development and/or application of schema for manual and automatic image description, the development of indexing languages for image description, the automatic processing of images for retrieval purposes, and the design of image retrieval systems and interfaces. All of these activities are concerned with placing images and information about them into a structure or system that facilitates the provision of access to those images.

The initial stirrings of research interest in image organization in institutional collections became visible in a January 1978 panel entitled “Subject Access to Visual Images,” organized by Eileen Fry and held at the College Art Association in New York. Ohlgren (1980) traces the early work in this area beginning with and following this panel. The questions asked and issues raised then remain central to research in this topic. Additional reviews have been published periodically as the field has developed (Markey 1986) (Baxter and Anderson 1996) (Rasmussen 1997) (Chen and Rasmussen 1999) (Jorgensen 1999a) (Goodrum 2000) (Jorgensen 2003) (Enser 2008).

What is being organized in this domain?

The items of interest in this research have variously been referred to as images, pictures, and pictorial works. In general, these terms have not been rigorously defined, likely because common sense seems to indicate what an image or a picture is: we know an image when we see it. Two exceptions are Jorgensen's definition of image and Shatford's definition of pictorial works. An image, defined using its Latin root, is "a pictorial representation of a person, scene, or object" (Jorgensen 1998, p. 164). Following this definition excludes any concern with provision of access to abstract images. Indeed, little work has been focused on this issue. Pictorial works are "any predominantly two-dimensional, static … items that convey information in the form of images" (Shatford 1984, p. 14). Using this definition, identifying an item as a pictorial work requires a determination of both what counts as an image, and whether a given image conveys information. Given the lack of a clear definition of image by Shatford, and the subjectivity of information, the exact nature of the pictorial work remains open to interpretation. In general, image organization researchers have been primarily concerned with two-dimensional, static representations of living things, places, and things.

Types of images

Several typologies of images have been developed, illustrating differing conceptualizations of what counts as an image and how the various types of images break down into categories. In their structural classification, Lohse et al. (1994) identify pictures—" realistic images of an object or scene"—as just one out of eleven kinds of visual representation. Enser and Sandom (2003) break images into five categories: creative images, models, moving images, and general and specific documentary images. Jorgensen (1999a) lists three non-mutually exclusive types of images: data image, informative images, and expressional images. Another three-category typology was developed by Greenberg . It is includes visual resource images, art images, and archival images.

Table 1 synthesizes these four image taxonomies, highlighting that image organization research in LIS is concerned with few existing image types. A recent review of visual image retrieval (Enser 2008) includes a new taxonomy of still images which skews closer to that of Lohse et al. (1994) than the other three schemes presented in Table 1. As is suggested in the definitions given in the literature, knowledge about the organization of images is generally limited to the types of images in the first two rows of Table 1: photographs/faithful representations of reality and creative or expressional representational art images. The types of images represented in the third row—special purpose documentary or data images—have been given attention in specialized areas of informatics, such as biomedical informatics (Marcos et al. 2007; Lacoste et al. 2007). Moving images are included in only one of the typologies. Moving image description, surrogates, and retrieval is a rich separate research area existing in two bodies of literature divided by approach: automatic (National Institute of Standards and Technology 2008) or manual (Yee 2007). Maps are specified as one type of informative image in the Lohse and Biolsi taxonomy. Map librarianship is a well developed specialization in the library world. Again, much is known about organizing and providing access to cartographic materials, but this topic falls outside the literature of organization of images (Larsgaard 1998; Andrew and Larsgaard 1999). The organization of other informative images such as models, graphs, tables, and diagrams has received little attention in LIS (one notable exception is (Brunskill and Jorgensen 2002)), perhaps because few image collections consist primarily of these image types.

It is probable that the photographs produced and collected by amateur digital photographers will mainly be classifiable into the following image typology categories: Lohse and Biolsi's pictures, Jorgensen's expressional images, Greenberg's art images, and Enser and Sandom's general documentary images and creative images, and Enser (2008)'s direct picture. These are the main types of interest in image organization research, indicating the relevance of this domain to the proposed research.

Lohse et al. 1994	Enser & Sandom 2003	Jorgensen 1999	Greenberg 1993
Pictures - **realistic images of an object or scene**	Documentary--general - **faithful representations of reality**	Expressional images - **pictorial, photo-realistic, abstract, subject to multiple interpretations**	Archival images
	Creative - **may be placed on a spectrum of reality representation**		Art images
	Documentary--special purpose - **faithful representation of a some subject of specialised analysis and not necessarily visible without special equipment.**	Data image - **in which raw data is captured and perhaps processed for visual clarity**	
Graphs - **encode quantitative information using position and magnitude of geometric objects**		Informative images - **to which human intelligence has been applied to organize the visual material for communication of information**	Visual resource images
Tables - **an arrangement of words, numbers, signs, or combinations of them to exhibit a set of facts or relationships in a compact format. Tables have less abstract symbolic notation than graphs.**			
Graphical tables - **tables that use visual elements such as shading to encode data in the table. This is contrasted with numerical tables, which present only numeric data**			
Time charts - **display temporal data**			
Networks - **show the relationships among components using symbols indicating the presence of components and lines, arrows, proximity, etc to represent relationships among components**	Models - **2- and 3-dimensional images which model aspects of reality such as processes and geographical phenomena**		
Structure diagrams - **express spatial data. A static description of a physical object**			
Process diagrams - **express spatial data. Describe interrelationships and processes associated with physical objects.**			
Maps - **symbolic representations of physical geography**			
Cartograms - **spatial maps showing quantitative data**			
Icons - **impart a single interpretation or meaning for a picture**			
	Moving images		

Table 2 - Taxonomies of image types

The landscape of the research area

The domain of image organization can be divided into three main research areas. The first is the intellectual process of conceptually representing images to facilitate retrieval. Any intellectual work done by information professionals to make images accessible to users (indexing, annotation, cataloging, etc.) falls into this category. The second research area is content-based image retrieval (CBIR). This is the automatic processing of images to facilitate retrieval based on the content of the images themselves. To contrast with CBIR, the first research area is called concept-based image description (CBID). CBID takes place before retrieval and serves to represent images in text-searchable language to facilitate retrieval. CBIR techniques and processes can be used before retrieval to generate searchable data that may or may not be human-readable, but can also be carried out during retrieval. Though the overall goal of both CBID and CBIR is to provide access to images, there is an enormous rift in research focus and approach. CBID research tends to be carried out by LIS researchers and practitioners. CBIR research tends to be carried out by computer scientists and engineers. Two distinct bodies of literature exist with virtually no overlap (Chu 2001). This disconnect poses a challenge to progress on image organization, as a combination of concept-based and content-based techniques will result in the most useful and powerful image retrieval approach (Enser 2000).

The third main research area within image organization is user behavior. This includes study of how people use images, how people use image retrieval systems, and the queries that people make to those systems. This area is foundational because the goal of image organization is to facilitate retrieval. The best organization methods will take into account how people search for and use images. It is impossible to know this without user behavior research. The area of concept-based image description (CBID) has been heavily influenced by user behavior research in ways that will be described in more detail below. This area has had much less impact on developments in content-based image retrieval (CBIR). In fact there is little evidence that kinds of content-based image processing that are currently possible are of much use to general users. Enser (2000) suggests that CBIR techniques have more potential for usefulness for users of special purpose documentary images or data images. These types of images include things like medical imagery, radar imagery, and complex data visualizations.

The remainder of this review will focus mainly on concept-based image description (CBID). Certain findings from this area may have potential relevance to the organization of images in the personal collections of amateur art photographers. Images will have certain attributes regardless of the type of collection of which they are a part. Identifying which attributes should be represented in retrieval systems is a large area of inquiry in CBID. Whether the same image attributes are important in the organization of institutional and personal collections is an open question to be explored.

The user behavior aspect informing image organization is not covered in depth because the searching and use of information in a large institutional collection is very different than the searching and use of information in a personal collection. People tend to generally know what exists in their personal collections. They have usually seen the items before and have often made decisions to keep them and have often organized the items themselves. Refinding in a personal collection is a different activity than finding in an institutional collection. I make an exception for image organization user behavior research that is directly focused on improving CBID. These studies will be covered in more detail with the relevant topics in the CBID section.

CONCEPT-BASED IMAGE DESCRIPTION

Concept-based image description (CBID) is the intellectual process of conceptually representing images to facilitate their later retrieval. This consists of describing images using words—indexing, annotation, or cataloging them—and developing the languages, formats, and systems with which to do so. A foundational issue in CBID is the appropriateness and sufficiency of text in representing non-text resources. Using text to describe images, particularly the subjects of images or what they are about, is seen by some as problematic. Svenonius states, "It would be a mistake to suppose because subject access, using language, is a prevalent and successful mode of retrieval in some contexts, that it should be employed in all possible contexts" (1994, p. 605). She claims that any attempt to index what an item is about comes from a scientific perspective based on definable objects about which propositions can be made in language. Art and other images are not expressed verbal and their methods of representation are complex. The symbolism in the visual language of iconography is too rich to be expressed in a keyword or subject heading. The expressiveness of the lexicon of form cannot be captured in words as it is purely visual.

Enser (1995) analyzes the verbal inexpressibility of image subject and other issues. These include the multiple meanings of any image to multiple viewers, inter- and intra-indexer inconsistency, and limitations of and dissatisfaction with image indexing languages and systems. He concludes "that the attempt to satisfy queries by matching their linguistic form against the linguistic identifiers, in the form of indexing terms, titles and captions, attached to images within a collection offers little promise as an effective pictorial information retrieval procedure" (p. 156).

Shatford (1986) cautions that anyone attempting to analyze and encode in indexing or description the "aboutness" of an image runs the risk of introducing bias into the collection and limiting user interpretation of images. However, as will be discussed below, she shows that some other types of image subjects lend themselves more safely to verbal description.

These are serious concerns, but there are two constructive messages for CBID that emerge from these criticisms. The first is that that creative steps should be taken to explore appropriate means of representation and retrieval of aspects of images cannot be captured in words. Content-based image retrieval is a move in this direction, but currently has had little success in developing techniques to represent and retrieve images based on attributes that are conceptually useful to users. Finally, it is critical to understand the various attributes of images in order to make informed decisions about which aspects of images can be adequately represented in text and other formats.

IMAGE ATTRIBUTES

The previous section underscored the importance of understanding the attributes of images. For this reason, identifying and describing image attributes has been a main focus of concept-based image description (CBID). Some of the questions explored include: What attributes do images have? What attributes are useful for retrieving images in institutional collections? Findings on these questions are reviewed below. All images have attributes regardless of the type of collection in which they are housed. It may be instructive to compare the attributes useful for organization and retrieval of images in institutional collections with those attributes that are useful for the same tasks in personal collections.

Jorgensen (2003) defines an attribute as "a feature, component, or property of a stimulus (an image) that can be represented by an information processing system. An image attribute is thus not limited to purely visual characteristics, but includes other cognitive, affective, or interpretive responses to the image such as those describing spatial, semantic, or emotional characteristics" (p. 3). In short, an image attribute is some aspect of the image that can be described. An attribute is a property, and for each image that property will have one or more values. For clarification of this distinction, Table 3 presents some image attributes and associated values. There are many types of image attributes and several frameworks to represent and categorize types of attributes have been developed.

Attribute	Possible value
Creator	**Ansel Adams**
Form	**Collograph**
Subject	**Birds**

Table 3: Distinction between attribute and value

Shatford Layne's framework of image attribute types

DESCRIPTIVE ATTRIBUTES

Image attributes can first be divided into descriptive and subject attributes. Layne (1994) lists three families of descriptive attributes: biographical, relationship, and exemplified. Biographical attributes describe the birth or creation of an image (creator, place and date of creation, title assigned by creator, etc) and the image's travels (provenance, alterations, etc). Relationship attributes specify links between images and other images or texts. Exemplified attributes describe what an image, as an object, is—a certain type of photographic print, a specific digital image format, an example of a particular genre or style. Exemplified attributes (what it *is*) are distinct from subject attributes (what it is of, or what it is about) (Shatford 1986).

Statements of descriptive attributes are propositional; therefore, there is no concern about the appropriateness of representing these attributes linguistically in image databases. It is a fact that a specific image was created by a certain person. Persons are represented by names, which are textual. Usually the values for descriptive attributes can be objectively and clearly determined. The task becomes somewhat more difficult in the description of art images—for example, photographs of artworks. Given a photograph of the Mona Lisa, should the indexer record the photographer of the painting or Leonardo da Vinci as the creator? This conundrum is resolved by introducing separate attributes to describe the work in hand (the photo) and the work represented in the photo (the Mona Lisa) (Shatford 1984).

SUBJECT ATTRIBUTES

Sara Shatford Layne pioneered the careful analysis of the different types of image subjects (image subject attributes) in LIS. Her analysis began with Panofsky's levels of subject matter in images (1962). In the context of studying the iconography of Italian Renaissance art, Panofsky outlines three levels of image subject matter. All three levels must be considered to understand an image fully.

Panofsky's first level is primary/natural subject matter of two sorts: factual and expressional. The objects of interpretation of factual subject matter are the generic objects or actions represented in an image: a man, a flag, or the lifting of a hat. Expressional subject matter includes the atmosphere or character expressed in an image: gloominess, cheer, warmth. The first level may be interpreted and understood by anyone with practical experience and familiarity with objects and events. The factual objects are objective, while some subjectivity enters into identifying expressional subject matter—the key is that no special knowledge is required to recognize sadness or excitement. Interpretation of this level takes the form of pre-iconographical description.

Panofsky's second level is secondary or conventional subject matter, requiring "iconographical analysis in the narrower sense of the word." A viewer with knowledge of literary sources and representations of specific themes and concepts can at this level identify a grouping of men around a table as representative of The Last Supper tale from the Bible. Likewise, two fighting figures may be identified as representative of the concepts of Vice and Virtue.

Panofsky's third level is that of intrinsic meaning or content, requiring "iconographical interpretation in a deeper sense," or iconographical synthesis. This allows the interpreter to understand how the themes and concepts represented in an image fit into the particular time, place, culture, and worldview of the creator of the image—and how all of these are in turn unconsciously condensed into the image by its creator. For example, the depiction of the position of the Virgin Mary at the nativity was changed in the later Middle Ages from reclining to kneeling before her child. According to Panofsky, this shift revealed "a new emotional attitude particular to the later phases of the Middle Ages." Analysis at this level requires expertise, synthetic intuition, and familiarity with concepts of the expression of personal psychology and worldview at different points in history.

To demonstrate the complexity of describing image subjects, Shatford developed a classification—based heavily on Panofsky's levels of meaning, with contributions from linguistic theory, and Ranganathan's fundamental facets—of types of image subject attributes (1986). This explicit enumeration makes it possible to decide which types of subjects to represent in a particular image retrieval system. At this level of analysis, judgments may be made about whether a text string or index term is an acceptable value for a given subject attribute.

Shatford (1986) introduces a distinction between *ofness* and *aboutness* as different types of subjects. In Panofsky's first level, the factual subject is what the image is *of*. The expressional subject is what the image is *about*. Munch's "The Scream" is *of* an open-mouthed figure of indeterminate sex on a road, two figures in the background, and a red sky over Oslofjord. "The Scream" is *about* anxiety and existential dread. Panofsky did not divide his second level into two types, but Shatford demonstrates that secondary/conventional subject matter can also exhibit separate *ofness* and *aboutness*. At this level we can say a painting is *of* a specific woman: Mrs. Siddons. The artist posed Mrs. Siddons as the Tragic Muse, so the painting is also *about* the Tragic Muse. The distinction between *ofness* and *aboutness* becomes less sharp at this second level.

Applying referential theory to image description, Shatford states that an image is a depiction of a specific referent (or multiple specific referents). The sense of the image—its "subject"—is derived from the referent depicted in the image. A referent can be described with different words having senses at varying levels of specificity. A specific canary can be accurately described as Tweety, a canary, a bird, or an animal. An image of that canary can factually be described as of Tweety, a canary, a bird, or an animal. The description of image subjects must account for both generic and specific descriptions. Panofsky's first level factual subject matter is equated with *Generic Ofness*, and secondary/conventional subject matter with *Specific Ofness*. Findings from research on cognitive category structure would suggest that the inclusion of a description of the referent at the basic level of specificity is likely to be most useful (Rosch et al. 1976).

Finally, Shatford draws on Ranganathan's basic facets—personality, matter, energy, space, and time (PMEST)—to further specify the types of subject attributes an image may have. *Specific Ofness*, *Generic Ofness* and *Aboutness* can be separately described within each facet. The resulting classification of subject types is presented in Table 3. Each shaded cell represents a kind of subject attribute. Cells are populated with the types of values that might be recorded for each attribute. Non-facet-specific Aboutness stretches across the facets because certain themes or concepts are represented by objects in a combination of facets. Many images will not display all of the types of subject attributes. Keeping in mind the caveat that recording textual values for attributes describing *ofness* is less problematic than attempting to textually represent attributes related to *aboutness* (Svenonius 1994), designers of image organization systems may choose which subject attribute types to represent in their systems. There is also evidence of the usefulness of this classification for conducting fine-grained query analysis in order to understand the needs of users of an image collection (Armitage and Enser 1997).

Ranganathan's Facet	Natural Language Facet Description	Specific Of	Generic Of	About	
Personality Matter	**WHO? Animate and inanimate; concrete objects and beings**	**Individually named persons, animals, things**	**Kinds of persons, animals, things**	**Mythical beings (generic/specific); abstractions manifested or symbolized by objects or beings**	**Non-facet-specific Aboutness**
Energy	**WHAT are the objects and beings doing? Actions, events, emotions.**	**Individually named events**	**Actions, conditions**	**Emotions; abstractions manifested by actions, events**	
Space	**WHERE? Locale, site place; geographic, cosmographic, architectural**	**Individually named geographic location**	**Kind of place; geographic or architectural**	**Places symbolized (generic/specific); abstractions manifested by locale**	
Time	**WHEN? Time; linear or cyclical**	**Linear time; dates or periods**	**Cyclical time; seasons, time of day**	**Emotions or abstractions symbolized by or**	

	manifested by time.

Table 4: Shatford's (1986) Classification of Image Subjects

Jorgensen's image attribute scheme

Corinne Jorgensen's dissertation research is an example of user research producing important findings for CBID (1995). A scheme of image attributes was derived from written natural language image descriptions generated by people in three different task contexts. The Descriptive Viewing Task asked people to describe what they notices about an image. The Descriptive Memory Task asked participants from the Descriptive Viewing Task to describe what they remembered about each image four weeks after the initial description task. The Descriptive Search Task asked people to write a description as if they hoped to find the image in an image collection.

Using the constant comparative method of content analysis, Jorgensen identified 47 individual image attributes and categorized these into 12 higher level classes (1995; 1998). Attributes and their classes fell into three main types. Perceptual attributes are described in direct response to a visual stimulus. Interpretive attributes are described based on interpretation of perceived perceptual cues and inferences made applying a general level of knowledge. Finally, reactive attributes affective and subjective personal reactions to the viewing of an image. Table 4 presents the higher level image classes falling into each of these main types.

Table 5: Jorgensen's (1995, 1998) image attribute scheme

TYPE OF ATTRIBUTE	ATTRIBUTE CLASS	SELECTED ATTRIBUTES
PERCEPTUAL	LITERAL OBJECTS -- contains items which are classified as being literal (visually perceived) objects.	Object, Text, Body part, Clothing
	PEOPLE -- the presence of a human form.	People
	COLOR -- includes both specific named colors and terms relating to various aspects of color value, hue, and tint.	Color, Color value
	LOCATION -- includes attributes relating to both general and specific locations of picture components.	General location, Specific location
	VISUAL ELEMENTS	Orientation, Shape, Visual Component, Texture
	DESCRIPTION -- includes descriptive adjectives and words referring to size or quantity.	Description, Number
INTERPRETIVE	PEOPLE QUALITIES	Relationships among people depicted in an image, Emotional states of depicted people, Social status of depicted people
	ART HISTORICAL INFORMATION -- information which is related to the production context of the representation.	Artist, Medium, Style, Type, Technique
	ABSTRACT CONCEPTS	Theme, Atmosphere, Symbolic aspect, State
	CONTENT/STORY -- attributes relating to a specific instance being depicted	Activity, Event, Setting, Time aspect
	EXTERNAL RELATION-- comparison of attributes within a picture or among pictures or reference to an external entity. EXTERNAL RELATION-- comparison of attributes within a picture or among pictures or reference to an external entity. EXTERNAL RELATION-- comparison of attributes within a picture or among pictures or reference to an external entity. EXTERNAL RELATION-- comparison of attributes within a picture or among pictures or reference to an external entity.	Comparison, Similarity, Reference
REACTIVE	VIEWER RESPONSE	Personal reaction, Conjecture, Drawing, Uncertainty

This scheme is particularly notable first because it was derived from different image task contexts (Jorgensen 1998). Second, it is important because it has been tested with various kinds of images. The initial study gathered descriptions of illustrations, but further research has tested the applicability of the scheme to fine art images (Jorgensen 1999b) (Chen 2001), and scientific diagrams (Brunskill and Jorgensen 2002). The scheme has been found to be applicable to these image types with the addition of some specialized attributes. In all of these studies the frequency with which individual attributes are described varies some depending on the description task and the image type, but attributes in the Object class are consistently the most frequently described.

The Pyramid Model of visual image attributes

Drawing on the literatures of cognitive psychology, LIS, art, and content-based image retrieval (CBIR), Jaimes and Chang (2000) developed separate models for visual and non-visual information. Non-visual information is information you cannot know by looking at the image. The price of a painting is one example of non-visual information. In contrast, a visual examination of a painting reveals that the painting is very blue, has a shiny surface, or depicts a seascape. These are visual image characteristics.

The Pyramid Model in Figure 1 represents a conceptual framework describing ten different levels of visual image attributes and the relations between those levels. The model is based on three major distinctions: percept vs. concept, syntax vs. semantics, and general vs. visual concepts. The basic distinction between each of these is that the former concerns what is objectively perceived (light perceived as color and texture; lines, shapes, and tones in a spatial arrangement; something round and blue) and the latter concerns what interpretations are made of what is perceived and ideas generated about those interpretations (what it is and what it means).

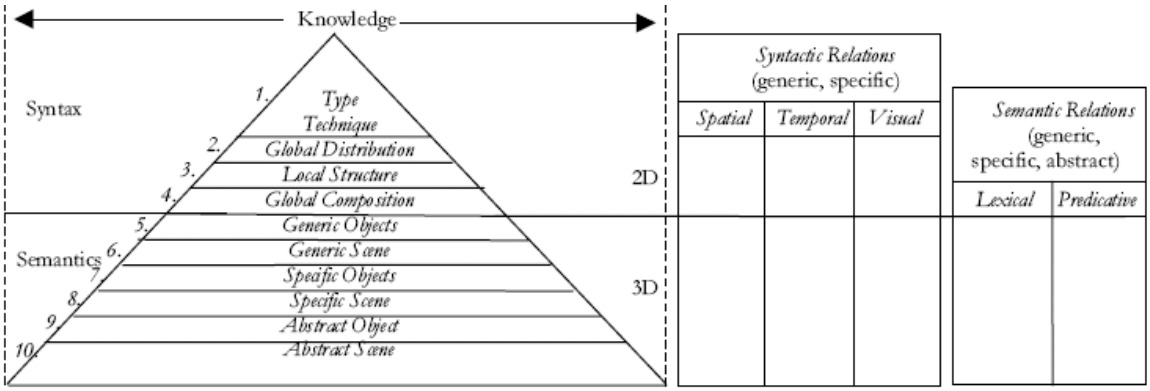

Figure 1: Pyramid model of visual image attributes (Jaimes and Chang 2000)

The top four levels of the pyramid represent levels of image description concerned syntactically with percepts. The lower levels represent semantic and conceptual levels of description. The width of each level in the pyramid represents the amount of knowledge or expertise needed to index at that level. CBID has been concerned with the six levels at the base of the pyramid. Elements in levels 2 through 10 can be syntactically related spatially, temporally, and/or visually. Semantic relationships can be described for elements in levels 5 through 10 only.

In a separate framework, Jaimes and Chang (2000) present types of non-visual image attributes in three levels: physical attributes, biographical information, and associated information. The availability of this non-visual information is valuable in enabling the indexing of images at the lower conceptual levels of the pyramid.

This framework is notable in its scope, precision, and representation of the complexity of image description. Also, the framework came out of the content-based image retrieval (CBIR) community and is the first to specifically include low-level image attributes unlikely to be perceived or described by people, but potentially powerful for retrieval based on similarity or visual query. Finally, its synthesis of findings from multiple research areas increases the power of the framework. Included in the framework are Shatford's emphasis on the split between generic and specific (1986), as well as Jorgensen's findings on the importance of Object, Location, and Story attributes (1998). Further research has demonstrated the harmony between Jorgensen's image attribute scheme and the Pyramid Model and has shown how the two have complementary strengths in guiding rich image description (Jorgensen et al. 2001).

Hollink et al.'s synthesized framework

Concerned with understanding the gap between what is represented in image databases and what attributes of images users actually use for searching, Hollink et al. (2004) conducted a study using content analysis to categorize image attributes from user-generated image descriptions. The scheme they used to categorize the attributes is a unified framework synthesizing the previously discussed work of Shatford (1986) and Jaimes and Chang (2000) with two frameworks of image search queries. These include Eakins' primitive, logical, and abstract query types (Eakins 1998) and Enser and McGregor's 2x2 matrix of uniqueness and refinement (Enser and McGregor 1992). The combination of findings from work on image indexing and user search queries is explained by the fact that both of these are types of image descriptions. Ideally, the goal is a perfect match between them.

Unified Modeling Language (UML) was used to synthesize the previous schemes into a unified framework with three now-familiar levels: nonvisual, perceptual, and conceptual. Only the conceptual is divided into the general (defined as the basic level or broader), specific (narrower than the basic level), and abstract. User descriptions were analyzed and slotted into these categories. Conceptual attributes were by far more common (87%) than perceptual (12%). The lack of nonvisual attributes is an artifact of the study design, which used imaginary images with no objective associated nonvisual information. 74% of the conceptual attributes were general, with 16% specific and only 9% abstract. This roughly mirrors Jorgenson's findings of the most frequently described attributes falling into the Object class.

Important attributes identified in user query studies

Enser and McGregor (1992) classified user queries of an image collection into a 2x2 matrix with the dimensions of uniqueness and refinement. Unique queries are for specific subjects, while non-unique are for generic . A refined query is qualified by adding another image attribute to the query. "Red-winged blackbirds" would be an unrefined unique query. "Birds flying" would be a refined non-unique query. 70% of queries were for unique objects. Armitage and Enser (1997) found similar results in the analysis of the search queries of users of seven different image collections. They followed up by using Shatford's classification of image subject attributes to analyze the queries in more detail. General similarities exist across all collections. Queries tend to focus most frequently on specific attributes, a bit less on general image attributes, and rarely on abstract attributes. Specific persons and locations are searched for more frequently than specific objects or times. Of the generic attributes, person is searched on most frequently.

These findings on the prevalence of searches for specific image attributes, while limited, are interesting given the preponderance of representations of general attributes in image descriptions as identified by Hollink et al. (2004). Shatford Layne suggests that part of the apparent contradiction in the research may be the different types of image collections used for stimuli or searched by users (2002). The images searched in Hollink et al. (Hollink et al. 2004) were commercial stock photographs searched by design professionals and publishers; however, a preference for specific queries in art image databases has also been found (Chen 2001).

The general level matches up with the basic level of cognitive categorization. This is supposed to be the level at which people most frequently and easily name a concept. Jorgensen (2003) suggests that indexers focus on adding more basic level index terms to items, and that more research be done to identify basic level values for image attributes outside the realm of objects and natural kinds. In practical indexing terms there is good reason to index images more heavily at a general level. General attributes require less knowledge to describe and CBIR systems are likely to be able to extracted general attribute information from the content of images they will be able to identify specific attributes (Jaimes and Chang 2000). However, the purpose of any image retrieval system remains to connect a person with a desired image in the easiest way possible—for this reason it remains important to also attend to specific attributes in description.

As is discussed earlier in this section, concerns exist about the appropriateness of textually representing the aboutness of images—the abstract, connotative attributes (Svenonius 1994). Adequately representing these attributes requires much more indexer knowledge and effort (Jaimes and Chang 2000) and the ability to make decisions about indexing in an area that is subjective, complex, and sometimes ambiguous (Shatford 1986). The aforementioned study of user queries of existing image collections found searches on abstract attributes to be quite rare. Perhaps this is less indicative of the importance of these attributes than it is of low expectation of their efficacy as search criteria in existing databases that do not represent them. Jorgensen's work has highlighted the importance of interpretive story and content attributes (1998). Other work likewise supports the importance of representing the narrative as well as affective attributes of images for retrieval (O'Connor, O'Connor, and Abbes 1999) (Greisdorf and O'Connor 2002) (Yoon 2006).

PRINCIPLES FOR IMAGE DESCRIPTION

Another area of interest in CBID is the development of principles for image description. These include considerations such as what classes of subjects will be indexed and at what granularity an image will be indexed. What is appropriate will vary from collection to collection, but two basic principles seem to be generally applicable.

Two overarching principles for the subject indexing of images are the threshold of detail and the threshold of pertinence (Shatford 1986). The threshold of detail principle tells the indexer not to describe integral parts of a whole which itself may be indexed. For example, if "woman" is described, it is redundant to also describe "face," "hands," and all of the other expected parts of "woman."

The threshold of pertinence instructs the indexer to describe only those wholes that are meaningful in the context of the image. If an image is of a loaf of bread, or a loaf of bread is an important symbol in the context of the image, "loaf of bread" should be described. If the image is of a banquet table laden with foods, among which is a loaf of bread, it is typically unnecessary to describe the presence of the bread.

DEVELOPMENT AND EVALUATION OF IMAGE INDEXING VOCABULARIES AND METADATA FRAMEWORKS

A final topic of interest in CBID is indexing vocabularies and metadata frameworks that have been developed for the description of institutional image collections. Examples include the VRA Core (Visual Resources Association 2007), the Art and Architecture Thesaurus (J. Paul Getty Trust 2000), ICONCLASS (Rijksbureau voor Kunsthistorische Documentatie 2007), and the Library of Congress Thesaurus for Graphic Materials (Library of Congress 2007). While very important in the context of institutional image collections, such tools are not for use in personal image collections and have no relevance to the current discussion.

USER BEHAVIOR

There are three main areas of user behavior research related to the organization of images and their retrieval. The first is the analysis of user image search queries. Relevant studies of this type have been discussed in the above section on image attributes because they have been useful in identifying important attributes and testing existing frameworks of image attributes. The two remaining areas of research in user behavior are outside of the scope of this review but bear brief mention. Much research has been conducted on user judgment of image relevance and similarity. This area is fruitful for the design of image retrieval systems and the development of content-based image retrieval (CBIR) techniques. Understanding the cognitive process of searching for images is another area of user behavior research, but relatively little work has been done in this area (Matusiak 2006).

Different types of users will rely on different image attributes to describe and retrieve images. Hollink et al. (2004) three user characteristics that will affect their image retrieval needs and behavior: domain, expertise, and task. Enser and Sandom (2003) includes a brief discussion of the differing needs of specialist and generalist users.

O'Connor et al. (1999) described a potential image browsing and retrieval system based on allowing users to enter descriptors, annotations, or captions to images they encountered in the system. This user-generated information would then be used by the system to construct categories and access for subsequent users. Such a system would provide a mechanism for capturing and utilizing Jorgensen's Viewer Response class of image attributes. This idea is mentioned here because it seems in recent years to have come to life with the advent and rise of image tagging systems like Flickr (for personal photos) (Yahoo! 2008b) and the Steve.museum project (for art images) (Bearman and Trant 2005; Trant and Wyman 2006). The use of such systems will be covered in more detail in the section of this review that describes what individuals do with their photos.

CONTENT-BASED IMAGE RETRIEVAL (CBIR)

Content-based image retrieval (CBIR) is automatic image processing, organization, and possibly description based on algorithms utilizing the content of digital images. The promise of CBIR includes the provision of more efficient, objective, and predictable methods of describing and searching image collections. Enser (1995) characterizes the current CBID image organization mode as linguistic-linguistic (LL). It involves the retrieval of images using the matching of linguistic user queries with the indexer-created linguistic representations of images in a retrieval system. This is seen as inefficient and problematic. CBIR offers three new modes of image retrieval presented in Table 5.

Image Retrieval Model	Description
Visual-visual (VV)	The query assumes a visual form and the search operation proceeds by attempting to retrieve digitised images which match the query image.
Visual-linguistic (VL)	The visual properties of images in system are encoded in text that can be indexed and searched using textual input and pattern matching techniques.
Linguistic-visual (LV)	Thesaural image classification schemes are visually augmented so that they can be searched which can be searched via visual query. Images with matching visual features would be returned and images associated with them in the classification scheme would be available.

Table 6: Enser's (1995) image retrieval modes

CBIR is currently fairly limited to the processing of low-level, perceptual, syntactic attributes like color, texture, shapes, and basic composition, but the field hopes to make progress in the lower levels of the Pyramid Model (Jaimes and Chang 2000). CBIR techniques have heretofore not become useful or interesting to general users, though they are quite powerful for some specialized image types. This is blamed on the still-yawning "semantic gap" (Enser and Sandom 2003).

The semantic gap has been defined by Smeulders et al. as ". . . the lack of coincidence between the information that one can extract from the visual data and the interpretation that the same data have for a user in a given situation" (2000, p. 1353). Methods of attaining CBIR's current goal of closing the semantic gap fall into two camps. Work is being done on developing algorithms to break down raw images into separate features and learning how to interpret those features as generic objects. Other research focuses on developing the high-level reasoning necessary to place those generic objects in sociocognitive space and to label them properly as specific image attributes (Enser et al. 2007).

Reaching these goals will take time, especially in large, general image collections. Limited, well-defined domains make machine learning and processing much simpler. It is possible that advanced CBIR techniques such as face recognition (specific person identification and description) will appear in general usage in tools for personal image collections. The reasoning here is that personal and family image collections are more constrained; there are fewer faces to differentiate from one another and more examples of each face for the machine to learn from.

It is not yet known whether such capabilities would greatly improve the situation of the general consumer photographer and her personal or family image collection. Relatively little is known about the image organization practices and needs of this population. The existing literature is review in the following section.

ORGANIZATION OF IMAGES IN PERSONAL COLLECTIONS

Personal image collections in this review are defined as collections of images created and/or gathered by individuals primarily for use outside of work contexts. This includes family image collections—collections of images created and/or gathered by a family for the use of those in the family.

The importance of studying the organization of personal image collections

The number of photographs taken by individuals shows great increase with the increasing availability of stand-alone digital cameras and digital cameras built into other nearly ubiquitous items such as mobile telephones (Rodden and Wood 2003) (Frohlich and Fennell 2007). Individuals need systems or tools to maintain some level of control over the photos they take. Chen et al. (2006) provide a concise review of many tools that have been produced and the principles upon which they are based. Some suggest that the need to understand the practices and needs of individuals when designing these tools has been often overlooked in the development of these tools (Vroegindeweij 2001). Others note that these tools have tended to constrain what the user can do with photos, rather than expand the possibilities (Frohlich et al. 2002).

Crabtree et al. (2004) have described a photo practice ecology that includes the use of conventional photos and their management. The entire ecology must be understood broadly in order to provide support for any discrete part of photo practice. A large focus in photoware development has been on designing tools to support two of the most important uses of personal photos: sharing and storytelling. To support this end, user research has been conducted to discover how people share photos and tell stories using them (Balabanovic, Chu, and Wolff 2000) (Crabtree, Rodden, and Mariani 2004) (Frohlich et al. 2002) (Miller and Edwards 2007).

Less is known about the rest of the photo practice ecology, particularly the background personal information management work that supports the activities of sharing and storytelling with photos. This work, named “photowork” by Kirk et al. (2006), includes the organization of photos so that individual photos can be retrieved at a future point for sharing (Crabtree, Rodden, and Mariani 2004). A 2005 survey asked 763 professional photographers about their primary issue or challenge with photo management and found a cluster of concerns the researchers labeled "time consuming, learning related issues." The issues so labeled are: photo management, tagging/cataloging, learning/keeping up to date on technology, time consuming, search/locating files, and workflow (InfoTrends 2006). This is among professionals for whom photo management is a priority, so it seems consumers would only have more trouble. This indicates that research on photowork is necessary in order to understand the photo practice ecology and inform the development of tools that can better support photo practice.

The increasing accessibility of digital photography has complicated photowork in several ways. Because there is no cost associated with taking and viewing a digital photo beyond the initial cost of the camera equipment, people take many more digital photos than conventional photos. As the size of a photo collection increases, it becomes more important, yet possibly more difficult, to do photowork in order to use the collection. One reason for the increase in collection size related to the lack of any cost per digital image is practice of capturing non-identical multiple photos—slightly different photos taken of the same subject (Rodden and Wood 2003). Similarly, many original digital photos are edited after creation. The edited versions are often saved as new files, leaving the original photo file unchanged. The end result is another type of non-identical multiples. The ease of simple duplication of digital photos once they have been created also contributes to increased collection size (Kirk et al. 2006). Therefore, the problem is not simply one of managing more photos, but also of more complex collections to be managed.

Assumptions and misconceptions about personal photo collections

POPULATION

First, it should be mentioned that the bulk of the research reported here cannot be assumed to apply to the population of interest in the proposed research. The people that have been studied in research on personal photo collections are mainly general consumer photographers. Most of the collections are characterized as "family photos." These people and collections fall squarely into Chalfen's (1987) home mode of pictorial communication—a pattern of interpersonal and small group communication centered around the home and focused on pictorial materials. My assumption is that amateur photographers will approach photography and their photo collections differently. They are interested in the process of photography as a skill to be learned and in the artistic end result of that process whereas those in Kodak culture are snapshooters concerned with capturing memories of events and to share with people in their lives (Slater 1991; Miller and Edwards 2007).

This review focuses on the organization of these Kodak culture personal collections for two reasons. First, I identified very little research focusing specifically on amateur photographers and their photo collections. Second, it may be interesting to compare the findings of the proposed research on the organization of personal photo collections of amateur photographers with the findings from the literature reviewed below.

CONTENTS OF THE PERSONAL COLLECTION

The assumption of most of the research in this area is that the personal photo collection consists of photos taken by the person or family that owns the collection. In truth, personal photo collections have not only been found to contain photos from other sources, but also images that are not photographs. This issue of multiple sources and multiple types of images in the personal collection issue has been mentioned in a few only studies. Koh and Kerne's study (2006) of undergraduate student collecting behavior did not focus only on photos and images, but the collections examined included images. These images were of various types including photographs taken by the participants and their friends, photos from the popular media (movie star or musician photos, etc.), art images, and other images saved from the web for various personal or academic uses. Descriptions of the personal photo collections of 22 undergrad students revealed that these collections consist of photos taken by the students using one or more digital cameras, including mobile phones; photos received from friends and relatives via email attachment, by SMS, or on CDs, and images found on the web. In addition to regular photos the collections include photos that have been modified using graphics software, cartoons, and drawings (Cunningham and Masoodian 2007). Users of the photo sharing website Flickr reported that photos received from others enter their personal collections. These users either filed these photos as "received" or integrated them into their overall filing structure (Miller and Edwards 2007).

It is no paradox, however, to find content from other sources in the personal collection. Much of the content of interest in PIM research originates with sources other than the people participating in the PIM studies. We must all deal with the information that comes at us from all sides in the course of our lives. The acquisition, addition to a personal collection, maintenance, and use of any content by an individual makes that content personal. In a study of the use of personal photos and purchased commercial music, people were found to treat the two types of information in similar ways despite the differences in format and origin (Bentley, Metcalf, and Harboe 2006).

PRINT VS. DIGITAL PHOTOS: A FALSE DISTINCTION

It is easy and convenient to think about print photos as distinct and separate from digital photos. Indeed many papers, including this review, discuss them separately. It is important, however, to admit there is not a clear distinction between the two. An industry now exists to scan photographic prints, rendering them digital images (Red Mountain Media Group 2008) (ScanCafe Inc. 2008). Digital photos get printed and are then treated like any other photographic print (Frohlich et al. 2002). This review will refer instead to a distinction between digital and conventional photography, where the latter describes the photography that begins with film in a camera that is developed into photographic prints.

How people keep and organize their personal photo collections

Photowork is a specialized form of PIM. The types of studies that have been done on personal photo collections are similar to the majority of PIM studies: qualitative, semi-ethnographic explorations of the practices of a small sample of people. The results of any one of these studies are not generalizable to a larger population, however, similar findings consistently emerge across the studies, indicating some basic patterns in how consumer photographers tend to organize their personal photos. As in studies of PIM, a wide range of photowork practices has been identified. These practices are summarized below.

CONVENTIONAL PHOTOS

The significance of a photo or collection of photos to an individual will often influence how that photo or collection is kept and organized. A couple's wedding photos may be kept in a special wedding album, while their children's school photos are kept in a special photo file box. Photos from family vacations are less precious and are perhaps placed into a stack in a cabinet (2004). Very important and meaningful photos are often displayed. Usually this means the prints are shown in frames, but it can also include wallet pictures, unframed prints hung in the office and any other ways of displaying a photo. Frohlich and Fennel (2007) and Rose (2003) have written about the importance of the displayed photo and the importance of its placement. The main methods of organizing conventional photo collections are summarized below.

THE PHOTO PROCESSING ENVELOPE

Conventional photos are taken with film cameras. The film is then sent out for processing. Film negatives and photo prints are returned to the consumer in a photo processing envelope. This envelope is commonly the basic unit of organization in a personal photo collection (Rose 2003). There are several advantages of retaining photos in the photo processing envelope. First, it requires no extra materials or effort. Second, the prints within each envelope are in film exposure order, which corresponds to chronological order. Given the usual way of flipping through photos by placing the top photo on the back of the pile, it is not difficult to retain this order. Even if this order is lost within the contents of a photo processing envelope, keeping the photos in their respective envelopes can allow a rough chronological arrangement. Photos taken on one roll of film, regardless of how long it takes to use up the roll of film, are together in one envelope (Rodden and Wood 2003). Of course, this affordance assumes that only one camera is being used over any period of time by a person or family. Another advantage of the photo envelope as a unit of organization is that it preserves a link between film negatives and photographic prints (Vroegindeweij 2001).

THE SHOEBOX

It is common for conventional photos to be stored in shoeboxes, special photo boxes, or other similar containers. Often this type of box is a larger container for storing the photo processing envelopes. The envelopes can be filed in the shoebox in order of receipt, maintaining the rough chronological order mentioned above (Balabanovic, Chu, and Wolff 2000) (Rose 2003).

THE ALBUM

The photo album is the pinnacle of photowork involving conventional photos. In families, mothers typically feel responsible for chronicling family memories in albums (Rose 2003). The album generally consists of a carefully selected and ordered set of photos, presented in a book-type format (Balabanovic, Chu, and Wolff 2000). Prints that are judged as "good" are actively selected (Frohlich et al. 2002)and arranged, usually in chronological order, within an album. Albums tend to be classified by event, often with one album per event. Likely due to this careful process of selection and arrangement, photos in albums are viewed more than photos left in their envelopes (Rodden and Wood 2003). Unfortunately, compiling an album is a time-intensive activity that is rarely an urgent priority of life. In most cases, prints remain in their envelopes, or sometimes in "temporary" albums that end up becoming permanent (Frohlich et al. 2002). Having an external motivator for the creation of an album—giving it as a gift or planning to share it at a special event—increases the likelihood that the album will be created (Vroegindeweij 2001).

ANNOTATION

The ideal album is one annotated with information about the event, the location, and the people appearing in the photos, but this level of description is rarely achieved for the reasons explained above (Frohlich et al. 2002). Stay-at-home mothers mentioned the importance of dating photos, but confessed they rarely get around to doing this (Rose 2003). Even less detailed annotation, such as the labeling photo processing envelopes, happens rarely. Rodden and Wood (2003) identify an "annotation paradox": Because one does not need annotations when one remembers who and what is in a photo, annotating photos while they are recent is a low priority and is not done. Annotations become important when one does not know who or what is represented in a photo, but then it is too late to annotate.

DIGITAL PHOTOS

Crabtree et al. (2004) developed their idea of the ecology of photowork practice in the context of conventional photos. The introduction of digital photographs into the conventional personal collection is a step outside of the normal ecology. Different tools are used and different strategies are needed. Unless all of the conventional photos are scanned, or all of the digital photos are printed people are now facing the problem of multiple hierarchies in the management of their photo collections (Boardman, Spence, and Sasse 2003).

CONCEPTUALIZING DIGITAL PHOTOWORK

In order to conceptualize this space outside the conventional photowork practice ecology, two schemes describing the tasks and lifecycle of digital photowork and one model for thinking about the different ways in which this work can be accomplished have been developed. Vroegindeweij (2001) identified three subtasks of digital photowork as view and retrieve, sort and add, and storage and media. There are also three stages in Kirk et al.'s (2006) lifecycle of digital photowork: pre-download, at download, and pre-share. The pre-download stage includes image capture and sometimes on-camera editing. Activities undertaken in the at-download stage include downloading and filing pictures. Editing on the computer may take place between downloading and filing, and back-up may be done after filing. The pre-share stage includes another round of editing, possible photo printing, and then sharing.

Vroegindeweij (2001) also introduces a 2x2 matrix for thinking about different digital photowork systems. The first axis is personal vs. shared. This refers to who can see the photos and their organization. If the system is completely personal, it is private: only the creator of the collection can view the photos and their structure. There is a continuum of openness on this axis. Shared systems may be viewable by a few select individuals, or by anyone with an internet connection. The second axis is hierarchic vs. dedicated. A hierarchic photowork system relies on the hierarchic directory structure of the computer's operating system. The photos are arranged in levels of folders. A dedicated system uses specialized software based on the metaphor of the album. A personal, dedicated system would allow a user to create albums on his own computer. Picasa is one example of this sort of system. Examples of a shared, dedicated system could include any of the web-based photo sharing tools which allow the creation of albums. Most of these give the user some control over who can view her albums. The "My Photos" directory on a user's computer would constitute a personal, hierarchical system, while moving such a directory to a web server and allowing others to navigate it and view the images in the photos would constitute a shared, hierarchic system. There is a bit of a false dichotomy in this model, however, as many albums created with dedicated software are hierarchically organized. These applications present the hierarchies in a more attractive and navigable manner, and usually allow titles, captions, and keywords to be shown with the photos.

DIGITAL PHOTO ALBUMS

The use of dedicated photo albums software for organizing personal digital image collections appears to be relatively unusual. Album-based photo management software is rejected because it is often complicated, and because a simple hierarchical folder-based organization system meets the needs of the users, as discussed below. An exception to this finding is that Mac users are more likely to use the iPhoto software that is their operating system's default tool for photos (Kirk et al. 2006).

People do create digital equivalents to the conventional photo album for sharing images, but they do not organize their entire collection in digital albums. This is parallels conventional photo collection management, in that creating an album is a special, separate activity outside the basic management of the collection. The ability to create these albums is predicated on the photowork done to maintain the collection so that images can be located and used. Kirk et al. (2006) point out that people do not typically approach the management of their personal photo collection as a long term, overall activity. Rather, various short term tasks involving photos (adding new photos to the collection, editing photos, choosing photos to upload to a personal website, emailing photos to family, etc) drive the management of the collection. The preparation and description of sub-collections of images to share is a large part of this activity. They suggest that software tools leverage the implicit metadata created in these activities to provide better access to photos. In a sense, and on a much larger scale, Google image search provides an example of this. The results of a Google image search are not retrieved because they were specifically described for retrieval. To automatically index web images, Google analyzes text adjacent to the images in web pages, the file names of the images, and many other factors in addition to image captions (Google 2008). Even though an image has never been explicitly described as being of a cat, it could be retrieved in an image search for "cats" because of how the image is used on a web page. Likewise, how a person uses her personal photos could be analyzed to sort or automatically describe those photos.

HIERARCHICAL FOLDERS

Despite the attractiveness of and features offered by digital photo albums, the hierarchical folder structure of the computer's operating system is generally the preferred of organizing the overall personal photo collection. Multiple studies have confirmed this finding (Vroegindeweij 2001) (Rodden and Wood 2003) (Frohlich et al. 2002) (Kirk et al. 2006). When a batch of images is downloaded from a digital camera, they are usually automatically placed in a folder labeled by default with the date of image download. Typically, one folder on the hard drive is designated as the destination for these downloads, so this folder becomes filled with these dated batches of images in subfolders.

This folder-based organization is analogous to the common arrangement of conventional photos in photo processing envelopes inside a shoebox, and it seems to work for the same reasons. The file naming conventions of digital cameras ensure the maintenance of chronological order, and the downloading of images in batches supports keeping groups of images together. The studies above found that people often download their digital photos after events so that all of the photos from the event are together in a folder. If there are a large number of photos downloaded in a batch, people will sometimes organize images into subfolders of this dated batch folder. They also often edit the batch folder file name, leaving the existing date, but adding the some indication of event or occasion to the end. Beyond this editing, annotation of digital photographs in the personal collection is rare. This makes sense, as the annotation of individual files is not well supported at the basic operating system where this photowork is being done. Also, in strictly personal photo collections, the annotation paradox would still be in effect.

PHOTO TRIAGE

The sorting, selecting, and filtering of photos have been identified as important tasks in photowork (Vroegindeweij 2001) (Frohlich et al. 2002). Kirk et al. (2006) found this "photo triage" work to be a key task at multiple stages of the digital photowork lifecycle. The first two stages at which this triage process tends to occur are on the camera and when downloading photos from the camera to the computer. On-camera triage is generally only conducted when data storage becomes limited. Triage at the time of download is more common. At each of these stages, photo triage tends to focus on the general quality of the photos. Overly blurry or dark photos, unflattering portraits, and photos that did not capture the intended subject may be discarded. The number of non-identical multiples of a single subject may be winnowed to the best shots of that subject. The third stage at which photo triage occurs tends to be before sharing the photos. This includes sorting and filtering to decide which photos to feature in an album, send to relatives, or post to the web. Here the triage focus tends to be on choosing the best quality photos of each subject a person wants to share and selecting the most appropriate photos for the intended audience. This often means choosing one photo from any group of non-identical multiples.

The prominence of triage work in the digital photowork lifecycle indicates a user need that photoware systems could support. The typical focus in photoware development has been on designing systems that can automatically sort or organize enormous numbers of photos. Frohlich and Fennell (2007) point out that there is a greater need for interfaces that allow people to easily compare and sort their photos. The result of supporting this triage work would be smaller image collections which would be easier for people to organize and use.

SEARCHING AND BROWSING IN THE PERSONAL DIGITAL PHOTO COLLECTION

Several studies have found that people search their personal digital photo collections relatively rarely (Rodden and Wood 2003) (Bentley, Metcalf, and Harboe 2006) (Kirk et al. 2006). Chronological, event-based browsing is far more common, and most people report this method is sufficient for finding photos (Miller and Edwards 2007) (Cunningham and Masoodian 2007). The prevalence of chronological, event-based browsing for photos may be in part explained by almost pervasive findings that the most recent photos in a collection are the most frequently used, browsed, and viewed. Users in only two of the studies reviewed here reported interest in going back to look at older photos (Cunningham and Masoodian 2007) (Rodden and Wood 2003). People are familiar with their recent photos, and so there is little need to search for them in order to use, browse, or view them.

Rodden and Wood (2003) found that, though searches of personal digital photo collections are relatively rare, the types of searches conducted fall into three categories. The most frequent searches are conducted to find the set of photos from a particular event, such as a holiday. Next, people search for specific individual photos that they remember. Searches for photos sharing a property (such as the depiction of a certain person) but taken at different events are the least frequently conducted.

One cannot assume that these frequencies reflect user need or desires; they may instead reflect the affordances of the photoware tools in use. The most common method of organizing photos is in the hierarchical directory structure of the computer operating system. Especially if the directory names are edited to include an event label, searches on dates and events will be possible. Specific individual photos may likewise be searched for by event or date. Most photoware tools will also support these search types because they use the automatically captured date information to enable the chronological ordering of photos, and provide for the grouping of photos into folders or albums which can be labeled with event name.

The least frequent type of search—for photos sharing a property but taken at different events—is the least likely to actually be possible in available photoware systems because it assumes some level of semantic indexing or description at the individual photo level. The basic operating system file structures most commonly used do not support this level of description in an easily usable way. Even in photoware tools that make this level of description easier, the annotation or indexing of individual photos research findings so far indicate this is unlikely to be done with any consistency or completeness. Content-based image retrieval cannot yet provide access at the semantic level of interest to end users. For these reasons, searches for all photos sharing a specific property are not likely to be possible. If they are possible, the results will at best tend to suffer from low recall. Therefore, this type of search will not be frequently conducted.

With advances in both digital camera technology and content-based image retrieval, more automatic capturing of image descriptions will be possible. Already, some digital cameras and camera phones are equipped with GPS. These automatically record the geographic coordinates of the photographer's position at the time each image is created in the image's EXIF file along with the date and time of image capture and camera settings such as shutter speed, focal length, and aperture. Automatic face recognition may be accomplished in personal image collections before it is feasible on a large scale. When such contextual information is automatically available, image search behavior in the personal collection may change.

COMPARING THE ORGANIZATION OF IMAGES IN PERSONAL PHOTO COLLECTIONS AND INSTITUTIONAL IMAGE COLLECTIONS

DIFFERENCES

Turner (1999) developed a typology of image collections which identifies the characteristics of image collections along the following facets:

- personal or institutional collecting entities
- users
- activities
- images collected
- responsibilities for collections.

In this typology, collecting entities are identified as having characteristics including status (public/private), type of institution or sponsor, physical organization, and collector. “Type of institution or sponsor” appears to refer to the creator of the collection—artists are included as one type. “Collectors” appear to be the institutions that keep and maintain the collection. The examples here include large institutional library, museum, and corporation. Personal photo collections can be fit into this typology if one considers individuals and families to be local, private, personal collecting entities.

After fitting personal photo collections into the typology, one can use it to compare them with institutional collections on other facets of the typology. A facet with major differences is “users.” “Type of use” is the most relevant aspect of this facet. In personal collections, main uses include sharing with others, storytelling, and remembering. In institutional collections the range of uses will be wider because of the larger, heterogeneous user base and the makeup of the collections. The uses will depend on the nature of the collecting entity and its mission.

The “images collected” facet includes type of images collected. Again, for institutional collections, this will depend on the nature of the collecting entity and its mission. In an institutional collection, the types of images collected will vary, but the goal is to build a collection that will meet the needs of the entire population of users. As mentioned above, personal photo collections often contain other types of images besides photographs, from sources other than the collector. However, all of these images hold some meaning to or interest for the collector, indicated by their inclusion in the collection. They are made for and by a user base of one (or, in the case of the family collections, a small few).

The above review has shown large differences in the methods of organization of images in these collections. Institutional collections take a formal approach to organizing and providing access to image collections. The research on important image attributes reported above is meant to inform the design of databases for image retrieval in this context. In contrast, the most common method of organizing the personal photo collection is a set of directories labeled by date and event. Most users say this method of organization is sufficient for their personal collections. It is unlikely anyone would find this method sufficient for organizing institutional collections. One reason for this is simply the differences in the scale of institutional and personal collections. Institutional collections are typically much larger than personal collections and therefore need more involved control and access systems.

A more important reason for the differences in methods of organization of images in these two types of collections is the distinction between finding and refinding. Users of institutional collections do not know the extent of what is in the collection and often have not previously seen the items for which they are searching; therefore, institutional collections must support finding. The contents of personal image collections have been created or collected by the individual who will later be using the collection, so these collections must support re-finding. As was covered in the review of personal information management, finding and re-finding are two different tasks with differing requirements.

SIMILARITIES

In the past several years web applications for sharing and exploring content have emerged that incorporate tagging as an important description and access mechanism. Many such tools exist for many types of content, including URLs (Yahoo! 2008a), academic papers (Oversity Ltd. 2008), music (CBS Interactive 2008), and blogs and blog posts (Technorati, Inc. 2008). Of particular interest here are photo sharing sites with tagging. The most notable and popular of these is Flickr (Yahoo! 2008b). In Flickr, an individual has an account to which he or she can add photos. The general assumption is that these will be photos taken by that individual, though users can upload any sort of image from any source to their own accounts. Each account features some or all of the content of a personal photo collection. Photo sharing and browsing is the main purpose of Flickr. Photos can be kept private, but most photos are shared publicly or with a chosen set of specific people.

The ability to share one's personal photos publicly in some ways makes these shared collections of photos similar to institutional collections. All photos publicly shared on Flickr become part of vast larger photo collection that comprises the bulk of the site. The user base for these personal photos now becomes immense, heterogeneous, and for the most part, unknown. When users of Flickr move outside their individual photo collections and any other accounts they regularly follow, the main activity becomes finding images rather than refinding them.

These changes appear to affect how people organize their own personal collections, or at least those parts of the collections made available to others in public systems. Overall, people report tagging their photos not for themselves, but to build community on the site and help other people find their photos (House 2007) (Miller and Edwards 2007). Users sometimes tag (albeit cursorily) despite finding the process to be boring or difficult; however, some people go to great lengths to thoroughly tag their photos with synonym terms, plural forms, and even equivalent terms in other languages (Beaudoin 2007; Cox, Clough, and Marlow 2008). Personal photos are not being tagged to facilitate refinding—they are tagged so they can be found. Since the impetus for describing photos in these openly shared collections is no longer remembering and revisiting, the annotation paradox present in unshared personal photo collections disappears.

Morrison (2007) derived a typology of motivations for tagging from an analysis of a variety of tagging systems. Some motivations that particularly apply to personal image collections include a) increasing the exposure to photos by generating traffic; b) voicing opinions; and c) taking advantage of functionality built on top of a folksonomy. Tags facilitate these in different ways. First, tags increase exposure by making photos findable and browsable in the larger Flickr collection. The concern with generating traffic and feedback on one's photos is backed up by recent research on Flickr users (Cox, Clough, and Marlow 2008). They found that other methods such as targeted commenting, group participation, and strategic posting of images are also used to maximize exposure and feedback. Second, tags express opinions when people use them to make statements regarding the *aboutness* of their photos. People can tag the photos of others in Flickr if those other people have set their account options to allow this. When this is allowed, tags are often used to voice opinions on the quality of photos (Dennis 2006). Finally, Flickr builds a variety of useful features on top of the folksonomy created by individual taggers. Cox et al. (2008) suggest that people tag to make their photos browsable via folksonomy-based functions browsing functions, since tags are not necessary for searching.

Analyses of the tags assigned in photo sharing systems suggest that these tags generally fit into the models of image attributes and descriptors developed in research in the context of institutional collections (Alexander 2005) (Beaudoin 2007). The exceptions can be explained by the dual personal/social nature of photo sharing systems. “Signalling tags” such as *top50, deleteme*, and *saveme* are described as those that communicate that other users should take action on a photo or recognize the importance of a photo (Dennis 2006). Signalling tags may be applied by the creator of a photo, or by viewers of that photo if the creator has public tagging enabled. A parallel can be drawn between the signaling tags found in photo sharing systems and the time, task, and emotion-based persona tags sometimes applied in the scholarly paper tagging system CiteULike (Kipp 2007).

To study user descriptions of shared photos not based on tagging, a system was designed to support the annotation of shared photos (Alexander 2005). The annotations entered by users were analyzed and found to be characterized by four descriptive dimensions: word types used in annotation, length of annotation, creative vs. descriptive annotation approaches, and structure. Structure characteristics parallel the image attributes identified in other studies, including *who, what, location, event, action, timeline*, and *emotion*. The most frequently described characteristic was *what*, followed by *who*, as Jorgensen's (1998) work would predict. In decreasing order of frequency, main English word types used in annotations were common nouns (40%), proper nouns (25%), verbs (19%), adjectives (11%), adverbs (5%). The high frequency of common nouns supports Hollink et al.’s (2004) conclusion that general attributes are described more often than specific attributes. Finally, 33% of the annotations contained emotion description, confirming the importance of affective image attributes identified by Griesdorf and O’Connor (2002). There seems to be some evidence that important image attributes for description may be the same in institutional and personal collections, at least when the latter are shared with others.

Layne (1994), in the context of institutional image collections, states that the goals of image indexing are: to provide access to images based on the attributes of those image and to provide access to useful groupings of images in addition to access to individual images. These goals also apply to personal photo collections. People tend to look for photos taken at a certain time or at a certain event, so the attributes of time and event are most important in personal collections. These attributes can be described and browsed using a simple hierarchical folder system. Rodden and Wood (2003) reported rare searches for photos sharing a certain attribute other than time or event, but it is unknown whether these searches would be more frequent in systems that better supported the description of individual photos. The most common searches, aligned with Layne’s second goal, were for sets of images.

CONCLUSIONS

REGARDING PHOTOWARE

Building good photoware tools that will support the needs of users requires an understanding of the real ecology of digital photowork and digital photo use practice. Based on the findings reported above, one of the most pressing needs in photoware is support for photo triage—the comparing, sorting, filtering, and weeding of the personal digital photo collection at various points in the photowork lifecycle. A simple folder-based organization scheme based on events in chronological order seems to meet the needs of most people, so focusing on developing sophisticated automatic classification features for photoware is probably misguided. In fact, some people choose to use the directory structure of their operating system to organize their photos because it gives them more control over how their photos are organized and managed. Vroegindeweij (2001, p. 32) writes that, "in reality people like to apply their own organising strategy, which develops and changes over the years." They do not want to adapt their practice to meet the design of a specialized photoware tool. The annotation of unshared digital photos in private personal collections is rare. This could be caused by the same annotation paradox found in conventional photowork, but it could also be affected by poor support for easy and natural annotation. Photoware should provide the capability to annotate and index photos at the folder or album level instead of requiring this work to be done at the individual photo level.

WHAT WE DON'T KNOW ABOUT PHOTOWORK: PLANNING FOR THE FUTURE

The ways in which people create sub-collections of digital photos for sharing has been little studied. However, a major lacuna in knowledge about digital photowork is the long-term archiving, preserving, and management of photos. One of Vroegindeweij's (2001) digital photowork subtasks is storage and media, which includes personal archival storage. Kirk et al. (2006) briefly treat the topic, reporting that keeping their photos on their hard drives seemed adequate for many of their subjects. Others reported saving photos to CDs, but this might be precipitated more by running low on hard drive disk space than by any concern about preserving or archiving the photos. Rodden and Wood (2003) identify long-term storage of digital photos as a concern that should be investigated further. While this topic is treated in the digital curation and preservation literature, the focus does not tend to be on strategies for personal collections. To fill this gap, people's long-term keeping strategies should be investigated in studies of photowork. Another approach might be to analyze the coverage of this topic or the lack thereof in the popular literature about how to do photowork, since this might be the only place many people would encounter an idea of the importance and difficulty of long-term strategies.

WHAT WE DON'T KNOW ABOUT PHOTOWORK: OUTSIDE THE "HOME MODE" OF PHOTOGRAPHY

Research on photowork in personal photo collections has focused almost exclusively on average consumer photographers and general personal/family photo collections, but there are indications that other modes of personal photography and photowork exist. In their study of general consumer photographers in the home mode, Frolich et al. (2002) discovered that photos taken in the course of a hobby, or to document the activities of a hobby, were treated differently and were more likely to be shared publicly than the regular personal or family photos. These were photos were not described as results of photography as a hobby, but nevertheless their difference from the rest of the personal collections indicates different modes of photowork exist related to hobbies.

In their study of Flickr users, Miller and Edwards (2007) found that their sample contained two different types of users that they named Kodak Culture users and Snaprs. Kodak Culture users are typical consumer photographers in the "home mode" as described by Chalfen (1987), while Snaprs appear to be serious leisure photographers. Their goals for taking photographs and using Flickr were focused on improving their photography skills, creating and sharing artistic images, and building a community of people with similar interests. Snaprs' photowork practices were very different from those of the Kodak Culture users. Snaprs tended to download, process, and organize their photos more quickly after initial capture. They also viewed this work as an enjoyable part of their photography-related activity. They preferred to use the basic directory structure of their operating system to organize their photos, explaining that this strategy gave them more control over the photos. Finally, they were heavier users of Flickr than the Kodak Culture users, did not consider their photos to be private and personal, were more likely to share their photos publicly on Flickr, and were interested in using the site to build a wider community to support photography skill building. The Kodak Culture users tended to use Flickr to share photos with specific family members and friends only.

If Miller and Edwards' (2007) Snaprs indeed are serious leisure photographers, the study is a first glimpse at how tools like Flickr may have changed the landscape of serious leisure photography as a hobby. Alternately, the old landscape may be intact, and the Snapr-type hobbyist may be a new kind of serious leisure photographer. Flickr and its communities of Snapr-type users look very different from the amateur photo contest communities studied by Grinter (2005). Grinter did not examine individual photographers or their personal collections, but how classification was used to deal with large numbers of submissions to photo contests and organize the activities of the group. She traces how the advent of digital photography necessitated the re-working of the classification. These communities were much more structured and formal than the communities of Snaprs; however, it should be noted that photo communities that run contests do exist on Flickr. The structure of these groups might be more appropriately compared with Grinter's findings.

The photowork practices of photobloggers and participants in webcam and photo portal communities have also been found to be quite different from those of typical consumer photographers (Cohen 2005a) (McDonald 2007). These photographers cannot be categorized as serious leisure photographers simply because they photoblog or participate in communities—serious leisure photography and online photo posting and sharing are overlapping, but distinct activities. These studies do provide additional evidence that there are populations with ecologies of photowork practice that differ from what has been described in the bulk of the photowork research.

The proposed research aims to fill the intersection of gaps in knowledge about long-term photo keeping strategies for personal photo collections and the basic ecologies of photowork practice developed by photographers outside the typical consumer "home mode."

PERSONAL INFORMATION MANAGEMENT (PIM)

The PIM literature can be roughly divided into two categories: research into user behavior, practice, and needs in PIM; and development and evaluation of PIM tools. I focus on the former in this review. The review begins with an analysis of definitions of PIM. Next, the basic activities of PIM are discussed. Then, I discuss the types of information objects considered in studies of PIM, and summarize the main findings regarding the management of specific information objects. This discussion highlights the central problem of PIM: fragmentation of information, which is described. Next, I discuss two things that appear to be constant across different forms of PIM, despite fragmentation. These are the importance of contextual cues and document attributes in PIM, and the emergence of basic PIM personalities. Then I pose two questions: what now, and so what? I will outline the main outstanding challenges in PIM research.

DEFINING PIM

Defining the object or field of inquiry situates the work and bounds its scope. I will begin by exploring some definitions of personal information management. A gradual broadening of the scope and focus of the definition of PIM emerges, along with three tensions in defining what PIM is.

Broadening the Scope

Though the phrase “personal information management” appears to have been first used by Lansdale in 1988, ideas about what we might now call ideal PIM systems were posited by pioneers in information and computer science long before. Bush’s (1945) memex was “a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory.” (Engelbart 1961) proposed microdocumentation, described as “a way to store, retrieve, and manipulate the information within our individual's private domain, with information-packet sizes that match his actual needs (i.e., separate concepts, facts, considerations, etc.).” Nelson (1965) intended “to think out (and eventually program) the dream file: the file system that would have every feature a novelist or absent-minded professor could want, holding everything he wanted in just the complicated way he wanted it held, and handling notes and manuscripts in as subtle and complex ways as he wanted them handled.”

Empirical research on individuals’ PIM practices began developing in the 1960s. Most early work examined the files and indexes of researchers (Jahoda, Hutchens, and Galford 1966; Sauvain 1970; Jahoda 1970; Burton 1972; Leggate et al. 1977; Sauvain 1979; Burton 1981). Burton (1981) moved beyond focus on the personal index by examining the "personal information systems," of scholars, defined as “systems where an individual collects, annotates, and stores bibliographic information according to his own (idiosyncratic) needs and preferences." In his study of how professional and clerical office workers organize the information in their desks and offices, Malone (1983) both looked outside the academic environment, and used the phrase "personal information environment,” highlighting the physical space aspects in which information organization takes place. The first appearance of the phrase "personal information management" in this body of research seems to have occurred in (Lansdale 1988). This study added the organization of information in domestic life to the definition of PIM.

More recently, the scope of PIM has been further broadened. Jones' (2004) definition of PIM "includes all activities relating to the acquisition of new information (whether by deliberate search or more happenstance encounter), its organization into a personal store and its eventual re-access for re-use." The activity of sharing information was included as part of PIM by Teevan, Jones, and Bederson (2006). Finally, Jones (2007) sets forth an ideal of PIM: " that we always have the right information in the right place, in the right form, and of sufficient completeness and quality to meet our current need."

Tensions in definitions of PIM

In examining definitions of PIM, it becomes clear that various researchers have defined PIM differently. Three main tensions in definitions of PIM emerge.

WHAT DOES "PERSONAL" MODIFY?

The phrase "personal information management" is ambiguous because it is not clear what exactly the adjective "personal" is modifying. Is it the information in PIM that is personal, or is it the management of that information?

Lansdale (1988) explained that the information in PIM is not personal in the sense that it is private, but because we have it for our own personal use. He then defined PIM as "the process of managing this type of information: the methods and procedures by which we handle, categorise, and retrieve information on a day to day basis." Before the phrase "personal information management" was coined, Leggate et al. (1977) highlighted that it was the process of working with the information added to one's personal index that made the index unique and useful:

> The communal records of the public data base are transferred to a private data base and given a unique identity by being reformatted, annotated, indexed, or abstracted to suit the personal requirements of an individual or a group. Each personal index is idiosyncratic to the extent that its content and organization reflect the nature of work, the method of working, the technical environment and the personality of its progenitor.

Bergman et al. (2004) define PIM as "the storage, organization, and retrieval of information by an individual for his/her own use. In these definitions, it is clearly the activity of management that is personal.

Others have defined PIM as the management of personal information. Cutrell, Dumais, and Teevan (2006) are interested in "the extent to which search can mitigate the need to organize one's personal electronic information." Here, it is clearly the information that is conceptualized as personal, for they imply the management part is unnecessary.

Bergman et al. (2004) state that "millions of computer users manage personal information (e.g. Files, email, contacts, bookmarks, reminders) every day." This highlights one pitfall of conceptualizing PIM as the management of personal information: one must then decide what is and is not personal information. This is problematic first because the LIS does not agree upon exactly what information is (Capurro and Hjørland 2003; Bates 2006). Second, the phrase "personal information" itself is ambiguous. Lally (2004) defines personal information as information that relates directly to our own lives because it is either about us or created by us, or our ancestors. In popular use, personal information generally refers to information one wants to keep private (Karat, Brodie, and Karat 2006). Neither of these is the personal information that is typically discussed in PIM research.

Recent reviews of PIM circumvent the entire issue by defining personal information so broadly it applies to almost anything, depending on how one defines information. This includes information controlled or owned by a person; information about a person; information directed toward a person; information created, sent, posted, provided, or published by a person; information previously experienced by a person; and information not yet experienced by a person that might be relevant or useful to him (Jones 2008a).

Despite the fact that it ruins a perfectly good acronym, I prefer to conceptualize PIM as the personal management of information because it obviates the need to define “personal information.” It also avoids narrow assumptions about what types of information should be investigated in PIM research. Finally, focusing on the actions of the individual keeps the focus directly on the person, not on the information, the technology, or the system.

A person's interactions with the information in his environment personalize that information for him. The information becomes personal only after a person has engaged with it. It is understanding these interactions and activities of engagement, and how to best support or augment them, that is the concern of my research in PIM.

COMPUTER AND PAPER-BASED PIM

Bergman et al. (2004) described PIM as a "fundamental aspect of computer-based activity—millions of computer users manage personal information (e.g. Files, email, contacts, bookmarks, reminders) every day to support their work and leisure needs." Cutrell, Dumais, and Teevan (2006) characterize PIM as a response to "the need to organize one’s personal electronic information."

Despite the usefulness of computers for managing information, and the vast amount of digital information many people must deal with, a large amount of personal information still exists and is managed on paper. A 1997 survey of 23 technology-savvy subjects in England found that less than one-fifth were using any computer-based technologies to manage their information. All use of computer-based technologies was augmented or supported by use of traditional (pen and paper based) PIM technologies (Jones and Thomas 1997). This study is dated now, but even at that time, the researchers expressed surprise at the lack of use of electronic PIM tools among the population studied. More recently, Whittaker and Hirschberg (2001) examined paper archives in an office amidst a move, and “found little compelling evidence that paper had no role in modern office work.” In fact, people were keeping more paper than ever, devising strategies to organize it, and struggling with information overload.

Finally, Peters (2002) found a striking definitive preference for using paper in PIM work. He concludes that people are familiar with the affordances of paper and that, "those affordances, predictability, familiarity, and generalizability promote the usability of these (paper) artefacts through simple recognition, ease of use and cognitive support that extends the interactions across information boundaries, respectively." Also, unlike most computer documents, paper-based information may be created and arranged in various ways without explicit naming or saving into a rigid hierarchical structure. Given the differing affordances of both paper and computer-based systems for managing information, it is unlikely that computers will replace paper for all information tasks (Sellen and Harper 2002). Recent trends such as the “Hipster PDA” further illustrate the continuing importance of paper-based PIM strategies. The Hipster PDA is simply a stack of index cards held together with binder clips. Its construction and various strategies for its use have been extensively discussed on various web sites, and it appears to be primarily popular among technology-literate people, among them many IT workers (Mann 2004; Wikipedia 2007).

Despite the continuing importance of managing information on paper, the majority of studies in recent years have focused on managing digital information. Comparatively few PIM studies examining individuals' strategies for organizing their paper-based information were identified as being published in the last ten years (Jones and Thomas 1997; Genoni and Partridge 2000; Whittaker and Hirschberg 2001; Sellen and Harper 2002; Peters 2002; Abrahamson 2002; Bondarenko and Janssen 2005).

While we know much about the organization and management of paper-based information from older studies, we know little about what issues arise in attempts to interface one's paper systems with one's electronic information. For example, how does one manage a personal collection of scholarly articles when some of them are kept in PDF format, while others are only available in print? How is a growing collection of music purchased as MP3 integrated into an extensive collection of compact discs? How and why do some people create digital catalogs of their physical collections, such as books, film, or music? The overlaps between the management of paper and digital information are many, and are largely unexplored.

PIM AT WORK, PIM AT HOME AND ELSEWHERE

The bulk of research in PIM has examined the management of information in the context of the workplace. Since about 2002, however, the number of studies looking into or allowing respondents to talk about the management of information outside the work environment has seemed to increase. Peters (2002) explored personal information spaces "in what was considered the usual workplace, home environment or both." Goncalves and Jorge (2003) attempt to characterize the entire personal document space of 11 individuals, across multiple locii. The tasks used in Capra and Perez-Quinones' (2005) experiment in web refinding were focused on everyday life tasks and information needs not tied to work. Jones, Munat et al. (2005b) asked about work and non-work projects in their study of the use of folders to organize information for projects. Koh and Kerne (2006) studied the collections students keep for both fun and for their work. One part of Hartel's (2006) work on hobbyist gourmet cooks as focuses on them as producers and managers of information resources.

Hartel (2003) makes a case for the importance of studying information behaviors in serious leisure and hobby domains. This approach and focus extends the larger movement within library and information science research to study Everyday Life Information Seeking (ELIS) (Savolainen 1995) and information seeking in context (Vakkari, Savolainen, and Dervin 1997). Where there is information seeking, one hopes there is information finding. Once information is found, PIM begins. In the everyday life context, these practices of PIM are mainly unexplored.

Another strand of literature salient to PIM in everyday life outside the workplace is the work done on information and information technology use in the home (Davenport and Higgins 1995; Hindus 1999; Kraut et al. 2000; Rieh 2004; Crabtree and Rodden 2004). In looking forward to ubiquitous computing, smart homes, and how to build tools to support the needs of people in their homes, it is important to understand the needs and desires of the target consumer and user. Many of the home-based tasks these tools will support are at heart personal information management tasks. Merkel (2002) conducted a study on the use of computers and the Internet for home-based "life-managing" in a low-income community. Here "life-managing" was categorized as a form of vernacular literacy. She found that "participants used their computers to make calendars, to organize their daily activities, and to keep track of collections. They looked up information on the Internet to organize themselves and their activities in the home. They planned trips using on-line maps and weather web sites. They used their computer to maintain budges, to check their bills on-line from local utility companies, and to look up financial information from their banks and employers."

In the home it is important to balance the desire for efficiency in home-based production and consumption cycles (Venkatesh 1985) with the need to support play and leisure in the home. Gaver explains that "people do not just pursue tasks and solve problems, they also explore, wonder, love, worship, and waste time." New home-based computing should not hamper these ludic pursuits by perpetuating a work-based model of human-computer and human-information interaction (Gaver 2001).

In the home, the management of physical things, including information artifacts to be managed (Nojima 2005), the patterns of routines (Tolmie et al. 2002; Crabtree and Rodden 2004), and the use of space (Junestrand, Keijer, and Tollmar 2001; Crabtree and Hemmings 2001a; Crabtree and Hemmings 2001b) are foregrounded. Finally, it has been pointed out that computers are not the only technological tools that will be useful in the home (Venkatesh and Nicosia 1997).

In summary, it seems that certain types of research in PIM could nestle comfortably in, and in some cases tie together, the loose threads of everyday life and leisure, information behavior and practices in context, and technology in the home. All of these threads are also reminders that strategies and approaches from the workplace may not be found, or found desirable, outside of work.

MESSES

PIM is often characterized as keeping things organized, and includes systems for doing so. Thinking of being organized tends to bring to mind images of everything neat, tidy, and clean. It is important, however, to remember that there are many types of systems, and many forms and levels of organization. Burton (1981) pointed out that a personal information system may bear "little semblance to a system in any rigorous sense of the word, although many such systems are quite well developed." There are less structured, yet still useful, ways that people handle their information. Abrahamson (2002; 2006) suggests that a certain type and level of mess in an organizational system is efficient and can enhance creativity. Williamson (1998a) outlines problems of finding and reminding that arise on the truly messy desk, when piles have degenerated into undifferentiated heaps. One should not overlook or discount a system or strategy simply because it doesn't look like one.

ACTIVITIES OF PIM

PIM activities are typically broken down into three categories: finding and refinding, keeping, and meta-level activities (Jones and Teevan 2007). This typology has emerged from research in PIM at the University of Washington, but much previous and ongoing research elsewhere fits into it nicely. My conceptualization of PIM roughly follows these classifications, with a few main differences, which I will explain in the appropriate sections below.

Finding

Finding and refinding are combined in the predominant frameworks for discussing PIM activities (Jones 2007; Jones 2008b). On one hand this works well. Strategies such as searching, browsing, scanning, and recognizing are used both to find both new and already-seen information. I may find a web page using Google today, read the page, close my browser, and go about my day. If I want to access that information again, my web browser gives me the option to revisit my browsing history, but often it seems easier just to re-do my previous Google search to re-find the page. In a sense, I'm doing the exact same thing.

But in another sense, everything changed after I initially found the web page. I discovered the existence of the web page and in my attention to and making sense of the web page, I personalized it. I now know something about what the page means to me and whatever I happen to remember about it. It is something in my experience that I have made meaning of. I use this personal knowledge of and previous personal experience with the web page to re-find it. This a very different process from finding. The differences between finding and re-finding are identified in the work using the framework which lumps them together (Teevan, Capra, and Perez-Quinones 2007; Jones 2008b), and it is true that tools are increasingly supporting both activities.[29]

My issue with finding is its inclusion as part of PIM. Definition of PIM associated with this activity framework tend to include "the practice or the study of the activities a person performs in order to acquire…information" (Jones 2008b, 5). This is problematic because it radically broadens PIM's scope by suddenly including within it the vast topic of information behavior and information practices.[30]

My position is that PIM begins at the moment of acquisition. Acquiring information means having that information, even if it is only in your mind. Having a thing (or access to a thing) means you can do something with it. The step of information acquisition means that PIM activities can then take place. The way in which a person acquires information indeed affects his PIM activities on that information, but they are not part of his PIM activities.

[29] In the example of finding the web-page, even though Google is primarily a finding tool, if I have a Google user account, I can access my search history for re-finding purposes. I use the Google Firefox Search extension which makes finding easy, but also saves my queries so I can re-find without even typing in the whole query.

[30] As described in the first section of this review, this literature has heretofore been predominantly concerned with information seeking behaviors and practices--those activities performed in order to acquire information.

An analogy may clarify my point. The content-creation, editing, design, publication, and distribution of an item in very large part define how that item will be cataloged or otherwise described in the organization of library materials. No one would claim, however, that the activities of content-creation, editing, design, publication, and distribution are included in the practice or study of bibliographic control. The process of bibliographic control begins when a cataloger sits down with the item in hand.[31] If one says that the acquisition of information is finding oneself in possession of that information, then PIM begins in this particular moment of finding.

Acquiring

In-depth coverage of the many ways that people come to acquire information is beyond the scope of this review. The section on information behavior and practice covers some of the ways this topic has been modeled in LIS. Its literature is vast and has been reviewed elsewhere (Case 2002). Here, I will present an initial framework of types of information acquisition situations in relation to PIM.[32] What leads to this moment of finding one has information precedes PIM, but is a situational factor which influences PIM decisions and practice.

There are at least four modes of acquiring information: directed information seeking, information receiving, information recognizing, and information creating. A directed information seeking situation is characterized by an active attempt to locate information for a specific reason. It may be a formal, explicit, and conscious process, beginning with the identification of an information need, selection of sources, and formation of a query. It may be a very subtle, almost unconscious process embedded in everyday interaction. If I am in a directed information seeking situations, I am ready for information and have a planned use for it. This can make PIM easier, at least initially.

Information receiving situations are characterized by the passive receipt of information. Many information receiving situations are unsolicited. Some of these are desirable: I might receive a useful citation from a colleague or an interesting news clipping from my dad. All too often, however, the unsolicited information received is undesirable: spam and junk mail are obvious examples. Some information receiving situations are not entirely passive in that they have been actively contrived by a person to ensure they will passively receive information later. I may subscribe to a listserv or RSS feed on a topic. This is related to information monitoring behaviors such as those investigated by Savolainen in his original ELIS study (1995).

[31] For the sake of argument, I'm pretending the LC Cataloging-in-Publication program does not exist.

[32] This is not based on any empirical work on my part or conscious synthesis of specific research findings. Instead it is an attempt to organize my thoughts on the relationship between information seeking and PIM, based on the gestalt of my knowledge of both literatures.

Perhaps unsolicited and contrived information receiving situations should be separate categories altogether since their origins are different. But I am concerned here with the moment of acquisition. A person has little control over any of these situations at the moment of acquisition. Email is a hub for information receiving and it is paradoxically both the home of many people's PIM practices (Ducheneaut and Bellotti 2001) and a big PIM problem area (Whittaker and Sidner 1996; Marshall 2007). When I open my email application each morning it is a torrent of happy surprises, irritating (and by now expected) surprises, and some widely varying number of semi-expected listserv posts. One saving grace is that PIM decisions about unwanted received information are probably the easiest of all to make. But even the happy and requested items can feel overwhelming or annoying at the moment of acquisition.

At a cognitive level, we are all receiving information at all times through our various forms of perception. What information we acquire in a consciously useful way depends on what we notice. This characterizes the information recognizing situation. Here information is not necessarily directed at or sent to us, and we are not particularly looking for it, but we may run across it anyway. This is the kind of information acquisition situation happening in information encountering, defined by Erdelez (1997; 2004) as “when a user actively seeks information related to one problem and unexpectedly finds information related to some other problem.” My conception of information recognizing situation does not require this happen in the context of an active information search, however. These types of situations can be challenging in terms of PIM because we are often focused on other goals when we recognize information.

Finally there are information creating situations, which include creating a spreadsheet, writing an email, taking a photograph, or scribbling down some notes. In each case the creator must make decisions about what to do with the information when it is created. Short term PIM in such situations may be easy if information is created for a specific reason, or in an area where one already has an established PIM structure or routine. Other types of information creating situations can be challenging since many PIM tools do not have good support for fragmentary or ephemeral information.

The type of situation in which one acquires information is very important context for understanding PIM, but has not been systematically explored in the research from this perspective. This is one area in which a Sense-Making approach to studying PIM could be particularly helpful, given Sense-Making's emphasis on Situation Movement States and their relationship with action (see below).

Keeping

Keeping includes deciding whether or not to keep acquired information, and what to do with it if it is to be kept. To keep means to take some action to bring information into a personal collection based on anticipation of the future. The keeping decision is central to personal information management and is fundamentally difficult (Jones, Bruce, and Dumais 2001).

The initial question of keeping is "Do I need or want to keep this?" This can be a difficult question to answer. It requires an understanding of and ability to anticipate one’s own future information needs (Bruce 2005). It also requires the ability to predict whether or not the found information has any sustaining value (Peters 2002). The initial keeping decision has been analyzed as a signal-detection task, similar to separating signal from noise (Jones 2004).

Once this initial decision is made, a cascade of other decisions must be made. How and where should the information be kept? In what form shall I keep it? Does it need to be filed, or can it be piled loosely? If I file it, what do I name it, and into which folder or under which label do I place it? The answers to these questions are dependent on a person's knowledge of his own information needs and extant information management systems (Jones 2004). They are also dependent on further questions about the contextual attributes of the found information and the tools and systems the user has at hand for managing that information. Is the information needed now, or am I saving it for the future? What is that best way to ensure that I remember this information? Do I need to add contextual information to it when I put it in its place? What are the affordances of the tools that I have for managing this information, and what are the costs and benefits of using those tools (Peters 2002)? The result of this decision-making process is some initial organization of the kept information.

Keeping is central to the practice of PIM. Without keeping decisions and activities, little management of the information occurs, and much of the personal meaning and usefulness of individual's collections are removed.

Refinding

Two basic approaches to refinding personal information have been identified in multiple studies. Teevan et al. (2004) called these orienteering and teleporting, and these terms are used here. A third technique of refinding, sorting, can be used as a part of both of these and will be discussed after they are presented.

Orienteering comprises navigating through the information space, step by step. Each new step is informed by the context of the information available at the destination of the last step. This spatially oriented approach is our only option in the physical world, where we re-find information objects by going to where we believe we put them, drilling down level by level, shuffling through papers, and eventually finding what we wanted. In the physical world, we almost unconsciously make use of multiple rich context cues or document attributes, such as form, size, color, and space to find what we are looking for. Despite the lack of such robust contextual cues in the digital environment, people orienteer there by navigating through file structures or browsing through lists of files. This approach has also been referred to as manual search (Ravasio, Guttormsen Schär, and Krueger 2004), and location-based finding (Barreau and Nardi 1995).

The second way of refinding personal information is teleporting. This approach consists of entering a query into a search tool to retrieve desired information directly. Teleporting can only be accomplished in the electronic environment, and it can happen at various levels. One application or information type can be searched, such as searching within the email application for a message. Teleporting can be system-wide, across multiple file types, as in the operating system based search functions or utilities such as Google Desktop. Teleporting also happens on the web at multiple levels. One can use a search engine to search the entire web, or one can use a site-specific search tool to find a specific product in an online store.

Teleporting or searching in personal, already-seen information is different from other searching. The personal nature of the information means that many more contextual cues are associated with the items in the collection. Also, one knows that the desired information is "in there somewhere," which can increase frustration if the information is not found.

Ideal search for supporting refinding would be cross-form, allowing a user to simultaneously search email, files, web content, and other forms of information. It would also need to support searching by rich contextual cues beyond simple keywords (Cutrell, Dumais, and Teevan 2006). The ideal search tool will search across all of the discrete digital information spaces in an individual's information environment. For example, the ideal search would allow you to locate with one search an item that may be stored on your desktop computer, laptop computer, external hard drive containing backups, iPod, or Palm Pilot. Finally, the ideal search tool will also allow for retrieval of information from personal collections at a various levels of granularity (Bovey 1996). Levels of granularity refers to the idea that the information objects a person has can vary from as small as a phone number or a fact within another file, to as large as an entire research report.

As mentioned above, sorting is a re-finding strategy that may be used in orienteering or teleporting. Sorting can be done in a paper-based environment, but computer-based tools are much faster at sorting on attributes supported by those tools. Ducheneaut and Bellotti (2001) found heavy use in email applications of sorting of messages within folders by attributes such as date and sender, instead of a teleporting approach. The contents of folders in the computer operating system can also be sorted by attributes such as date created, date modified, file type, and file size to assist in finding information by orienteering. Finally, many search utilities allow the results of a search to be sorted by various attributes.

The meta-level

The term "meta-level" to describe PIM activities was introduced by Jones (2007) and further described in (Jones and Teevan 2007; Jones 2008a). The meta-level includes organizing and maintaining the overall information structure and the information within it, making sense of information and planning for its use, managing privacy and security, and measuring the effectiveness of PIM practice. These activities require the individual to take a step back from the day-to-day tasks of PIM, consider his or her PIM system as a whole, and how it could be improved. I am primarily interested in the organization and maintenance aspects of the meta-level, and will discuss them below.

The management of information in the work environment has been described as hidden work (Neumann 1999b). People do not tend to give much thought to the hidden work that they do. As various PIM researchers have found, however, once you highlight the work of PIM, and demonstrate its importance by asking individuals about their strategies for research purposed, they begin to think about PIM more deeply, and often begin to reevaluate their systems (Barreau 1995; Boardman and Sasse 2004; Jones et al. 2005b).[33] This indicates that there is some possibility of raising awareness of the importance of PIM, and perhaps educating people on ways to manage their information.

[33] Unfortunately I know of no research into whether this effect persists past the research period. Longitudinal studies of PIM are needed. The one example I know of is Barreau's forthcoming follow-up on participants she studied in 1995 .

To date, PIM research has focused relatively little on meta-level activities, but some studies have touched upon it. Several of the factors that Kwasnik (1991) identified as important in affecting the classification of an item in an office hint at maintenance tasks. These mainly fall under the category “disposition” (change, discard, keep, locate, postpone decision). The maintenance of personal management systems was covered by Barreau (1995), but was generally reported to be of low priority. Seven of her participants, however, cleaned up their filing structures during their interviews. Likewise, Boardman & Sasse (2004) report little maintenance in collections beyond occasional spring-cleans. What maintenance did occur tended to be centered on a major life change. They also conclude that maintenance is of low priority.

In the same paper, however, Boardman & Sasse (2004) later report that most participants participating in the study changed their PIM behavior as a result of their participation. Many reported planning future PIM strategy changes. Out of 31 respondents, 14 reported changes to past strategies including both increases and decreases in level of organization. Some cleaned up their file structures during the interviews. These are meta-level PIM activities and do appear to be of importance to participants. To the users studied by Ravasio, Schär, and Krueger (2004), “archiving was decidedly an important matter,” and maintenance was found to be “an important activity in milestone situations, such as when projects end.” Khoo et al. (2007) report that 10 of 12 subjects in their study periodically adjust their folder structure and delete old files. Some of the subjects report positive affective effects from maintaining their structures, while some viewed the task either with resignation, or as a waste of time. In a study of 20 students, Koh and Kerne (2006) found that 36% of them organize their collections weekly, while 57% organize monthly. These tasks include creating and changing folder structures, renaming folders and files to include salient metadata in the name, and creating index files within folders to describe the contents. While meta-level activities may be of relatively low importance, and may happen much less frequently than keeping or re-finding, the findings I have summarized suggest that they are important to users. More research focused on these activities is needed in order to understand them.

The collections of information that people keep and manage are important to them (Kaye et al. 2006). As increasing amounts of information are collected, created, and kept by people in a digital format, ensuring the long-term accessibility and utility of one's personal information becomes an ever-more daunting task. As will be discussed below, the fragmentation of personal digital information does not mitigate the difficulty of this task. Cathy Marshall and associates have been conducting exploratory research on the nature of this task and the difficulties people face in keeping their personal digital information for long periods of time (Marshall, Bly, and Brun-Cottan 2006; Marshall 2007). Some of the problems found include lack of technical knowledge, lack of time, lack of interest,[34] dependence on others for help, the fragmented and scattered formats, applications, and places in which this information exists, lack of system metaphors and functions that support thinking about the long-term, and the basic fragility of digital information.

[34] This refers to the general low priority we assign to things that are not pressing in the moment but might be good for us in the future. Marshall also refers to an attitude of "radical ephemeralism" in which people have lost digital data and expect to lose more digital data. The attitude seems to be that this just happens. It can't be avoided, so why put the time and effort into trying?

Those working in the fairly new area of digital curation realize that digital information is both essential and fragile, requiring the active care and management of data to facilitate its current use and ensure future accessibility (Rusbridge et al. 2005). Digital curation activity has been primarily focused on scientific data and digital libraries. Marshall's work suggests that individuals are currently not up to the task of doing their own digital curation, while Beagrie (2006) explores the need for this sort of care and management for personal collections. Digital curation of personal information is not synonymous with PIM, but personal digital curation activities would be meta-level PIM activities. One project concerned with the long-term institutional preservation of digital archives of private papers suggests that archivists and curators should talk to creators of personal digital material because the inconsistent and haphazard management of this information puts its long-term survival at risk (Paradigm 2008, sec. 3).

All of this indicates that the meta-level of PIM is an important, yet relatively unexplored area of research. If we want continued access to our digital information, meta-level tasks are absolutely necessary, especially those of maintenance. The proposed research intends to add to this body of knowledge by focusing on amateur art photographers' organization and maintenance practices for information related to their leisure pursuit.

PERSONALLY MANAGED INFORMATION OBJECTS

While the focus of PIM is on the activities involved in it, those activities are performed on external information objects. The types of information objects that have been the primary objects of PIM research heretofore have been files (both paper and electronic), email, and web information. The following section is a simplified summary of specific findings regarding the PIM activities and behaviors associated with these types of information objects.

Files/documents

Early PIM studies examined the paper-based PIM systems used by researchers in their offices. The basic findings and challenges identified in these studies continue to inform the study of PIM in the computer-based environment.

Perhaps the most important finding is that users tend to organize their documents and represent their PIM systems in memory according to both document attributes, and highly individualized non-topical contextual cues (Cole 1982; Malone 1983; Kwasnik 1989b). These contextual cues apply not just to files, and their role in the activities of PIM for various forms of personally managed information will be examined in more depth below.

Another important finding is that PIM systems involve two main strategies: filing and piling. These support the twin functions of finding and reminding. Both piling and filing facilitate finding; however, only piles facilitate reminding. Piling is often a reaction to the difficult cognitive task of classifying documents into specific categories required by filing, and it affords interaction with information by the spatial and contextual cues mentioned above. This is in contrast with filing, which provides a more limited arrangement of information (Malone 1983).

These findings have been found to apply to the management of digital files as well. Barreau and Nardi (1995) found that many of Kwasnik's dimensions also apply to managing files on a computer. Boardman and Sasse (2004) categorized users by their digital document organization strategies. There were people who filed everything away, people who filed extensively, and those who only filed occasionally. The latter are left with the digital equivalent of piles. Goncalves and Jorge (2003) measured the dimensions of personal digital document spaces and found that the filing structures tended to be narrow and fairly shallow, but Khoo et al. (2007) found much greater variation in the depth and breadth of file structures. Goncalves and Jorge (2003) also found that about 80% of files are inactive—they have been untouched by at least a month, but that since personal document spaces are so large and difficult to visualize, they are difficult to maintain.

Web information

Web browsers support several ways of returning to previously viewed web pages (Tauscher and Greenberg 1997). People have various ways of keeping web-based information for future access and reuse. These methods include emailing URLs to themselves and others, saving web pages to a local computer, printing the information, pasting URLs into a document or adding them to a web page for keeping, and bookmarking the site in a web browser (Jones, Dumais, and Bruce 2002). In a survey of 236 web users, Aula, Jhaveri and Käki (2005) found that the most common methods of re-finding web information was using a web search engine, typing the URL in directly, or saving web pages or documents as local files. The study claims that bookmarks are made frequently, but used less often; however, it is unclear how making bookmarks and using existing bookmarks were teased apart, given the design of the survey instrument. A study by Capra and Perez-Quinones (2005) reinforces the importance of web search engines in re-finding information on the web. If users initially found information with a search engine, it is most likely that they will re-find it with a search engine. This changes as the value of the information increases to the user, or as the user's familiarity with or frequency of use of the information increases. When these occur, shortcuts such as bookmarks or typing in the URL directly tend to be used.

Bookmarking behavior has been investigated in more depth. Individual ways of spatially and cognitively organizing bookmarks vary greatly. File structures range from elaborately nested folder hierarchies, to basic groups placed in folders one level deep, to a single listing of all of the bookmarks. Bookmark placement and folder labeling decisions are based on the situation or task context of the individual user (Gottlieb and Dilevko 2001; Gottlieb and Dilevko 2003). A common complaint among users is that the bookmark organization tools provided by web browsers manage to be simplistic, yet unwieldy to use (Abrams and Baecker 1997; Abrams 1997; Abrams, Baecker, and Chignell 1998). These studies are ten years old, but the situation in browser-based bookmarking tools changed little. There is little to no native support for the needs that Abrams identified: annotating bookmarks, keyword searching in bookmark titles and annotations, and placement of bookmarks into more than one folder at a time. Cockburn and McKenzie (2001) found that most users in their study used bookmarks, that the rate of addition of new bookmarks was far greater than rate of deletion, and therefore the collections tended to grow in size and become unmanageable. Also, about a quarter of the bookmarks were invalid at the time of the study, indicating that maintenance is a problem.

Recently, "social bookmarking tools" such as del.icio.us and Furl have been developed. These tools allow users to easily and flexibly tag, annotate, and share their bookmarks. Furl allows each user to search across the content of pages that he has bookmarked using the tool. So far there has been little research into the use of these tools by individuals. Most of the research that has been done focuses on the social nature of the tools and what can be learned by aggregating user-created tag sets. Whether these tools are filling a gap in PIM for web-based information, and how they may be doing so, are open questions.

Email

Though email was developed as a communication tool, it is also used to manage information, tasks, and time (Mackay 1988a; Mackay 1988b). Bellotti and Smith (2000) discovered that email "may well be the most important and frequently used computer application for most people." It is the one application that the majority of people tend to leave running all day as they do their work, and it is checked and managed multiple times a day. This finding was later developed into the idea of email as a work habitat, where people live and embed their work (Ducheneaut and Bellotti 2001). Today, email is still playing a major role in task management, personal archiving, contact management (Whittaker and Sidner 1996; Whittaker, Bellotti, and Gwizdka 2006).

Classificatory structures used in email are highly individualized, and most often based on situational cues such as project, time, or sender. Later retrieval of emails depends heavily on the user's memory of those cues (Mackay 1988a). Likewise, email PIM schemes range from deep and nested folder structures, to shallow folder structures, to simple accumulation of messages in the inbox (Mackay 1988b).

Email applications were not designed to support the range of PIM tasks for which people use them. Problems arising from using email for PIM include information fragmentation and a lack of direct support for PIM functions such as reminders and file management. Combined, these findings suggest that email could be the base for a redesigned PIM tool that is truly embedded in the existing work routines of users (Whittaker, Bellotti, and Gwizdka 2006). Tools such as Microsoft Outlook, which combine email with calendars, contact management, and reminders, have moved in this direction. The danger in this approach is packing so many features into one application that it is difficult to learn and use, or does none of the desired functions as well as you would like it to.

Unlike document filing systems or web information keeping, email has been studied in great depth outside the area of PIM. Though now dated, Rudy's 1996 critical review of email research in the area of computer mediated communication (CMC), is a useful in-depth synthesis of the foundational work on email as a communication genre. Ducheneaut and Watts (2005) review of thirty years of research on email, and draw attention to the failure of email research to have impact on the design or use of email. Email researchers are spread over multiple disciplines and their research stems from vastly different theoretical and methodological assumptions, often with "incommensurable theoretical gaps" between studies. As a result, the body of research on email can seem incoherent and even contradictory.

Other formats

In-depth empirical PIM research has focused almost exclusively on the aforementioned three formats of information, while the types and formats of information that make up personal collections of information continues to grow. As reviewed above, there is a body of literature on photowork, but it is mostly separate from research describing its topic as PIM. The overall problem here is a focus on information format rather than information practice. More studies have begun to look across tools and information types to get a more holistic picture of PIM.

Marshall, Bly & Brun-Cottan's (2006) participants collected a wide range of digital objects in addition to files, email, and bookmarks: photographs, video, self-generated remixes of video and audio, Web sites, blogs, manipulated images, game characters, IM transcripts, and music purchased from online sellers or moved to the computer from CDs. Koh & Kerne's (2006) participants likewise collect broadly across format: articles, URLs, images, animations, audio, and video. Other types of items frequently managed include task to do lists and reminders, contacts, calendars/schedules/appointments, notes, clippings, and annotations. The management of all of these formats of information leaves open many issues and interesting questions.

Related domains

Two sub-areas of PIM attracting increasing research attention. Personal health information management is a specific type of PIM that has been of interest in the health informatics community for some time (Moen and Brennan 2005). Interest in its relation to PIM is recently growing (Pratt et al. 2006). Our health is enmeshed with and inextricable from our everyday life. Persons with health problems often face information management challenges. These mirror many of the more general PIM challenges, such as information overload and fragmentation, and decision making about keeping, and refinding. In addition, some unique challenges include the need to make sense of what is often specialized medical information, the need to share information with doctors, family, and friends without compromising the privacy and security of the information, and the need to support specialized health context/cues such as treatment events or phases of care.

Group information management (GIM) is another area that has long been a topic of interest in computer supported cooperative work and knowledge management (Berlin et al. 1993). It has recently been suggested that GIM should be approached as a research area that overlaps with PIM (Erickson 2006). The keeping of personal information to share it with others is not a new phenomenon, however new online social software tools are making this sharing more frictionless than ever to simultaneously keep information for oneself while sharing it with others. New tools of this nature continue to emerge. Some of these services allow a user to control what information is public or private. Some also allow for levels of privacy. For example, on Flickr, you can allow only people you have designated as Friends to see certain photos. Easily sharing information with approved people, while keeping others from accessing it, is a central problem in GIM.

Personal health information management can also be seen as a form of GIM, in that the information being managed centers on the health of an individual, but is in part created by various medical practitioners. Personal health information is shared with care providers, family, friends, and insurance companies. Likewise, personal financial information management could also be approached as GIM.

Questions of privacy and trust in sharing information in GIM are key. Also of interest from a PIM standpoint are understanding the motivations for sharing what is shared in GIM systems, and how the sense-making about and organization of personal information changes when the expectation is that the information will be used by a group, rather than only one person.

CONTEXTUAL CUES AND DOCUMENT ATTRIBUTES

As stated above, users tend to organize their documents and represent their PIM systems in memory according to document attributes and non-topical contextual cues (Cole 1982; Malone 1983; Kwasnik 1989a). The use of a document influences what cues a person will remember, and how well (Lansdale 1991).

Ideal PIM systems will support keeping and refinding through these contextual cues. Currently, available tools do a relatively poor job of this. (Ravasio, Guttormsen Schär, and Krueger 2004) wrote that the technical metadata captured and available for managing files on the computer do not significantly help in searching and finding because they do not match the way people remember their documents. Hierarchical file structures do not easily facilitate the placement of a document into various places in the structure. File naming is highly constrained. There is little support for annotating documents or files or adding any meta-information that will be of use in searching, browsing, or sorting through the documents.

Once contextual cues were identified as important in this area, researchers examined them more closely. For Case's historians, physical storage space was the most influential element on document organization within the office, followed by form, topic, and either treatment, purpose, or quality (Case 1991a). Kwasnik determined that a number of document aspects affect item naming and classification. Situation aspects of documents--access, circumstance, need, and use--must be taken into account along with document aspects such as form and topic (Kwasnik 1988). Current or intended use may be the most salient classificatory cognitive reference point (Kwasnik 1989b).

What follows is a relatively brief examination of the attributes that have been most frequently identified as important in PIM systems.

Level of Use

One of the most important contextual cues affecting the organization of individuals' information is level of use. Level of use is affected by the frequency of need for the information object, what projects or topics it is related to, and the expected use of a document as time passes. Information objects move through the different levels of information as work is done and time passes. PIM tools should support the need to treat information at different levels differently; ephemeral documents need to be managed in different ways than do archival files.

Cole (Cole 1982) identified three levels of paper-based information in the office: action information, personal work files, and archive storage. Action information is information that is being dealt with currently or that is to be dealt with in the near future, as well as reminders. It tends to be organized so that it is within reach and immediately accessible. It may be piled in the workspace, or stacked in trays. The space action information inhabits is tightly coupled with its purpose and use. Personal work files are information that is relevant to ongoing work schedules. Personal work files are arranged in some strategy in the immediate office environment. Finally, archive storage is for information that is no longer needed for ongoing work, but which should not be discarded. It is kept in a location away from the individual's immediate office, and tends to be in a very structured form of storage, not under the control of the individual.

Examining the organization of electronic documents in the office, Barreau and Nardi (1995) identified three similar levels of use: ephemeral, working, and archived. Ephemeral information is of very short use. Like Cole's action information, the placement of ephemeral information is important, as its visibility is important to facilitate its reminding function. Working information is frequently used, as it is relevant to current work. An item may remain at the working level of use for weeks or months. The frequent use of working information builds rich familiarity with that information based on spatial and other cues. Archived information is irrelevant or indirectly relevant to current work, but is kept. It may consist of completed work and information related to that work. It may be kept for months to years, but it is infrequently accessed. A difference between Cole's archive storage and archived information in the computer-based environment is that in the latter, the user still has access to the information in his or her office, and may be the sole person responsible for maintaining it. Gwizdka (2000) changes the label of Barreau and Nardi's archived information to "retrospective information" and adds the category of prospective (future) information, characterized by its reference to or expected usefulness in a specific time in the future. Boardman & Sasse (2004) argue that the facets of levels of use should be separated into attributes of information usefulness and information ownership. Levels of usefulness include: active (which maps to ephemeral and working), dormant (mapping to archived), not useful, and un-assessed (mapping to primitive). Information ownership is split into mine and not-mine, which is related to whether a keeping decision has been made on the information.

Peters (2002) extends Barreau and Nardi's levels of use classification, but describes the temporal states a piece of information can exist in relative to the person's interactions with that information object within the PIM system. This is different from the previous sense of levels of use because it is not primarily focused on and linked to attributes of the work that the information object is supporting. He does away with the ephemeral/action information category, replacing it with three new states: primitive, formative, and transitory. The primitive state is a "state of initial recognition needing additional contextual information for addition" to a person's actual personal information space. This state seems to exist between the activities of finding and keeping. An item cannot ever return to the primitive state. The formative state "implies awareness of the original content of the information permitting placement of the item into a contextual waiting state for further task analysis and processing." This seems to include information which an individual has decided to keep for future use, but is not actively using. The transitory state is another temporary state "where contextually focused information may reside awaiting additional supporting information or contextual refinement." This seems to include information which has been worked on, but is waiting until a certain point in the future to either be used further, filed away, or discarded. Finally, Peters adds another state between working and archived information. The reposited state is one "that the user creates to place valued information into a contextually important and visually active position within the information space." This seems to include information that is to act as a reminder.

Of these classifications of levels of use, only Peters' was developed from research that included personal information spaces outside the workplace. This could explain the shift away from work-centric levels of use. Future research could examine whether these same basic levels of information are found in PIM in everyday life.

Space

The location of paper documents in the physical office has been identified as an important contextual cue. The location of papers, piles, and files in the office space is not simply an indication of disorder or neatness. The placement of information objects in the workspace serves functions of loose organization (as opposed to filing) when naming or classification of information is difficult. Objects placed in spatial arrangements remind, as well as organize tasks and other actions (Malone 1983). As discussed above, spatial location of information objects is often related to level of use.

Kirsh (2005) states that humans manipulate objects in the space around them to improve recall, visual search, perceptual acuity, reasoning, and the execution of tasks. "How we manage the space around us, then, is not an afterthought; it is an integral part of the way we think, plan and behave, a central element in the way we shape the very world that constrains and guides our behavior." Neumann's findings in her examination of the role of the physical environment in information work support this as well. The space, place, and artifacts involved in work are key support in the accomplishment of that work (Neumann 1999a).

Peters (2002) found that the primary organizational method of paper-based personal information was spatially organized, or geographical in nature, but for electronic information, the primary method was by topic. He suggests that the users find it difficult to reconcile their natural spatial approach with the hierarchy of the computer's file structure. The natural spatial affordances of physical space, objects and documents have not yet been translated well into electronic information environments. The ability to create messy, yet informative stacks in the computer does not yet exist. This idea was being developed at Apple Computer (Mander, Salomon, and Wong 1992), and researchers are still trying to get it right (Atzenbeck and Nürnberg 2005). The critical difficulty in supporting spatial organization in the computer may be that the gestures and actions for manipulating and managing papers easily in the physical world do not work well given the limited representations of spatiality and methods of input available in the digital environment. The current lack of support in the electronic environment for natural spatial abilities and preferences may explain why many people continue to rely on paper for their work (Sellen and Harper 2002).

People organize information spatially, but space and place is also a cue that we associate with and remember about particular documents when we try to re-find them. We may remember where we were when we created, last worked on, or viewed an information object. Ways of representing these various facets of place into the metadata of information objects for searching and browsing are needed. Hewagamage, Hirakawa, and Ichikawa (1999) cover capturing location using GPS to record location associated with the creation of multimedia information that is added to a personal collection as a primary part of the user's "situation." Situation also includes time and user activity.

Time

As was discussed in the section on levels of use, time is an important factor in making keeping decisions. When and with what frequency an individual expects to access an item again affects how the item will be kept.

Time is also an important cue for refinding. Over 60% of all search result sets in an evaluation of the Stuff I've Seen tool were sorted by date for browsing. An information object has many dates with which it can be associated, including dates of creation, encounter, receipt, last access, and last change. The date remembered in association with an information object tends to differ for different document types. For example, we remember when we received an email, when we created or edited a file, or when we last visited a website (Dumais et al. 2003).

The ideal PIM system will allow for support of time-based keeping and refinding beyond simple dates. People aren't very good at recalling the exact date that something happened. They are better at remembering roughly dates in relation to other things going on in their personal lives and the world in general. For this reason, refinding via episodic access is likely to be more useful than retrieval by exact date (Bovey 1996; Ringel et al. 2003).

Task/Project

Task or project is an important contextual cue in PIM. Ducheneaut and Bellotti (2001) found that email folders were created most frequently for projects. This makes sense, with the previously discussed finding that email is heavily used for task and time management. Most of the overlap across multiple hierarchies in categories was based on projects. They were a common cue in organizing files and web information, as well as email (Boardman and Sasse 2004). The structure of a task or project can also provide a useful structure for the information required to complete the project (Kaptelinin 2003; Jones et al. 2005b).

Document form

In physical collections, Case (1986; 1991a) found that type or form of information affected organization of that information most, after the factor of available physical space. This makes sense in the physical environment where it is easier and a more efficient use of space to store books with books, and reprints with other reprints. Also, there is strong visual recognition for form when looking for an information object in a space.

Barreau (1995) found that the application used to create a document was a strong contextual cue that people remembered about their documents. The application used to create and edit documents is related to their form. Text documents are manipulated with a word processor, emails with the email application, and so forth.

As mentioned above, one of the biggest PIM challenges is form fragmentation. Form cues should not be forced as the primary axis along which information is organized in the digital realm. However, they must be retained as a useful facet for keeping and refinding, as the individual so desires.

PIM PERSONALITIES

Various studies have identified broad classes of what can be described as PIM styles. If the generalized applicability of these styles across populations could be demonstrated, this might be a key to designing PIM systems that flexibly accommodate different styles or approaches to PIM. While a system cannot be built specifically for every individual, there could be systems more hospitable to the general tendencies of a particular PIM style.

The major PIM style distinction has come from Malone (1983), in which offices were categorized as either neat or messy. Some people tend to file things away while others pile things around, so that there are filers and pilers. Malone noticed that the office workers with jobs of a more structured and routine nature seemed more likely to be filers, and guessed that this might be due to a better match between their structured work and the nature of filing systems. In digital document filing, Boardman and Sasse (2004) identified categories: total filers, extensive filers, and occasional filers (who would be more like pilers). Khoo et al. (2007) found that most of their subjects were frequent filers or spring cleaners.

In email organization, Whittaker and Sidner (1996) found further support for filers and pilers. They called pilers "No Filers," who let all of their mail pile up in their inboxes. Filers were divided into two groups: Frequent Filers, and Spring Cleaners, who clean out their inboxes and file things away periodically. Likewise in email, Teevan et al. (2004) provided further support for Malone's classification of people into filers and pilers. Boardman and Sasse (2004) also found Frequent Filers and No Filers in email, but added two other categories: extensive filers and partial filers, based on how many emails are filed each day.

Similar findings have emerged regarding individuals' web bookmark organization behaviors. Some file and label each bookmark as it is made. Others do it at the end of each browsing session. Some do "spring cleaning" of their bookmarks on a semi-regular basis, while others let all of their bookmarks collect, undisturbed, in chronological order (Abrams, Baecker, and Chignell 1998). Boardman and Sasse’s (2004) bookmark strategies of extensive filer, partial filer, and no-filer match up with those categories identified by Abrams.

Berlin et al. (1993) identified dimensions on which people differ in categorization behavior: purist vs. proliferator ; semanticist vs. syntacticist ; scruffies vs. neatnicks ; savers vs. deleters. It was also found that the role a person played in the organization shapes their understanding of the purpose of the document and reason for saving it, thus resulting in different categorization behaviors.

Peters (2002) developed three whimsically named profiles of PIM behavior in relation to attitude toward and use of technology for PIM tasks. The Luddite Larry is resistant to the idea of using new technology to manage their information. Pragmatic Polly identifies where technology will make her information management tasks more efficient or easier. She uses technology daily and solicits recommendations for better ways to manage her information, but is not enticed only by newness. This is in contrast with Gadgety Georgina, who actively seeks out and explores new technologies, showing great persistence for learning a tool's functionality and making it work for her.

Research on this topic has recently been reviewed by Gwizdka and Chignell (2007), who find little support for the existence of stable PIM personalities for individuals. PIM practice varies widely based on situation and context. This is another place where a Sense-Making approach to PIM would be useful. Sense-Making does not expect to find stable differences between people across time and space that predict behavior, because people are all assumed to be flexible and chaotic. Sense-Making has, however, found relationships between how people viewed their situations at various points in time, and how they reacted to those situations.

PIM FRAGMENTATION

As early as 1985, the specter of information fragmentation was looming, and the need to integrate or unify different types of personal information was recognized (Burton 1985). Unfortunately, the fragmentation problem has grown worse over time. Jones (2007) identifies it as the major challenge of PIM. The basic problem of fragmentation is that people must separately maintain and manage information that is conceptually or contextually related. There seem to be three main axes along which PIM fragments: form, location, and granularity.

Form fragmentation mainly results because many digital information forms require that the information be managed using specialized applications. For example, email must be managed within the email application, web bookmarks within the web browser or other tool, contacts in the contact management application, files in the operating system hierarchy, and so forth. Form fragmentation also results from managing some information digitally, and some on paper. Form fragmentation goes against the subjective classification principle, which states that "all information items related to the same subjective topic should be classified together regardless of their technological format" (Bergman, Beyth-Marom, and Nachmias 2003).

Location fragmentation results because information exists in different places. You may keep files on your laptop, your home desktop computer, your office work computer, on various external media, or in various forms or remote electronic or physical storage (Goncalves and Jorge 2003). This leads to problems with access, re-finding, backup, and synchronization.

These types of fragmentation require individuals to maintain multiple hierarchies in order to organize information. Boardman (Boardman 2001b) discusses multiple hierarchies in the context of form fragmentation, but the problem is multiplied by location fragmentation. The extent to which individuals attempt to mirror their multiple hierarchies varies, but managing multiple hierarchies based on format with overlapping topical coverage introduces extra overhead in the workspace organization process. Even when users attempt to mirror hierarchies across formats and software, inconsistencies in labeling and spatial placement of nodes occur (Boardman 2001a). The amount of redundant work and inconsistency across hierarchies in email, file systems, and web bookmark collections was associated with feelings of guilt, stress, and lack of control over disorganization of data in all three collection areas (Boardman, Sasse, and Spence 2002). Ironically, the development of specialized PIM tools has helped to worsen the form fragmentation problem.

Granularity fragmentation is due to the fact that information objects contain information which may be related to information that is part of another object, or to another information object as a whole (Bovey 1996). A paragraph from one paper may be related to another whole article. A folder containing 100 digital photographs may be related to one web page, to one sentence on that web page, or to the entire web site of which the web page is a part. There is currently no way for individuals to control the granularity at which information objects can be described and linked to one another. The problems of this sort of fragmentation must be addressed to develop flexible tools for the collection and synthesis of information in personal collections.

WHAT NOW?

Unification

If fragmentation is the main problem of PIM, the main challenge for research and development in this area is to attain unification of PIM in the face of the various forms of fragmentation currently faced.

Various approaches to this problem exist. Bergman, Beyth-Marom and Nachmais (2003) introduced the user-subjective approach to guide a more unified PIM. This approach is a set of three principles. The subjective classification principle suggests that all information items related to the same subjective topic should be classified under the same category regardless of their technological format. The subjective importance principle suggests that information items should be characterized by their subjective importance, and that this attribute should determine their visual salience and accessibility. The subjective context principle suggests that information should be retrieved and viewed by the user in the same context in which it was previously used.

Support for powerful searching across personal information is another approach (Russell and Lawrence 2007). Some advocate search--a powerful method of bringing together fragmented information and supporting refinding-- as a way to eliminate the need for individuals to manage their personal information (Cutrell, Dumais, and Teevan 2006). In essence, this approach seems to seek to obviate the keeping and meta tasks involved in PIM. Research continues to suggest that elimination of the organization of information is not what users want. They want to be able to organize in better ways *and* to search all of the information.

People do not want to give up the structures created via keeping activities. People’s file folder hierarchies are informational in their own right, serving sensemaking and planning purposes. The folder structure often is a bottom-up version of a problem decomposition, and serves task management and reminding functions (Jones et al. 2005b). Peters (2002) found that the acts of creating their own information structures helped users to achieve their personal information goals, moving "more deliberately and with greater intent" within their personal information spaces. Various field research has demonstrated that "the sensemaking activities that surround keeping are critical for our ability to use things later when we most need them, whether these activities involve associating material with a particular taxonomy or establishing a stable sense of place" (Marshall and Jones 2006).

Also, search has been shown in previous research to only be used as a last resort for refinding information (Barreau and Nardi 1995). An alternate explanation for this finding was that people in the study did not like to use search because, at the time, search didn't work very well (Fertig, Freeman, and Gelernter 1996). However, more recent studies on systems with much more powerful search tools continue to conclude that people prefer a more orienteering approach to finding their information (Teevan et al. 2004; Ravasio, Guttormsen Schär, and Krueger 2004; Koh and Kerne 2006; Khoo et al. 2007). Even supposing the existence of a perfect search tool, people say they want to be able to organize things themselves in folders (Jones et al. 2005b).

A final problem with relying on search alone for refinding information in personal collections is that it can make information invisible unless the user specifically searches for that information. This can reduce a) memory for what is in the collection; b) serendipitous information discovery or encounter. One answer to this is building systems that can present users with possibly related and relevant documents, such as the Implicit Queries in Stuff I've Seen (Cutrell, Dumais, and Teevan 2006).

In addition, Jones (2007) identifies several other approaches to integrate PIM. The first is to extend the functionality of email applications to support all PIM tasks (Whittaker, Bellotti, and Gwizdka 2007). Another is using the notion of project to organize related information regardless of form or granularity (Jones et al. 2006). Expanding project to encompass different types of topics, this approach follows the subjective classification principle. Yet another is to allow for the organization and retrieval of information by properties, attributes, or associated cues, instead of in the file folder hierarchy (Kargar 2007). Unification through a common underlying representation recalls transclusion (Nelson 1999), and is the only approach to clearly address granularity fragmentation. Two final integration strategies hinge upon the digital recording of "everything" (Tan et al. 2007) and integration through the adoption of specific organizational techniques and strategies such as personal ontologies (Catarci et al. 2007).

Development of Methods & Evaluation

A preponderance of PIM studies to date have used quasi-ethnographic methods, comprising in-depth interviews, and tours or observation of personal information spaces. These studies have provided rich, detailed explanations of how people manage their information. More importantly, they have been able to tell us in many cases why people do the things that they do in PIM. But these studies are very expensive in terms of both researcher and participant time. For this reason, they can only consider relatively small numbers of subjects, in very specific settings. Findings across these studies are not comparable, and their results are not generalizable.

One way of gaining some broader knowledge of PIM practice and challenges would be to take a survey approach with a greater number of respondents per study. The findings of such studies would be shallower than the heretofore typical PIM study approach, but could provide an empirical basis for identifying problem areas for more in-depth research. Also, surveys can be developed to explore and provide empirical validation of specific findings from more qualitative studies.

Kelly (2006) introduces the idea of developing and sharing a bank of qualitative data on individuals' PIM behaviors from various studies. Rich information about the individual cases and their PIM practices would be made explicit in a structured manner. Information on these individuals would be available in such a way that various analyses could be performed.

As described at the beginning of this review, a large portion of the PIM literature has been devoted to the development and evaluation of tools to solve PIM problems. A proliferation of tools has been blamed for at least of the portion of the problem of fragmentation in PIM. Many of these tools are examples of radical invention (Whittaker, Terveen, and Nardi 2000). "A well-known problem with radical invention is that it often is not based on an understanding of user tasks and requirements. Researchers thus find themselves proposing radical solutions to problems that are of little interest to users, while neglecting genuine problems." In order to avoid the troubles of radical invention, Whittaker, Terveen, and Nardi (2000) advocate a reference task approach based on identifying common, well-defined, important problems, and focusing research efforts there.

Kelly (2006) also points out that, while a majority of the prototype PIM systems developed and described over the years have indeed been user tested and evaluated, there has been little comparison of these systems against each other to learn which approaches are most efficacious. The reference task approach would make this type of comparison possible.

The highly idiosyncratic and unpredictable nature of PIM makes it an extremely difficult phenomenon to study in a structured, measurable way, but this approach is necessary to further the field. Only in this way can metrics for evaluation, theory, and models of user PIM behavior be developed.

Synthesis

Another large problem in PIM is how to better support individuals in their need to make sense of and synthesize the enormous amounts of information in their personal collections. This begins to cross the line into interface design, data mining, and other subfields outside the scope of this article, but it is important to note that the problem of supporting people's sense-making tasks in their personal information environments is of great importance. Research supports the idea that categorizing incoming information increases information integration and knowledge synthesis, improving decision-making (Hilmer and Dennis 2000). Burkett's (1999) dissertation work began to inquire about the processes of scholarly thought and work, and how computers and personal documentation systems can augment these processes, including the synthesis and manipulation of large amounts of information. The M2 project currently underway is also concerned with issues of managing information for knowledge synthesis. (Barreau et al. 2006).

Maintenance

Very little research has been focused on understanding the meta-level PIM activities of maintenance, managing privacy and security, and measuring the effectiveness of PIM systems. This is a wide open area that is of great importance for PIM.

SO WHAT?

The preceding sections have presented many findings and challenges in PIM. Why is this an important area for study? Below, I outline the three main reasons.

First, advances in PIM will bring greater quality of life and work. PIM is something that everyone must do, to a greater or lesser extent. As a very widely held problem there is much benefit to be had from solving it. (Jones et al. 2005a) states that "better PIM means a better use of our precious resources (time, money, energy, attention) and, ultimately, a better quality to our lives." In the workplace, it "means better employee productivity and better team work in the near-term. Longer-term, PIM is key to the management and leverage of employee expertise." As we are increasingly surrounded by more information in every area of our lives, the problem of information overload continues to grow. PIM has been identified as a response and solution to information overload (Edmunds and Morris 2000). We need to do PIM to retain control of the information we need, but we also may take comfort in the way PIM allows us to carve out our own information spaces in which to operate. Making this task easier will improve the quality of life for large numbers of people.

Second, advances in PIM can enrich our knowledge of information behavior in general, and advance the discipline of library and information science. In the above discussion of finding, the ambiguity between the process of seeking and finding information and the process of managing the found information was discussed. Case (1986) outlines the need for studying the stage at which information is assimilated into the minds and files of the researcher. We currently understand a lot about information seeking and use. We also understand a lot about PIM. We don’t know much about how the two interface. Bringing together different bodies of research in a discipline is one way of generating rich new knowledge.

CONCLUSION

There are many open questions about PIM practice and how to reach the PIM ideal of always having the right information in the right place, in the right form, and of sufficient completeness and quality to meet our current need (Jones 2007). The main challenge now is to facilitate unification of currently fragmented PIM. Meeting this challenge will require understanding the reasoning, motivations, and concepts that underlie PIM behavior and practice. Understanding this will require knowing how people think and feel about their PIM practices. There is a need to better understand PIM in everyday life, without limiting the object of study computer-based PIM. Finally, the meta-level of PIM activities remains to be explored.

ORGANIZATION OF INFORMATION

CATEGORIZATION IN COGNITIVE PSYCHOLOGY

There are many theories about the structure and representation of concepts, and hence categorization, in the mind. These theories are alternately called views, and that is how they will be referred to in the following. Each view has varied expressions by different researchers and over time, as well as associated models, experiments, and empirical confirmation. However, no agreement has been reached as to what the true nature of concepts in cognition actually is.

The study of concepts and categorization is central in many disciplines including philosophy, cognitive science, cognitive psychology, linguistics, computer science/artificial intelligence, and recently, neuroscience. This review will primarily focus on approaches from cognitive psychology. Because even this subset of the literature on the topic is vast, most of the following review is a highly simplified and necessarily incomplete overview. I spend go into more depth on views that have been influential in LIS, particularly in organization of information. Several excellent and in-depth reviews of the subject are available (Smith and Medin 1981; Mervis and Rosch 1981; Lakoff 1987; Oden 1987; Medin 1989; Komatsu 1992; Lamberts and Shanks 1997; Cohen and Lefebvre 2005; Rips and Medin 2005; Chemlal and Cordier 2006). My organization and presentation of the views below roughly follows Komatsu's (1992) review.

NOTES ON TERMINOLOGY

Though it often seems that they are used interchangeably,[35] the terms concept and category have been disambiguated. In general category refers to an actual set of things sharing some property or properties, or to which some assertion or set of assertions can apply (Medin 1989). A concept is a mental representation of a category or a property. Concepts are used in a variety of cognitive functions including learning, reasoning, and communication *in addition to* categorization (Medin 1989; Solomon, Medin, and Lynch 1999).

SIMILARITY-BASED VIEWS

Each of the similarity-based views has in common the notion that similarity (by some definition) is the primary criteria for the grouping of members of a category into a concept. As will be shown in following sections, more recently developed views of concept have moved away from similarity as the central feature.

CLASSICAL VIEW

The classical view of concepts was assumed by default in cognitive psychology and philosophy until the middle of the last century. It is called the classical view because some trace its origins back to Aristotle (Smith and Medin 1981; Lakoff 1987), though others have interpreted Aristotle's work on categories differently (Hacking 2001). This view has three core assumptions. The first is that each concept is represented by a summary representation of the entire class. Second, the features that make up this summary representation of a concept are both singly necessary and jointly sufficient to define the concept. Finally, the third assumption is the hierarchical nesting of features. The features of a concept are necessary, but not sufficient, to that concept's sub-concepts. Each sub-concept's summary representation includes additional defining features beyond the parent category's representation (Smith and Medin 1981). The classical view has also been called the traditional view or the definitional view (Armstrong, Gleitman, and Gleitman 1983; Laurence and Margolis 1999; Storms 2004).

[35] See (Markman and Stilwell 2001).

FAMILY RESEMBLANCES AND THE PROTOTYPE VIEW

Though the classical view still has its defenders (Harnad 2005), its status as the default view of concepts in human cognition began to slip with growing criticism. Most notably, using the example of the concept "game," Wittgenstein (1953) showed that there is no summary representation consisting of a set of necessary and sufficient features for all concepts: no one feature is shared by all games. Therefore the existence of a summary representation defining what is and is not a game cannot be created. Yet we know what is a game is (and what is not), and can produce instances of specific games. Wittgenstein posited that members of a category are instead related by family resemblances, "a complicated network of similarities overlapping and criss-crossing: sometimes overall similarities, sometimes similarities of detail."

Wittgenstein's family resemblances theory was empirically validated in (Rosch and Mervis 1975). In no semantic (conceptual) or artificial category studied did all members of the category fully share a set of attributes. Instead there was a network of attributes shared to different degrees by the category members. Some members shared more attributes in common with other members; these members were judged to be "more typical" of the category. This typicality effect will be examined more closely below. Finally, (Smith, Shoben, and Rips 1974) showed that category judgments are often made using features that are characteristic of the category, but not necessary. None of these findings makes sense if the classical view is correct.

The prototype view is also called the family resemblance view (Komatsu 1992) or the probabilistic view (Smith and Medin 1981). The core of the prototype view is that information about the features of a concept are abstracted from the individual category members, resulting in a "best example," or prototype. New categorization decisions are made by comparing a new item to the prototype. If the new item surpasses a certain threshold of similarity to the prototype, it is judged to be a category member.

Ideas about what exactly the prototype is and how to identify it differ. If the prototype is considered to be represented by an actual member of a category, that member could be identified by measuring cue validity (Rosch and Mervis 1975), or use of the contrast (Tversky 1977; Tversky and Gati 1978) or feature comparison (Smith, Shoben, and Rips 1974) models. Another possibility is that the prototype may be construed as an abstract average image representing the category in the brain (Kosslyn 1978), or as the central tendency of a category (Reed 1972).

The prototype view was initially modeled by (Posner and Keele 1970) and (Reed 1972), but the researcher most strongly associated with the view is Eleanor Rosch. Though (Rosch and Mervis 1975) posit that prototype(s) might be the member or members most representative of the category and least representative of other categories, this was not tested in Rosch's work. In (Rosch 1978, p. 40), she points out that this is "an unspecified formula until it is made concrete by inclusion in some specific theory of representation." Rosch's major contributions to knowledge about concepts in human cognition were demonstrations of graded structure within categories and a basic level of categorization in taxonomies. She explicitly stated that these were not theories of category representation or models of cognitive processes such as category learning or use. They are instead characteristics of the structure of categories that should be accounted for in any model of categorization (Rosch 1978).

Rosch's contributions will be discussed in this section because they emerged from and are related to her work refuting the classical view and supporting the existence of family resemblances. Keep in mind, however, that they do not apply only to concepts as conceptualized in the prototype view.

Graded structure

Concepts have a graded structure. This means that not all members are equal members of the category. Members with higher typicality ratings are better examples of the category, while less typical members are worse examples. In addition, graded structure accounts for why edge cases can be difficult to categorize.

(Berlin and Kay 1969) identified a number of "focal colors" they claimed served as best examples of their broader color categories. Rosch (her previous name was Heider) found evidence for graded structure in by comparing focal colors to other colors in their categories, and showing that:

- young children initially become attached to focal colors (Heider 1971);
- focal colors are more accurately remembered (in short- and long-term memory) (Heider 1972);
- names of focal colors are learned more quickly (Rosch 1973);
- focal colors are judged more typical of their category than other colors (Rosch 1973).
- Likewise, certain "best-example" forms are also learned faster and receive higher typicality ratings (Rosch 1973). Mervis and Pani (1980) confirmed similar findings among young children.

Categories learned through exposure to more typical examples of the category were learned more quickly and accurately than those learned though exposure to less-good examples. Better-examples were learned as members of their categories more quickly than were less-good examples. Finally, best example members of natural categories serve as cognitive reference points to which other members of the category are compared, and by which other members of the category are judged (Rosch 1975).

Basic categories

Graded structure pertains to the horizontal axis of category structures. This means there are typicality effects and graded structures within concepts and across concepts at the same hierarchical level. Rosch and her colleagues also found evidence of a preferred level of abstraction on the vertical axis of categorization—within a hierarchical taxonomy of conceptual categories. The basic level of abstraction was identified as "the level at which categories carry the most information, possess the highest cue validity, and are, thus, the most differentiated from one another"(Rosch et al. 1976). It has an optimal balance of cognitive economy and informativeness (Komatsu 1992).

The determinant of the basic level in a taxonomy is theorized to be a combination of the correlational structure of features of objects in the world, the emphases and state of knowledge of the culture or group, and the level of expertise of the individual (Rosch et al. 1976). In general, the basic level should be the most useful level of categorization. It has been shown to be the most general level at which:

- Attributes are predictable
- Objects in the category are used the same way
- It is most readily possible to identify the category by the shapes of its members, and by an averaged shape of its members.

- It is easiest to generate a mental image for the category

Basic object categorizations are considered to be the basic categorizations made during perception, the first learned and first named by children, and most necessary in the language of any people (Rosch 1978). The basic level also appears to be the preferred level for remembering episodic information (Pansky and Koriat 2004).

The identification of a basic level of categorization assumes a hierarchical arrangement of concepts, yet views of concepts that are not based on hierarchical conceptual representation must still account for the evidence found by Rosch and her colleagues. Graded structure has found in virtually all concepts, even those such as "even numbers," which clearly are defined by necessary and sufficient criteria (Armstrong, Gleitman, and Gleitman 1983). As such, it too must be accounted for in views of concepts and categorization.

As will be outlined below, many more views of the nature of concepts have been developed within cognitive psychology. Rosch's theories are still the most prevalent in the literature on organization of information. I discuss some of the impact it has had below. First, I survey some other ideas about concepts.

EXEMPLAR VIEW

Recall that the prototype view assumes one "most typical" representation of each concept. In most prototype models, this prototype is assumed to be abstracted from all of the members of the category. The exemplar view, in contrast, maintains that in learning new categories, representations of members of the category are retained in the form of exemplars—examples of that category. Some exemplar models posit that only exemplar information is retained and summary information is abstracted from the exemplars at the time of need (Hintzman 1986). Others, such as the context model (Medin and Schaffer 1978), do not preclude the retention of specific types of summary information about a concept, but hold that retained exemplars are more heavily used in categorization. Some, such as the proximity model (Reed 1972), assume all encountered instances are stored as exemplars, while others, such as the best-examples model (Smith and Medin 1981), assume that only some instances are stored.

HYBRID VIEWS

Various hybrids of the previously discussed views also have been developed. The dual view (Landau 1982; Armstrong, Gleitman, and Gleitman 1983) holds that concepts exhibit dual structures. Family resemblance-like structures support the identification of examples of a concept, while the structures of the classical view form the core of the concept to support explanation, reasoning, or justification.

Norm theory (Kahneman and Miller 1986) accepts the basic exemplar view but adds that stimuli experiences trigger exemplars related to them in various ways. From these retrieved exemplars, summaries are constructed on an ad hoc basis. These summaries are then compared to the current stimuli on certain features highlighted by the current context.

The schema view (Rumelhart 1980; Rumelhart 1983) can be seen as a hybrid of the prototype and exemplar views. It sees knowledge structure as made up of packets of information about concepts. This includes both retained exemplars and summaries of what category members, in general, are like. Also included in a schema is information about relationships between concepts, and how each concept is to be manipulated (Komatsu 1992). This view is a step in the direction of the explanation-based views, which are reviewed next.

EXPLANATION-BASED

There are several critical reviews of the role of similarity in concepts and categorization, including (Murphy and Medin 1985), (Rips 1989), (Goldstone 1994) and (Sloutsky 2003). In his review of the shift from similarity-based views to explanation-based views, Medin (1989) summarizes the trouble of relying on similarity to explain conceptual structure with two questions:

- What constrains the features on which similarity is salient for categorization, or, when things can be seen as similar on an infinite number of features, why do we have the concepts we have instead of the other possible concepts?
- How do we know if the similarity of things leads us to categorize them together, or if the fact that things are categorized together means we see them as similar?

Similarity-based views, because of their fundamental assumptions, cannot address these questions. Therefore many have recognized a need for explanation-based views of concepts and categorization.

The explanation-based view in general does not deny that prototypical summary representations or the retention of exemplars play a role in conceptual structure; however, it maintains that in addition to these, there is an explanatory component consisting of rules and causal principals regarding concepts. Keil (1989) explains the heart of this view:

> …concepts are construed as intrinsically relational sorts of things. They are not isolated entities connected only in the service of propositions. No individual concept can be understood without some understanding of how it relates to other concepts. Concepts are not mere probabilistic distributions of features or properties, or passive reflections of feature frequencies and correlations in the world; nor are they simple lists of necessary and sufficient features. They are mostly about things in the world, however, and bear nonarbitrary relations to feature frequencies and correlations, as well as providing explanations of those frequencies and correlations. If it is the nature of concepts to provide such explanations, they can be considered to embody systematic sets of beliefs—beliefs that may be largely causal in nature. (p. 1)

THEORY VIEW

The theory view[36] holds that individuals' theories about the world comprise the explanation component of conceptual structure. Concepts encode causes and explanations just as scientific theories encode how and why things work. Features that play into these causes or explanations become part of the concept (Murphy and Medin 1985). Features involved in causal theories become the most typical and important features for making categorization decisions (Ahn et al. 2000).

It appears that children may start out using similarity-based conceptual structures, but very early they begin to use theories to structure concepts as they learn (Karmiloff-Smith and Inhelder 1974-1975; Carey 1985; Gelman and Markman 1986). However this has been debated. Also disagreed upon is which of the two types of processing takes place first in the categorization processes of adults (Keil et al. 1998).

[36] This view is sometimes amusingly referred to as the theory theory (Margolis and Laurence 1999).

Psychological essentialism

Many of the theory-based views to some extent embrace psychological essentialism—a view about the nature of people's causal theories of natural kind concepts. This view states that a causal theory of a natural kind arises from the individual's belief that there is an internal essence belonging to each member of that kind that is responsible for its typical features, category membership, and more. These essences can be seen as folk theory and beliefs about concepts and objects in the world (Rips and Conrad 1989; Waxman, Medin, and Ross 2007). Individuals will defer identification and testing of an essence to experts if they cannot see or test for it themselves. In addition, even if people do not know and cannot explain what the essence is, there is a belief that there must be one holding the members of the concept together (Medin and Ortony 1989). For example an expert would be able to conclusively identify an object as gold by examining it for essential properties. Most adults will say that a horse painted to look like a zebra is still a horse, because it still has its essential internal "horseness" (Keil 1989).

SPECIFIC EXPLANATION-BASED VIEWS

Lakoff (1987) posits a conceptual structure organized by idealized cognitive models, or ICMs. An ICM is itself a complex structure informed by four structuring principles: propositional structure, image-schematic structure, metaphoric mappings, and metonymic mappings. Here there is an interaction between conceptual knowledge and background knowledge and theories. This can result in even more complex category structures, such as clusters of related models Lakoff calls radial categories. An example of a radial category is the concept of mother, which is made of various models such as the birth model, genetic model, nurturance model, and so on. Lakoff (1987) is fairly frequently cited in LIS, but usually in reference to his discussion of the demise of the classical view of categorization and summary of Rosch's work.

Johnson-Laird (1980; 1987) emphasized that the relational conceptual schemata stored in long-term memory contain information about how concepts are to be used in working memory to construct mental models. These mental models of concepts constrain how members of the concept can interact with each other, and other objects and forces in the world. This view is echoed in Barsalou's explanation of how graded structure is derived differently for the same concept in different contexts (Barsalou 1987). A representation in long-term memory that is used in working memory to interpret a concept in a particular context is also found in Michalski's two-tier approach (1989).

HOLISTIC VIEWS

Medin (1989) stated that in this area of research:

> …we have neither consensus nor stability. The relatively recent past has experienced at least one and probably two major shifts in thought about conceptual structure, and stability is the least salient attribute of the current situation. (p. 1469)

This lack of stability has not changed, but it seems to be becoming clear that there is no one explanation, theory, or view that can explain conceptual structure and categorization. Views are becoming broader and attempting to explain more. There is evidence for multiple, qualitatively distinct systems, explained by different views of conceptual structure, at work in different types of category learning (Waldron and Ashby 2001; Ashby and Maddox 2005; Ell and Ashby 2006). Ashby and Maddox (2005) state that much research in the next decade will focus on determining under what condition these separate systems operate, how they work, and how they are related.

Further broadening the scope of what must be taken into account in the study of concepts is a multi-function approach. Categorization is only one of the cognitive functions in which concepts play a role. Others include conceptual combination, inference, explanation, reasoning, learning, and communication. In order to understand concepts, their multi-function roles must be studied and explained (Solomon, Medin, and Lynch 1999).

Others have found that approaches to concepts which assume a separate cognitive system for representing concepts is too limited, and that conceptual knowledge is inextricably linked to other processes in the brain. Some state that because memory plays a role in retaining concepts and knowledge over time, conceptual structure and processes cannot be separated from memory processes (Pansky and Koriat 2004; Rips and Medin 2005; Hahn, Bailey, and Elvin 2005; Ashby and O'Brien 2005). Others point out that conceptual structure cannot be separated from the perceptual system because concepts, to some extent, use same representational and processing mechanisms as perceptions (Goldstone and Barsalou 1998). Barsalou (1999) and colleagues (Barsalou et al. 2003) have gone further, making a case for all conceptual representation and processing being grounded in modality-specific perceptual systems through perceptual symbol systems.

Types of categories

Several different types of conceptual categories appear to exist. Types of concepts, criteria for differentiating types of concepts, and issues with identifying a fixed typology of concepts are reviewed in (Medin, Lynch, and Solomon 2000). The vast majority of the research on conceptual structure has been carried out using three types of concepts: natural kind (things that exist in nature, such as bird, tree, metal), artifact (things humans make or conceptualize, such as furniture, vehicle, weapon), and artificial (patterns of dots, lines, digits, and letters).

Other types of concepts have also been discussed. We have concepts of individuals and of instances of categories (Blok, Newman, and Rips 2005). Some types of concepts, such as color and shape concepts, are generally considered to be perceptual categories rather than conceptual categories. While there are no sharp distinction between conceptual and perceptual categories {Nolan 1994 #39878}, perceptual categorization is concerned with basic sensory phenomena and has a physiological basis. For example, we see only a limited portion of the color spectrum because of the way our eyes work. This physiological component of categorization is related to categorical perception—the idea that we perceive certain things in chunks or categories due to our physiology (Harnad 1987; Harnad 2005). Abstract concepts (such as love, anger, intelligence) make up a large portion of our conceptual knowledge, but little is known about their characteristics and structure (Sloutsky 2003). Exceptions include Rehder and Ross's (2001) work on the features and structure of abstract coherent categories, and the theory that artifact or natural concepts are used as metaphors for abstract concepts (Lakoff and Johnson 1980; Lakoff 1987).

AD-HOC AND GOAL-DERIVED CATEGORIES

Ad hoc categories are defined as categories constructed to achieve goals, with two further characteristics. First, they do not match the correlational structure of natural categories. For example, in the ad hoc category "Things to take on a picnic," there are no features of blankets which are correlated with features of the other members of the category, such as salads, spoons, or baskets. Second, ad hoc categories are also not generally thought of by most people as a category outside of the context of a goal (Barsalou 1983).

Ad hoc categories tend to be less established in memory than natural and artifact categories because they are constructed impromptu when needed. With repeated use, however, an ad hoc category can become established in memory, causing the category to lose its ad hoc status and become a goal-derived category (Barsalou 1991).

Influences on conceptual structure

The review above was by necessity fairly brief and simplified. Many differences in views have been glossed over. Also, many findings about the influence of variables on conceptual structure have been skipped because they are out of the scope of this review. What follows is brief mention of a few of the more important influences that may be related to the overall topics at hand.

INFLUENCES ON TYPICALITY AND GRADED STRUCTURE

The type of category has an effect on what determines the graded structure of the category. Ad hoc categories exhibit graded structures as stable and salient as those found in common natural and artifact categories, but the most important determinants of the graded structure are different. As discussed above, similarity to central tendency is an important determinant of graded structure for common categories; however, similarity to the "ideal" of the category is the major determinant of graded structure for ad hoc categories (Barsalou 1985; Barsalou 1987). Estes (2003) found that some categories exhibit more gradedness than others. Artifact categories tend to be more graded than natural categories, but the latter are still graded to some extent and do not exhibit absolute membership.

Expertise also affects typicality ratings, indicating differences in graded structure. Central tendency is an important determinant at all levels of knowledge of a domain; however, at the expert level, subjective familiarity with the domain becomes an even stronger determinant than central tendency. Different kinds of expertise may lead to variations in conceptual structure between experts in the same domain. This may be because at the expert level goals, ideals, and familiarity play a larger part in determining graded structure, while non-experts rely more heavily upon similarity-based central tendency judgments (Johnson 2001).

Point of view, in providing a particular context, also appears to affect typicality ratings. For example, tea with milk is regarded as a very typical beverage if people are instructed to take the point of view of secretaries taking a break, while it is much less typical when the point of view is that of truck drivers taking a break (Roth and Shoben 1983). (Solomon, Medin, and Lynch 1999) further reviews influences on graded structure.

INFLUENCES ON THE BASIC LEVEL

There is strong evidence that expertise also changes the level of concept hierarchy considered to be the basic level. For experts, the basic level tends to fall at a lower, more specific, level of the hierarchy (Tanaka and Taylor 1991; Johnson and Mervis 1997). In the overall category of birds, genus functions as the basic level for ethnobiologists (Berlin 1992), whereas the class level (bird) was the basic level for psychology undergrads (Rosch et al. 1976). This can be partly explained by differences in expertise, but (Medin et al. 2002) show that expertise cannot be separated from culture, which also seems to have a strong effect on conceptual structure. Finally, (Medin, Lynch, and Solomon 2000) suggest that the type of task at hand (induction, category verification, or naming) have an effect on which level is basic, especially for novices in a domain.

INFLUENCES ON OTHER ASPECTS OF CONCEPTUAL STRUCTURE AND CATEGORIZATION

Yeh and Barsalou (2006) provide an in-depth review of the importance of context, in that all concepts are situated. They show situational context effects in multiple categorization tasks such as object categorization, object recognition, object memory, and elicited conceptual structure. They provide a taxonomy of situation effects with grain size, meaningfulness, and tangibility as factors. Though accounting for situational context is exceedingly complex, theories of conceptual structures that deny the situated nature of concepts are weak.

Lamberts (Lamberts 1995; Lamberts 2000) has shown that time allotted to categorization tasks has an effect on specificity or generalization in categorization. Under greater time pressure, subjects categorize more generally and weight differently the dimensions used to make their categorization decisions.

Relevance of cognitive psychology findings to the organization of information

Findings from cognitive psychology regarding concepts and categories can be applied to the organization of information, though the multiplicity of theories and inconsistent findings suggests caution be used. As early as 1955, Farradane noted the relevance of the cognitive psychology literature of the time to LIS. The findings supported the need for the relationships between concepts to be better represented in bibliographic classification schemes. Najarian (1981) highlighted the value of understanding the processes and structure of categorization in cognition for informing the design of systems for organizing information in libraries. These arguments were made before the classical view of cognitive categorization was largely rejected by the cognitive psychology community.

Marco and Navarro (1993) describe information science as concerned with the "transfer of information as a social event, mediated by psychological, historical, and social factors, as well as technological factors." A shared interest in how psychological processes mediate the information cycle is given as one reason cognitive psychology should be of interest to information scientists. Jacob argued that in order to further the primary goal of the information industry—facilitating effective interactions between users and information systems—there must be "an understanding of the relationship that exists between an external, artificial ordering of knowledge and the internal, mental representations of the user—of the interaction between the intellectual structure imposed upon recorded knowledge by the classification system and the cognitive framework individuals impose upon their experiences of the world" (Jacob 1991, p. 68). For this reason it is important for LIS researchers to take the findings of cognitive psychology into account in studying the spectrum of information organization and representation, from large formal systems to the conceptual structures and organizational schemes of individuals.

We must take care to do this in careful and appropriate ways, however. Cole and Leide (2006) draw on concepts such as ad hoc categories, frames, and metaphor to explore how information retrieval systems could better serve users by "transducing" the user's query (understood as some sort of metaphor instantiation) into the system language and vice versa. Unfortunately, how all of these concepts relate to each other and the findings is not explained, and the paper shows the difficulty people had with describing their research topics in metaphorical terms, perhaps indicating that it is unnatural for people to think about their research topics in metaphorical terms.

By now, it is well recognized that a shift to a cognitive approach in LIS has taken place. The cognitive approach, however, has been most strongly associated with the areas of information retrieval and user information seeking and use behaviors. Jacob and Shaw reviewed sociocognitive approaches to understanding information organization and highlighted the need for more study in this vein (Jacob and Shaw 1998). Some of this work will be reviewed below.

Relevance of cognitive psychology in PIM

In PIM research the focus is usually on the organization of things (books, papers, emails, etc). These objects are artifacts. As discussed above, one method of organizing these objects is by the kind of objects they are—by form or format. Some cognitive psychology findings on artifact categories may apply in such cases. A few studies have examined categorization of artifact objects (Malt et al. 1999; Sloman and Malt 2003).

More often these artifacts are not organized based on the kind of object they are. Instead they are organized based on some facet of the information the artifact carries. Alternately, they are organized based on the future purpose for which that information is expected to be useful. As discussed above, information objects are organized in PIM by topic, time, person, expected use, or associated project, task, or goal. The work on the cognitive structure of events may inform the organization of information by project or task (Rifkin 1985; Zacks, Tversky, and Iyer 2001) by explaining how people tend to break down events into smaller pieces. Research into episodic memory (Tulving 2002; Tulving 2002) clearly has some relevance to how we may organize information by temporal cues.

Cautiously, we may ask how findings regarding graded structure and basic categories may inform PIM. The fact that categories have graded structure may be related to the difficulty of filing and the ease of piling. In piling, one can simply put things that are roughly related together without worrying if something truly belongs in a category or not. A pile is a grouping without a label. The physical arrangement of a pile or group of piles can represent the fuzzy boundaries between categories with graded structure. By contrast filing requires a person to make a decision about whether something belongs in a folder or does not. If a new folder is needed, the process of naming the folder requires extra cognitive effort. Finally, the physical arrangement of files much better represents a classical model of categories than one with graded structure.

Research on the basic category level raises questions about the level of detail at which people tend to organize their information. Expertise and culture affect what level is basic, so there is unlikely to be any one level that will be useful for all users. PIM researchers cannot attempt to identify some correct level, but thinking about the basic level focuses our attention on which level in a person's organizational structure seems to be of primary importance. Further, might we be able to learn something about how the personal organization of information changes with increased expertise by paying attention to changes in categorization strategy?

Of all of the cognitive psychology research summarized above, it seems that Barsalou's studies of goal-derived categories may have the most direct relevance to work in PIM. His exploration of the instantiation of frames for the purpose of deriving ad hoc categories in the planning process (Barsalou 1991) could provide one way of approaching support for PIM in the context of planning personal projects (Jones et al. 2005b). Also, the notion that people do PIM to achieve some future goal of completing a project, remembering an event, or refinding information for some purpose suggests that some PIM may be a process of creating ad hoc categories for information objects, some of which become goal-derived categories established in memory. Systems should support the construction of flexible, dynamic information organization structures that mirror the flexible, dynamic way we appear to order concepts in different contexts and for different goals.

One example of research in cognitive psychology being directly applied to the problem of PIM is a recent paper by Huggett, Hoos, and Rensink (2007) outlining principles drawn from cognitive psychology in order to guide the design of truly human-centered information management tools.[37] They claim that the human-computer interaction approach at mediating between man and machine with interface is not enough and propose that:

> information within machines should be stored and retrieved in a manner that is inherently biomimetic (i.e. based on forms in nature) so that it is inherently comprehensible. Human memory represents a clearly successful approach to information retrieval and processing. One goal then is to transfer this efficient memory structure to machines for better organization and retrieval of information. Conversely, the implementation of evolved human information-management solutions, such as associative retrieval, makes machines more comprehensible by providing a familiar (in fact ingrained) information-management paradigm, instead of an ad hoc system-specific one" (458).

Some other studies and tool designs have already been based upon the relationship between memory and PIM (Jones 1986; Lansdale 1991). This suggests that research in human memory may be more applicable to PIM work than the research on concepts outlined above. The way in which we store and process concepts, however, is strongly related to memory (Johnson and Hasher 1987).

Different subsystems of memory are recognized in the literature, thought there are indications that they may not work as distinct, separate systems (Jones and Anderson 1987; Johnson and Hasher 1987). These memory types include working/short term memory (Jonides et al. 2008), long term memory , episodic memory, and prospective memory. The possible relevance of episodic memory to better support of temporal organization and PIM tools was touched upon above. Work on prospective memory also seems highly related to understanding PIM practice and supporting better tool development.

Prospective memory involves "the process and skills required to support the fulfillment of an intention to perform a specific action in the future" (Ellis and Kvavilashvili 2000, S1). Successful prospective remembering means we need to remember the content of the action we intend to do, and we need to remember this information at the right time. Reminders support successful prospective memory and research has been done into the characteristics of successful reminding (Guynn, McDaniel, and Einstein 1998; Herrmann et al. 1999; Meier, Zimmermann, and Perrig 2006).

[37] I assume that (Jones and Ross 2007) is also directly relevant, but it has not been available from the library since I found the citation. It is on my reading list.

Above, I claimed that the organization of information in the practice of PIM can be an important way of synthesizing information and thinking creatively. Unfortunately most current systems do not support such synthesis and thought in an effective way. Questions of how people think and learn by organizing information are related to research in sensemaking-R (Russell et al. 1993; Qu 2006; Russell, Jeffries, and Irani 2008). Such approaches may also be served by attention to work in extended (Clark and Chalmers 1998), embodied (Shapiro 2007), situated/grounded (Barsalou 2008), and spatial (Tversky 1993; Kirsh 1995; Tirassa, Carassa, and Geminiani 2000) cognition.

CATEGORIZATION AND CLASSIFICATION IN LIS

Researchers in cognitive science study and model categorization by individual people, but their goals are to generalize theories that explain how people in general cognitively organize concepts. Within LIS we have studied categorization and classification at many levels--from the broad general level of the universal bibliographic classification to the specific level of individual people's knowledge structures. Like the study of categorization in cognitive science, the study of classification in LIS has evolved from focusing on formal and well defined universal structures to an interest in a wide array of classification structures of varying levels of formality in various contexts. This review traces some similarities and connections between the treatment of categorization and classification in LIS and cognitive psychology. In this way, it narrows the focus from methods and structures for organizing information applicable on a large scale back down to my overall focus in this review: the individual person and her organization of concepts and information.

Jacob and terminology

Elin Jacob suggests that the confusion in the cognitive science literature and the lack of a cohesive general theory of cognitive categories "…is due, in large part, to a pervasive failure to acknowledge that classification and categorization are distinct processes..." (Jacob 1991, p. 80) Jacob illustrates the interchangeable manner in which terms such as category, class, and concept are used in cognitive categorization research by quoting a passage from Rosch et al.'s influential 1976 article discussed above. The emphasis is Jacob's (Jacob 1991, p. 77):

> "...one purpose of *categorization* is to reduce the infinite differences among stimuli to behaviorally and cognitively usable proportions. It is to the organism's advantage not to differentiate one stimulus from others when that differentiation is irrelevant for the purposes at hand. The basic level of *classification*, the primary level at which cuts are made in the environment, appears to result from the combination of these two principles; the basic *categorization* is the most general and inclusive level at which categories can delineate real-world structures" (Rosch et al. 1976, p. 384).

Jacob says that classes and classification are very similar to categories and categorization, but makes a fine distinction between them:

> "While traditional classification is rigorous in that it mandates that an entity either is or is not a member of a particular class, the process of categorization is flexible and creative and draws nonbinding associations between entities—associations that are based not on a set of predetermined principles but on the simple recognition of similarities that exist across a set of entities. Classification divides a universe of entities into an arbitrary system of mutually exclusive and nonoverlapping classes that are arranged within the conceptual context established by a set of established principles. The fact that neither the context nor the composition of these classes varies is the basis for the stability of reference provided by a system of classification. In contrast, categorization divides the world of experience into groups or categories whose members bear some immediate similarity within a given context" (Jacob 2004, p. 527-528).

According to Jacob, two distinct processes are being studied and discussed by cognitive psychology researchers; the different camps misunderstand each other and disagree because they have not distinguished between the processes of classification and categorization. If Jacob's distinction is taken into account, the classical theory of categorization appears to apply to much of traditional LIS classification theory, while the move in LIS to the “cognitive approach” is aligned with the newer ways of viewing cognitive categorization that account for graded structures, fuzzy boundaries, and the importance of context and expertise. The classical approach echoes the common approach in the design of classification systems and retrieval tools in LIS. Meanwhile, the prototype approach has implications for the design of interfaces for use by common people, choice of access points in bibliographic systems, and understanding the need for specialized information tools for specialized needs (Marco and Navarro 1993).

The development of classification theory

Much of the history of LIS research in organization of information has been related to classification theory. The term “theory” as used here generally refers to the identification of principles for classification, rather than the development of testable explanatory statements derived from empirical research (Jun-Sep2001; Smiraglia Jun-Sep2001; Smiraglia 2002). This branch of classification theory has primarily focused on the construction of bibliographic classification schemes. These schemes are commonly referred to as “universal” classifications, in that they are intended to organize the entire universe of knowledge embodied in the bibliographic world and collected in libraries. In a review of the development of classification theory prior to the mid-1970s, Dahlberg (1976) defined classification theory as having to do with the conceptual foundations of class formation, division and partition. As we will see, the scope of classification theory has changed over time. Smiraglia (2002) traces the move of the field through various epistemic stances beyond the original focus on rationalist construction of classification schemes based on reasoned principles. Aspects of universal classification schemes have also changed over time. The next section, however, focuses on the initial approaches to classification theory and scheme construction.

CLASSIFICATION AS TRUE STRUCTURE

> "Classification is a representation of the true structure of knowledge" (Farradane 1955).

Much of the work of early classification researchers and theorists was on how to best represent this true structure of knowledge. The major universal classification schemes—with the exception of Ranganathan's Colon Classification—were attempts at this type of representation. As such, they reflect the same world views and philosophies that nurtured the classical view of cognitive categories.

Bowker (2005) traces how knowledge of current science leads people to organize information based on those paradigms. This is borne out in the history of classification research and development. Foskett (1980) reminds us that "the history of classifications of knowledge shows that schemes for the ordering of knowledge or of documents containing knowledge always, and inevitably, reflect the philosophies and theories of knowledge with are dominant at the time." Likewise, Donovan (1991, p. 28) points out that "The categorization which necessarily precedes classification is therefore the product of a specific cultural and intellectual milieu."

Miksa (Miksa 1992) and Olson (Olson 1994) trace the history of the modern library movement and librarians' unquestioned assumption that "that the most natural and best way to organize books--obviously, on the shelves, but also in catalogs--was in terms of what was considered to be the natural hierarchical classificatory order of knowledge." (Miksa 1992, p. 105) Marco and Navarro (Marco and Navarro 1993) describe this assumption and the resultant classification schemes as products of 18th century developments in the fields of biological taxonomy and phenetics. These are related to rationalism and logical positivism—"the two principal contemporary Western approaches to human knowledge." Shapiro and Hughes (1999) write: "The majority of current schemes (e.g. the LC and Dewey Decimal systems) are in effect operationalizations of neo-Platonic, realist ontology and theology, the "Great Chain of Being" (Lovejoy 1936) that asserts the priority of the universal over the particular, of the abstract over the concrete and that see the individual or particular as mere emanations of the abstract and the universal." The empiricist and rationalist origins of traditional classification and knowledge organization tools are further described by Albrechtsen and Jacob (1998). Rafferty (2001) concurs that traditional classification theory has been a positivist endeavor that assumes "if we carve up and organize knowledge in such a way that it accurately reflects Truth, then the furtherance of knowledge is the outcome." Finally, Beghtol {Beghtol 1998 #972 /d} states the traditional desiderata for any classification system: "that the classes be both mutually exclusive (i.e., do not overlap) and jointly exhaustive (i.e., account for all possibilities)." These requirements are core features of the classical view of cognitive categories; traditional classification theory and the classical view are related.

DISCIPLINARY STRUCTURE AND ITS DISCONTENTS

The main classes of the major classification schemes—the primary joints at which they attempt to carve reality—are based upon traditional academic disciplinary structure. Some see this as a primary strength of these schemes and described disciplinary division as a historist and pragmatic approach to classification. In this view, the academic disciplines are historically developed structures that determine how subjects are interpreted and organized; therefore, they are the most useful way to divide up a classification scheme at the top level (Hjørland and Albrechtsen 1999). There is a tension between being a classification meant to represent the natural and true structure of knowledge and being a classification whose main divisions are academic disciplines; disciplines do not realistically represent the structure of all knowledge, but divisions that have arisen due to both the historic development of ideas, methods, and theories, and the administrative convenience of the university (Popper 2002).

While Hjørland describes dividing by disciplines as a pragmatic approach to classification, the approach is not without practical difficulties. Below three main problems with this disciplinary organization are outlined. They are discussed separately, but the issues are tightly intertwined. First, one subject may be treated by several disciplines. Works relating to that subject are then scattered into distributed relatives throughout the classification scheme and the library. This may confuse users who enter a library or retrieval system looking for a topic. In a library organized by the Dewey Decimal Classification a user looking for information on heroin addiction would have to look under the following classes to find a wide range of information on the subject: social problems and services, criminology, diseases, subcultures, and customs. These classes would not include works on programs, support, and services for recovery from heroin addiction. Literary treatments of the topic would be scattered by language and literary form. In the classification schedules many of these disciplinary treatments of the subject are linked by cross references to assist the classifier (Dewey 2003); however such references are not available to a library user browsing the shelves.

The second problem is how crossdisciplinary works should be classified in a scheme that scatters topics by discipline. Five types of crossdisciplinary interaction have been identified through longitudinal examination of domains and disciplines: interdisciplinarity, transdisciplinarity, multidisciplinarity, pluridisciplinarity, and syndisciplinarity (Dahlberg 1994). Beghtol (1998) traces how four universal classification schemes (Dewey Decimal Classification, Library of Congress Classification, Universal Decimal Classification, and Bliss Classification) have made changes to address the problem of representing these interactions. In some cases, instructions about where to class crossdisciplinary works have been added to the classification schemes. Again, there are likely no notes in libraries or online catalogs to inform the user of where to look for crossdisciplinary works. In other cases, methods of constructing classification numbers have been modified to allow the combination of numbers from multiple locations in the classification schedules—a representation of multiple disciplines in one number. Finally, various synthetic devices have been introduced, such as auxiliary tables of numbers to be added to primary class numbers. This use of the term synthetic is in the sense of synthesis. The importance of accommodating for synthesis in a classification scheme is discussed below in relation to the third problem.

The third and final problem with the disciplinary structure of classification schemes is how to accommodate entirely new topics (or disciplines) that arise from the combination or splitting of currently recognized disciplines. Changing the structures of the schemes themselves to include all new crossdisciplinary topics is generally dismissed, as the possible combinations (and splittings) of disciplines is nearly infinite. Ranganathan (1967) colorfully expressed the impossibility of designing any neat structure to represent topics:

> "In the true tree of subjects, one branch is grafted to another at many points. Twigs too get grafted in a similar way among themselves. The branches from one trunk get grafted with those of another. It is difficult to say to which trunk such branches belong. The trunks get grafted among themselves. Even then, the picture of the Tree of Subjects cannot be said to be complete. It is far more complex than all of these."

Upon their introduction to the West, Ranganathan's principles of analytic-synthetic faceted classification were celebrated for their hospitality to new and unknown topics, varied treatments of existing topics, and disciplinary combinations (Classification Research Group 1955). Recognition of Ranganathan's work by Western classificationists is identified by some as an initial sign of a move away from the classical approach in library classification. Ranganathan's work moved away from the notion of the superiority, naturalness, and utility of a top-down, pre-constructed system reflecting some true structure of knowledge.[38] Instead, it was based on processes of analysis and synthesis allowing various facets and combinations of facets of any new subject to be expressed at the time of classification (Dahlberg 1976). Kwasnik (Kwasnik 1992) characterizes Ranganathan as an early post-modern classificationist: "Ranganathan's contribution to classification theory is not only his innovative principles, canons, and techniques for notation, but also his acknowledgment that all classification is tentative in nature, that is, he developed his scheme with the understanding that there is no one way to view the world."

POST-MODERN CLASSIFICATION

> "There is no one correct or natural way of classifying a universe of objects." (Sparck-Jones 1970, p. 577)

Sparck-Jones went on to explain that the above statement was necessary because:

> in many cases remarks are made about the relative merits of classifications as if classification reflects something intrinsic to a set of objects, where it in fact reflects the frame of reference of the person seeking a classification.

Over time, the relative and arbitrary nature of classification has become less of a position to be defended or explained and more of a default statement or assumption. Jacob (1994) defines classification as involving:

> the systematic creation of order within a framework that is frequently both arbitrary and artificial: Arbitrary in that it adopts one perspective of the domain to the exclusion of all others; and artificial in that it is a tool or artifact created for the express purpose of establishing order.

Olson (Jun-Sep2001; 1994; 2001; 2002) has built her research career on deconstructing the assumptions and exclusions of the major classification schemes.

The growing acceptance of the tentative nature of all classification precipitated a shift in classification research. The field moved away from attempting to uncover universal true classifications and their principles. Researchers began to recognize the need to study the use of classification schemes in context. They saw that understanding the contexts in which classifications are used would inform the development of more useful classifications(Mai 2004). Jacob and Shaw (1998) reviewed early classification research using cognitive and social approaches, highlighting the importance of this line of research to the discipline of LIS as a whole. According to Jacob (2004), this sociocognitive shift can be seen as analogous to the shift away from the classical view of cognitive categories in cognitive psychology.

[38] "The intellect cannot be tied down with a decimal thong" (Ranganathan 1967, ch. P, sec. J, p. 362).

THE INTERACTION OF CLASSIFICATION AND KNOWLEDGE IN CONTEXT

Kwasnik (1992) explores the relationship between classification, theory, and knowledge. Some classifications—the periodic table of the elements for example—are theoretical. They are based on a theory of how the domain works, and inferences can be drawn from them. Other classifications are relatively atheoretical. The DSM classification for mental disorders is one example. These classifications are specialized instead of universal. They are examined in context of their disciplines, development, users, and uses. Kwasnik concluded that classifications can be thought of as theories in themselves:

> A good classification functions in much the same way that a theory does, connecting concepts in a useful structure. If successful, it is, like a theory, descriptive, explanatory, heuristic, fruitful, and perhaps also elegant, parsimonious, and robust (Kwasnik 1999, p. 24).

She went on to examine the use of these theoretical classifications in developing theory, facilitating discovery, and representing knowledge, identifying a number of ways that classification interacts with knowledge.

First, classification has a role in theory building and knowledge creation. Changes in classification can make new connections visible and bring about new explanatory frameworks. Again, the periodic table of the elements is one example (Kwasnik 1999). Beghtol (2003) examines how classifications developed by domain experts are used in the process of knowledge discovery. These "naive classifications"[39] are used for specific purposes by scholars, including:

- to discover gaps in knowledge;
- to fill gaps in knowledge;
- to reconstruct historical situations and evidence;
- to facilitate integration and communication of findings; and
- to suggest revisions or amplifications of accepted classifications (Beghtol 2003, p. 66).

Kwasnik (1999) discusses the process of qualitative data analysis as a form of classification used to build theory. In this process complex coding structures are developed by the researcher to organize data, findings, and thoughts.

[39] This terminology prompted heated debate (Nicolaisen and Hjørland 2004; Beghtol 2004; Hjørland and Nicolaisen 2004). Beghtol had contrasted naïve classifications with expert classifications, where the experts were those formally trained in the construction of classification schemes. Hjørland and Nicolaisen averred that the domain specialists were the experts when they were constructing their own classifications and using those classifications to generate new knowledge.

Second, new knowledge and technology have effects on existing classifications. As new knowledge is revealed important new dimensions to classify along may be identified. As new tools are developed new data can be gathered that reveal other new dimensions for classification. Bowker (2005) explores this phenomenon in detail. One example is the relatively recent ability to analyze the genetic sequences of species. The biological taxonomy derived from genetic findings differs from—and cannot be reconciled with—the traditional Linnean taxonomy of the species. Conversely, attempts at classification are complicated when there are gaps in our knowledge of the domain and tools for measuring its dimensions. Kwasnik refers to the domain of smell. There are no measureable units to describe smells, so they can only be described in terms of analogies and other comparisons. This makes it difficult to develop a useful classification of smells (Kwasnik 1999). A final issue is that new knowledge and new technologies emerge that do not fit into the existing structures of classification schemes. The Dewey Decimal Classification has struggled with fitting all of the new technological advances since its creation into its decimal structure; the results is often awkward and unintuitive placement of topics.

Third, some atheoretical classifications interface with knowledge problematically. Often these classifications are intended for use by multiple groups across which there is no consensus on the domain. Kwasnik's example of this is the Diagnostic and Statistical Manual of Mental Disorders (DSM) (Kwasnik 1999). The classification is used by doctors, counselors, patients, insurance companies, pharmacies, and others. For this reason it attempts to be neutral and reflect no one user group's conceptualization of the domain. This atheoretical stance meets the needs of all players at a basic level, but meets no one's needs well. Bowker and Star (1999) discuss the same type of issue and its practical consequences in relation to the International Classification of Diseases (ICD). Complex, atypical, and marginal cases are often forced uncomfortably into a class that doesn't quite fit in these schemes. In some cases, the method of classification distorts knowledge of the domain. Analysis of a classification scheme should attend to the question of whose interests are served by a classification scheme. This includes how economic concerns shape the theory or lack of theory of the scheme.

An understanding of the interactions between classification and knowledge provides a foundation for examining and evaluating the construction, maintenance, and use of all types of classifications. Given the shift to a social and cognitive interest in classifications researchers have turned more attention to classification and categorization in more specific contexts. These include disciplines, collaborative work groups both large and small, and the individual. Some of the most important ideas to emerge from the study of disciplines and work groups are summarized below. Then studies of individual people's conceptual models and categorization behavior are reviewed. At this level it is clear that all of this study of the organization of information is related to the study of PIM.

THE STRUCTURE OF INFORMATION IN DISCIPLINES (DOMAIN ANALYSIS)

The information structure of disciplines can be understood via multiple approaches, many of which have been described by Hjørland as approaches to domain analysis (Hjørland 2002a). Hjørland's theoretical domain analytic approach considers, among other things, classifications *of and within* disciplines. The goal is to design useful subject access, including new or modified classifications *of* disciplines (Hjørland 1998). Hjørland uses the term "domain" heavily. Particularly in his early work this tended to be used as a synonym for *disciplines* in the academic and scientific tradition.

This domain analytic approach is presented as a pragmatic, realist approach to subject in contrast with other ways of defining subject, or aboutness, in information science. Hjørland strongly critiques several other approaches: the facet analytic approach (Hjørland 1992); statistical and probabilistic models of determining subject using term frequency and more complex algorithms on general collections of full-text (Hjørland 1996; Hjørland 2002a); and individual indexer determinations of aboutness based upon imaging the author's intent or potential users (Hjørland 1992).

Hjørland further criticizes the cognitive paradigm that is prevalent in information science because "it is not possible to determine subjects by examining the minds of authors, users, or any other specific group of people" (Hjørland 1992, p. 173). Even if we can determine the individual user's cognitive structure and processes there is no realistic way to support an enormous number of individual mental models in information systems (Hjørland and Albrechtsen 1995). Finally, user knowledge of information sources and searching is often "defective," and it should be left to the experts on information—information scientists—to build systems that will work most effectively and efficiently for the competent user in a domain (Hjørland and Albrechtsen 1995; Hjørland 1996).

In contrast with the cognitive approach, the domain analytic approach is seen as a way to understand the qualities of the domain. With this understanding, the information needs of users within that domain can be supported in the most useful way. The researcher does not conduct empirical user studies on people in hopes of extrapolating a workable system structure from individual cognitive structures. The researcher instead qualitatively studies the domain—tracing its history, methodological development, and the changes in epistemological viewpoint that underpin the growth of the field—in order to objectively determine the shared knowledge structures and assumptions of users. Hjørland maintains this is the only way to gain a realistic, pragmatic view of knowledge domains for information science purposes. Focus on the domain necessitates a move from methodological individualism toward methodological collectivism—considering individuals only with the understanding that they are part of a larger group. (Hjørland 1997).

Because of its focus on larger groups and individuals cooperating across domains, the domain analytic approach can be aligned with a broader sociocognitive perspective despite Hjørland's criticism of individual cognitive approaches (Jacob and Shaw 1998; Hjørland 2002b). The domain analytic approach is also an example of the move to post-modern classification studies. First, it focuses on deeply understanding the structure of specific areas of the universe of knowledge. Second, it recognizes that no single view, or classification, of a domain will be enough to accurately represent it in a truly useful way. From the domain analytic perspective, the challenge to researchers in the organization of information is to find ways to represent the multiple dimensions of any domain.

The critiques of traditional classification by discipline briefly outlined above may appear to undermine the importance of conducting in-depth analysis of individual domains. Hjørland maintains that the rise in crossdisciplinary scholarship in fact heightens the need to understand the historic and epistemological developments of the traditional domains so that we may understand the qualities of crossdisciplinary knowledge and its structure (Hjørland 1994).

The domains Hjørland considers tend to fall into the traditional academic disciplines. However, the approach can be applied to less formal areas such as hobby domains (Hjørland 2004). Jenna Hartel, who has been studying the hobby domain of amateur cooks, states: “A question of the first order is: what are a hobby's information resources and forms? To that end, one strength of domain analysis is that it directs inquiry to objective, not subjective, features" (Hartel 2003, p. 233).

COMPUTER SUPPORTED COOPERATIVE WORK (CSCW)

In computer supported cooperative work (CSCW) the scope of classification research is further narrowed to groups of people working cooperatively. There are two camps of CSCW researchers that mirror the camps in PIM research. The first is made up of people interested in developing novel solutions to problems. This usually entails the development of new software tools. The tools are then tested to see if they solved anything. The second camp is made up of people interested in the study and in-depth description of work practices and the problems therein. They hope to use the knowledge thus gained to inform the design of technological support tools. This camp often focuses on understanding the articulation work done in a cooperative work environment, so as to understand how best to support that work (2003).

Articulation arises “as an integral part of cooperative work as a set of activities required to manage the distributed nature of cooperative work" (1992). It supports the management of workflows and common information spaces. The nature of articulation work is complex, expensive in cognitive effort and time, and often hidden (Star 1991; Suchman 1995; Star and Strauss 1999). Conceptual schemes including classifications are one of many mechanisms for reducing the cognitive complexity and overhead cost of articulation work. For this reason, classification schemes and other information organization structures have been studied to some extent in CSCW. In order to simplify the remainder of this section, I will use the word “classifications” to describe all of these structures.

Simone and Sarini (Simone and Sarini 2001) reviewed field studies of how classifications are used in cooperative work. They found that a key requirement of an effective classification is that it be adaptable. Martin et al. (Martin et al. 2007) reviewed and analyzed ethnomethodologically-informed field studies on classification in call centers. Two specific ways classifications have been identified as supporting articulation work are by acting as boundary objects and coordination mechanisms.

BOUNDARY OBJECTS

Boundary objects are concrete or abstract objects that inhabit several intersecting social worlds, but are able to meet the informational needs of all of those worlds. They are able to do this because they are plastic enough to adapt to local needs and constraints, but are robust enough to maintain their identity across sites. Broadly specified in general use, boundary objects become more specific and defined in each local setting as they are interpreted for the purpose of accomplishing work in that place. Boundary objects are one way of managing the tension between the need to accommodate the divergent viewpoints of actors and the need to collaborate and get work done (Star and Griesemer 1989). Four types of boundary objects were initially identified: repositories (libraries, museums), ideal types (maps), terrain with coincident boundaries (something with agreed upon boundaries, but where the contents within the boundaries have not been specified), and forms/labels (forms for gathering information in a standardized way) (Star 1989; Star and Griesemer 1989). Various types of items can be used as boundary objects.

Albrechtsen and Jacob (Albrechtsen and Jacob 1998) considered classification systems as boundary objects in libraries. As classification theory has left behind the idea of the classification scheme as a one-size-fits-all tool, the classification scheme can move toward being a discourse-based tool facilitating interactive cooperation between librarians and user groups. Jacob (2001) discusses two ways of viewing classification systems in the context of work. The first is classification-as-scaffolding. Here classification serves as a device for storing knowledge—supporting and promoting cognitive economy. The second is classification-as-infrastructure. Here classification is developed through the practice of work. The classification becomes deeply embedded in work practice and is mainly visible when it fails.

The concept of the boundary object can be useful in analyzing both of these types of classification in work contexts. Classification-as-scaffolding can help collaborating groups with different goals ensure they are communicating about the same things without requiring them to agree on all of the close specifications of each class. Classification-as-infrastructure can serve as part of an internal workflow or as a structure for sharing common documents across groups. Depending on the way one approaches classification-as-scaffolding and classification-as-infrastructure, they may appear similar and even overlapping. Looking through the lens of classification-as-boundary object may be a fruitful way to analyze other situated classification schemes.

Bowker and Star (1991) examined the International Classification of Diseases (ICD) as a boundary object allowing communication across highly distributed groups including doctors, insurance companies, pharmaceutical companies, and the government. They later expanded this work in their book, which also examined other classifications as boundary objects and infrastructure. The schemes covered include Diagnostic and Statistical Manual (DSM), Diagnostic Standards and Classification of Tuberculosis, Nursing Intervention Classification, and racial classification in South Africa (Bowker and Star 1999).

COORDINATION MECHANISMS

Schmidt and Simone (1996) included classifications as examples in their paper introducing the concept of coordination mechanisms. They defined a coordination mechanism as a construct consisting of two parts. The first is an artefact, or permanent symbolic construct. The second is a protocol that specifies how the artefact is to be used in the process of work. This protocol may be defined formally or implicitly by local work practice. Coordination mechanisms are useful for reducing the amount of cognitive work and negotiation involved in articulating distributed work activities in settings characterized by complex task interdependencies. Andersen (1994) analyses an index of technical drawings used by the technical documentation department of a large manufacturer. The index and the product classification used to describe the items in the index are discussed as coordination mechanisms. The helped to reduce complexity in the creation of new documentation by facilitating information reuse. In a case study of the development of a nationwide information system, Hertzum (2004) discusses a requirements classification as a coordination mechanism. The requirements classification was used by developers as a checklist for ensuring that work was done and also to organize bug reporting and repairs.

STUDIES OF INDIVIDUAL PEOPLE'S ORGANIZATION OF INFORMATION FROM AN LIS PERSPECTIVE

At the most specific level, researchers in organization of information have tried to understand the way that individual people conceptualize and categorize information. They hope to use this knowledge to inform the design or revision of information organization systems and information services and tools.

DETERMINING USER-ORIENTED INFORMATION ORGANIZATION THEORETICALLY OR WITH IMPLICIT DATA

Though formal classification is rarely carried out by people for their own purposes, knowing how people think about information could assist in providing better access to it through formal means like classification. Some researchers have attempted to approximate people's conceptual information organization either through the application of general principles drawn from cognitive science, or from implicit data.

Najarian (1981) reviewed studies from the classical school of cognitive psychology that provided support for a hierarchical structure of memory and learning in the human mind. From these, she concluded that the general-to-specific hierarchical organization of library classifications is the most useful and effective at facilitating access to information. For these hierarchies to be most helpful to the user, the structures should be made apparent in the library and its access tools. This would facilitate finding known information and exploring the structure of new topics.

Working well after prototype theory emerged, Donovan (Donovan 1991) assumes that general principles of individual cognition suggest orderings of information that match with universal classification schemes to a greater or lesser extent. His work draws on three principles found in the cognitive psychology literature: (1) radial category structures based on prototypes (Lakoff 1987); (2) Wilensky's law: more specific knowledge takes precedence over more general knowledge (Wilensky 1983); and (3) the basic level of categorization (Rosch et al 1976).

Comparing these principles with the structure of library classification, he identifies disjoints between the general patron's expectations of information organization and the organization that the library provides. First, in mental space there are not sharp distinctions between disciplines; there are sharp distinctions in classificatory space. Second, classificatory principles instruct classifiers to privilege the general over the specific in classifying works on multiple or hybrid topics; patrons expect the specific to take precedence. Finally, patrons expect materials encompassed by basic level categories to be collocated on library shelves, but in classifications distributed relatives are often scattered into separate disciplinary facets.

With the goal of determining which classification's citation order is closest to the psychologically real, Donovan developed a measurement to quantify how far distributed relatives get scattered by different schemes. The main weakness of this study is that the titles chosen for collocation measurements were selected by Donovan because, given the cited findings of the psychological research, he believed they should be collocated. Data on actual patron expectations were not gathered. As discussed above, expertise and context can affect what level of categorization is basic, as well as what members of categories are considered typical and atypical. The distance between psychologically real and really real will not be the same for all users. Also, regardless of these findings, libraries are locked into the classification schemes that are already in use. Findings from further research of this kind could, however, be used to develop user-friendly access layers atop classifications already in use.

Boter and Wedel (2005) analyzed library loan transaction data for adult fiction. They used ultrametric trees in combination with latent class analysis in order to derive overall segments of fiction and specific categorizations within segments. Clear hierarchies of works emerged. Two libraries changed their fiction shelving to reflect the categorization that emerged from the study, and saw an increase in the number of titles borrowed per visit.

ENGAGING THE USER IN RESEARCH TO IMPROVE CLASSIFICATION

Studies using naturalistic or qualitative methods are necessary for understanding how people use classifications and where breakdowns occur. This knowledge is necessary to create user-based classifications and information systems (Solomon 1991). While such studies are common in CSCW, the use of naturalistic qualitative methods to study classification in the context of the library is rare if not nonexistent. Though focused on children's use of Library of Congress Subject Headings (LCSH) in an OPAC instead of a classification proper, Solomon's 1993 study is an example of how such naturalistic methods can reveal possibilities for adding a user perspective to information organization systems. Suggested improvements include displays of the structure of topic areas and interrelations between subject headings.

A more common research approaches in this area include assigning tasks or conducting targeted interviews to elicit information people's conceptual structures. Cooper (2002; 2004) studied kindergarten through 4th grade children's cognitive categories, or typifications, of library materials over time to understand how their conceptions changed in the first years of formal schooling. The children were asked to shelve library books in a way that made sense to them. Then they labeled the resultant categories. Analysis was conducted using hierarchical clustering and multidimensional scaling to trace the development of categories or typifications over time.

Bilal and Wang (2005) used concept mapping to compare middle schoolers' conceptual structures of Science & Nature and Health & Family. Each child created a hierarchical arrangement of researcher-provided concepts. Then each child turned the hierarchy into a concept map by drawing in appropriate links. Hierarchies were compared across children and also to the hierarchical classification of two web directories targeted at children. Unexpectedly, the children's structures did not tend to be based on conceptual relationships. Instead, they were based on perceptual, experiential, and situational relationships. The children's hierarchies did not match the existing web directories' structures, which were based on the conceptual relationships of the disciplines. Each of these studies suggests that access to information for children could be improved by organizing it in a way that more closely mirrors the way children conceptualize information.

Kwasnik and Rubin (2004) used an iterative interview and concept mapping technique to elicit fourteen people's conceptual structures of kinship relations. Each person was from a different country and spoke a different language. The analysis of kinship terms and inter-term relationships across languages was used to highlight difficulties in making current universal classification schemes more hospitable to different cultures, and in constructing a multilingual universal classification scheme.

Some studies have examined how people categorize information with a different aim: to determine the elements or dimensions of library materials that are salient in people's cognitive structures. Howarth (1998) conducted focus groups with users of public and academic libraries in order to define more user-centered bibliographic descriptions and displays for monographs and serials. Users were asked to order descriptive metadata elements by their importance for identifying and accessing items. This study was focused on user's cognitive representations of ideal item surrogates, not how those surrogates should be arranged.

In order to elicit a set of attributes for grouping records in catalog displays, Carlyle (1999) focused on how users categorize and describe related documents. Her study used a sorting task of items related to Dickens' A Christmas Carol. Participants were recruited at a shopping mall, asked to group the items, name the groups, and describe the attributes used to create each group. Attributes such as document form, audience, and language were identified. Carlyle checked whether these attributes are recorded and encoded in current catalog to determine the feasibility of using each for record clustering. Use was one popular attribute not recorded in any standard way in catalog records.

Personal construct theory and its techniques of repertory grid and laddering comprise an approach to eliciting the mental constructs a person has regarding a topic and how those constructs are structured. It results in a set of verbal data elicited from the interviewee that can be analyzed statistically. This technique was developed in clinical psychology (Kelly 1955; Walker and Winter 2007) and has been used in knowledge elicitation for the development of expert systems (Cooke 1994). This approach appears to be useful for studying the dimensions on which people cluster items and information but has rarely been used in an LIS context.

One exception is Burke's (2001) analysis of people's classifications of nine photographs from the Irish Folklore Archive at University College Dublin. She compared the constructs of Irish folklorists with those of students in library and information studies. All of these constructs were also compared with the in-house classification scheme used by the Archive. Twelve frequently used constructs were identified. These twelve constructs could be matched with elements from established approaches for analyzing the subjects of images: Shatford's theoretical approach (1986), Panofsky's iconographical approach (1962), and Ranganathan's facet analysis approach (Ranganathan 1967). The method was deemed useful in identifying, from the user perspective, what aspects of photo subjects from previous approaches could be used to practically enhance photo retrieval.

In their review of the sociocognitive approach to knowledge representation, Jacob and Shaw (1998) highlight the importance of identifying shared patterns of cognitive organization and categorization. They cite two classic studies from the PIM literature discussed above as examples of important work of this nature (Kwasnik 1989a; Case 1991b). Each study was able to generalize dimensions on which people cognitively and physically organize and deal with the information objects in their information environments. In the study of PIM we have not yet developed a clear understanding of how people conceptualize their information environments. McKnight (McKnight 2000) explores the usefulness of eliciting constructs using repertory grid technique for understanding how individuals perceive and understand the notion of "information space." He found that the technique can be used for eliciting and analyzing the structure of the individual's view of the concept. A better understanding of how people or groups of people cognitively construe their information space could provide us with important context for the study of PIM.

This section has traced the study of classification and some other means of organizing information from the universal scope of the traditional library classification, to how working groups use information organization structures to mediate and articulate their work, to the way that individuals think about subjects and documents. Classification research has moved away from a focus on mainly large, formal classification schemes in the classical tradition. Now studies of information organization systems and practices of domains, groups, and individual people—and people's conceptual organizations—are seen as valuable. The findings can inform the improvement of formal knowledge organization structures and the information storage and retrieval systems that use them. The findings can also inform the tools developed to allow people and organizations to create and maintain their own structures for organizing information. This validates the overall questions of interest to this review: how do amateur digital photographer make sense of making decisions about how to organize the information they gather and create in their hobby? Have the systems and structures they have put into place changed over the course of their amateur digital photography careers? If so, how did they decide it was time for a change and how did they navigate the decisions involved in implementing that change?

SENSE-MAKING METHODOLOGY

The Sense-Making Methodology is a set of meta-theoretic assumptions out of which emerge a methodology which mandates methods of question framing, data collection, and analysis that can be used in conducting research that begins with the goal of understanding how people experience and make sense of the phenomenon being studied, in and on their own terms (Dervin 1992). The approach has been under development, primarily by Brenda Dervin, since 1972. It originally grew out of Dervin's work in communication research, but it has guided communicative approaches to research in various other disciplines, most notably information needs and uses.

The Sense-Making Methodology and some of its assumptions have changed over the course of its development. It was previously called the Sense-Making Approach, and is often referred to simply as Sense-Making. For brevity, in this review, I will use the shortened, capitalized, and hyphenated term Sense-Making to refer to the Sense-Making Methodology.

Sense-Making is not to be confused with theories or models of sensemaking--describing how people or groups make sense--such as those developed by Weick (1995) or Snowden (2000). Nor is it meant to be a cognitive science approach to uncovering the inner physical, chemical, or cognitive workings of the mind and brain in the process of making sense across all humans. Sense-Making, instead, is an approach to research that rests upon the assumption that people are making sense of their world at all times. Further, how they make sense of their world, and how they think and speak about making sense of it, tend to be related to their behavior. Therefore, Sense-Making underlines the importance of asking people about their individual processes of making sense of particular aspects of their world as they move through life. Sense-Making includes a set of assumptions that have informed methods of eliciting and analyzing descriptions of those processes, in order to both describe the experiences of people in their own terms, and to find patterns in them. Dervin has called it "a methodology disciplining the cacophony of diversity and complexity without homogenizing it" (1998). Because it is a metatheory encompassing general fundamental assumptions about the world, Sense-Making is not testable. However, it can be used to orient and inform research that tests theory (Vakkari 1997; Pettigrew, Durrance, and Vakkari 1999).

This review first presents the fundamental metatheoretical assumptions of Sense-Making. The general approach is then critiqued. Next, the ways in which Sense-Making has been used are summarized, followed by a brief overview of the methods associated with the approach. Finally an argument is made for using Sense-Making to investigate the research area of personal information management (PIM), and the question of what PIM would look like through the lens of Sense-Making is explored.

Why Sense-Making?

There are a few initial suggestions that Sense-Making might be a fruitful approach to PIM study. Savolainen (1993) writes that "it seems that the theory is applicable in contexts wider than just information seeking." As demonstrated by the summaries presented above, several other areas have been studied using the approach. Dervin (1976b) listed important unanswered questions approachable by thinking of information communicatively, i.e. through Sense-Making. These included two questions central to PIM: "What strategies do people create in dealing with real life situations, and how do they implement these strategies? How do they make order, make connections?" Both of these questions are central questions in PIM research.

The results of Sense-Making studies have been used to inform the design of tools and prototypes. These include a university information system (Nilan and Pannen 1989), an OPAC interface (Hert and Nilan 1991), a word processing application (Bergeron and Nilan 1991), and a desktop publishing application (Nilan 1992). Dervin (1998) believes that results of Sense-Making based inquiry can inform "...how can we build systems which are maximally useful and responsive to real living-breathing human beings and the real nitty-gritty, changing conditions of their work and lives." An ideal PIM system would fit this description.

Finally, PIM topics have already emerged as Sense-Making concerns in two studies. In Bergeron and Nilan's (1991) study of the information needs of people learning word-processing, nearly 9% of questions asked were related to file management. Cheuk (1998) examined information literacy in the workplace, and states that information organization strategy is an aspect of information literacy and behavior to be examined at the individual level, and that it is possibly related to situation movement state.

One of the challenges of PIM research is that PIM is highly individual. Each person will have a unique PIM process and strategy, which may be influenced by various aspects of context, task, and individual difference. Information seeking and use is also a personal and individualized activity, influenced by various aspects of context, task, and individual differences. The Sense-Making approach has been used successfully to generate theory driven, predictive findings in the latter areas. It follows that it might be a valuable tool for studying certain aspects of PIM.

THE METATHEORETICAL ASSUMPTIONS OF SENSE-MAKING

First it is important to review the context in which Sense-Making was developed. Dervin's disciplinary home is Communication. She began to develop her approach in response to the tradition of system-focused communication research based on what she perceived as flawed assumptions of what information is, and how communication with others takes place (Dervin 1980; Dervin 1981; Dervin 1984). Her alternative assumptions became the foundation of Sense-Making.

Early in its development, Sense-Making began to be used to study information needs and uses. Dervin saw identifying information needs, seeking information, and using information as communicative processes, and identified the same system-focused bias in library and information science (LIS) research as she had in communication research. Her 1986 review article with Michael Nilan is one of the most highly cited works in information needs and use, information seeking, and information behavior research. Using author co-citation analysis, White and McCain (1998) found Dervin to be the most influential of authors categorized in information science user theory, despite only entering the map of top authors in information science in the period 1988-1995. Today, citing the Dervin/Nilan ARIST review is shorthand for referencing what has been called the paradigm shift to user-centered research (Olsson 2003). Bates (2004b), notes that Dervin and Nilan (1986) overlooked user-oriented research conducted in information science since the 1950s, implying the importance of the review may be somewhat inflated.

Dervin has continued to synthesize the literature on information seeking and use, distilling this synthesis into a set of 25 propositions (Dervin 2005a). The propositions are a succinct and practical summary of ways to apply the current ideas and assumptions of Sense-Making in research and practice. I review the major assumptions of Sense-Making below. Each section contains an explanation of the assumption at hand, any critiques specific to that assumption, and some initial thoughts regarding what the assumption might mean in conceptualizing the practice of PIM and inform PIM research.

Discontinuity/Gappiness

The assumption of gappiness or discontinuity is the core of Sense-Making. Discontinuity is seen as a fundamental aspect of reality--gaps exist between people, things, spaces, and times (Dervin 1992). There are gaps between what is "actually here" and the small amount of it we perceive. There are gaps between what is perceived and what we make of it--is that shape in the darkness a frightening closet monster, or is it just my coat hanging inside the open closet door? There are gaps between what we think and the words we use to express our thoughts, between what I say and what you hear me say, between what you literally heard and what you understand me to mean, and even between me as I understand something today and how I might understand it tomorrow. What fills each gap, according to Sense-Making, is an active process of sense-making (or sometimes sense-unmaking). Starting from where we are in our situation, using (and creating) the materials we have at hand or can find, we construct a bridge over the gap and move on to outcomes. Here, it should be noted that ‘outcomes’ were initially labeled ‘use’ in Sense-Making. A bit later, ‘helps’ was sometimes used instead of ‘use’, which was defined as also including ‘hurts.’ For clarity and brevity, in this review, I will use the current label ‘outcomes’ to refer to this aspect of Sense-Making.

APPLIED TO PIM

In conceptualizing the practice of PIM within a larger information practices context, the triggering of PIM activity (organizing, re-finding, evaluating, etc) can be seen as a response to a gap situation. In this way, PIM activities can be seen as communicative sense-making strategies to bridge the gaps between self (and self's situated needs and understandings) at different points in space and time. This is discussed in more detail after related assumptions are introduced.

Alternately, the practice of doing PIM can be seen as an ongoing process (or processes) rife with gaps. A Sense-Making Approach to the study of PIM might ask users to explain where they get stopped in their PIM practice, how they see those situations, how they bridge those gaps, what the outcomes are, and what would help or hurt in those situations. As an example, look through the Sense-Making lens at making an initial keeping decision regarding an encountered web page of interest. The gap situation is a stoppage until a decision is made: "Do I want to keep this?" One might define movement in this situation as a fork in the road, because he sees only two options: keep the web page, or leave it behind as one continues surfing the web. Sense-Making would then ask: "What is the process of making that decision? What questions does one need answered in order to bridge the gap? If one bridges the gap by deciding to keep the web page, does one then immediately find oneself in another, possibly more complex, stopped position of having to make sense of how and where to keep it? What is that process?"

Transmission model of information

Given the discontinuity of reality, and the need to bridge gaps at each step, human perception and understanding of messages are not absolute; each of us must make sense of what we encounter. For this reason, Sense-Making's view of information is contrasted with Dervin's metaphors of the traditional approach:

- information as message to be cleanly transmitted
- information as brick to be thrown at people construed as empty buckets that catch or fail to catch the thrown bricks
- message-serum in a hypodermic needle to be injected into an audience.

In Sense-Making, "the empty bucket has evolved into a thinking, self-controlling human being. Information changes from brick to clay, moved and shaped in unique ways by each perceiver" (Dervin 1983a).

CRITIQUE

The concept of information as objective, transmitted thing has been useful and necessary in designing and evaluating mechanisms of communication and information systems. The study of information as an entity distinct from its meaning content can still have benefits in certain contexts (Bates 2004b). Sense-Making, however, is not interested in this conceptualization of information and rejects it as useful for studying how humans experience and use information in their lives.

Sense-Making conceptualizes information as "that sense created at a specific moment in time-space by one or more humans" (Dervin 1992). In its assumption of the subjectivity of all information, Sense-Making does not deny an external objective reality or an existing message; for its own purposes it instead focuses in on the subjective construction of that reality, or the encoding and decoding of messages by individuals (Neill 1987). Such a conceptualization of information may seem contrary to most definitions of information in information science. Savolainen (2006) suggests that the discipline is moving steadily toward understanding information as Dervin has conceptualized it, citing the shift to cognitive models and the recognition of the role of affect in information seeking and use.

Finn & Roberts (1984) imply that Dervin, Jacobson & Nilan's (1982) critique of Shannon's transmission-based information theory stems from conflating the two parts of the theory: the relationship between source and receiver, and the technical characteristics of transmission channels. Bates (2004b) states that Dervin's characterization of early work in information science "as reflecting a naive assumption that information is an objective entity to be transferred from a sender to a recipient and has an identical meaning to both parties in the transaction" is based on misreading and oversimplification. Exploring the veracity of these criticisms is beyond the scope of this review. Since Dervin's conceptualization of information has been extensively developed and used successfully in many research projects, any misunderstanding of other models in the development of Sense-Making do not lessen the proven usefulness of the Sense-Making conceptualization in tackling problems appropriate to its own methodology.

APPLIED TO PIM

The design of many PIM studies seems to assumption that the management of personal information is consists of the shuffling about and refinding of discrete, objective pieces of information or information objects found, received, or encountered by a person. This is based on a transmission model of information. A Sense-Making approach to PIM would require a different approach. It would certainly not preclude looking at what people do with information objects, but it would foreground the idea that an active and creative process of making sense happens each time a person interacts with said information objects. It would also recognize that by engaging in the practice of PIM, a person creates new information and informs herself. Perhaps the arrangement of the computer desktop is also the creation of a reminder. The placement of two documents into the same folder is also a statement about the relationship between the documents. The meaning and informativeness of such actions may change over time. A year from now I the presence of the documents in the folder might indicate to me that they are related, but I might not remember why. I might make a guess and create a new relationship between them I had not previously thought of.

The foregoing review has discussed various ways people use the process of making representations and organizing information to make sense of reality and learn. A conception of the personal information environment as a bucket into which information is dropped in hopes of later retrieval ignores the opportunities and abilities that the process of organizing information affords us. Given the quantity of information objects that quickly accumulate in our lives, the focus of PIM study on documents, files, objects, and emails is understandable, but it should not be the only focus.

Model of the individual

The Sense-Making Approach makes several assumptions about people. First, it assumes that individuals move through space and time. As an individual moves through space and time, his situation and context change. In Sense-Making, "the human is conceptualized as centered and decentered; ordered and chaotic; cognitive, physical, spiritual, and emotional; and potentially differing in all these dimensions across time and across space" (Dervin 1999). This view has been supported by at least one study of an individual's information behavior in everyday life (Julien and Michels 2004).

Dervin (1989b) describes the traditional approach to research that categorizing people by demographics, personality indicators, or cognitive style. Such categorizations assume the person remains static across time and space, with the result of perpetuating current assumptions about various populations and weakening research results. Ford (2004) sums up Dervin's argument against utilization of such categories: "Emphasis on across time/space constants may result in research methodology that is ultimately tautological to the extent that, as a perspective, it may constitute an a priori assumption that is not tested within the research."

In contrast, Sense-Making focuses on the types of situations and gaps in which people find themselves at particular points in time-space, how people define those situations and gaps for themselves, the behaviors used to bridge gaps and make sense of situations, and the outcomes of bridging gaps and making sense. In this way, Sense-Making moves the analysis to a unit smaller than the person. The unit of interest is instead the situation, gap, or question as identified and described by the individual at a moment in time-space. This shift in the focus of analysis has uncovered systems and order hidden within the apparent chaos of individuality, and poorly explained by across time-space constants.

Empirical work supporting the early development of Sense-Making hypothesized that the way an individual defines the situation or gap he faces at a particular moment is more strongly related to the steps he takes to bridge the gap than are across-time categories. Several Sense-Making variables were constructed to test this hypothesis. The most important and fully-tested variable was Situation Movement State, defined as:

> a measure that taps the different qualitative ways in which the respondent sees his/her movement through time-space blocked...The different Situation Movement States are all seen as different ways of being stopped in movement through time-space" (Dervin 1983b).

Several early Sense-Making studies of information seeking found that Situation Movement State was significantly related to both the types of questions asked and to how answers helped. Situation Movement State was found to be an equal or more powerful predictor of information seeking and use than demographic or personality traits (Dervin et al. 1980; Dervin, Nilan, and Jacobson 1981; Atwood and Dervin 1981; Dervin, Jacobson, and Nilan 1982; Newby, Nilan, and Duvall 1991; Shields et al. 1993).

This work demonstrated that the usefulness of Sense-Making is not limited to eliciting and dealing with the rich qualitative experience of users. It is also possible to conduct quantitative content analysis to test hypotheses, confirm theory, and make predictions. Dervin has called Sense-Making "a methodology between the cracks," because of its acceptance of positivist and post-modern approaches, quantitative and qualitative analysis, reality as both chaotic and ordered, the human as habitual and ever-changing and seeing structures as simultaneously static-seeming and continually constructed. Sense-Making embraces dichotomy and refuses to take sides (Dervin 2003). The approach acknowledges "the uniqueness of individuals and their circumstances, while identifying commonalities in the processes they go through. Such commonalities permit systems and services to be created that provide appropriate help" (Morris 1994).

Second, Sense-Making assumes the full human is present and active in this movement through time and space, "positing as possible fodder for sense-making not only thoughts and ideas, observations and understandings, but emotions and feelings, dreams and visions, pretenses and illusions, connections and disconnections" (Dervin 2003). Emotions, expectations, and imaginations are seen as potential outcomes of gap-bridging. They are also part of the bridging process, for they are central in allowing us to communicate and cooperate with others, to evaluate, and to plan. Finally, gap situations are often entangled with emotions which may affect how a person sees his situation, and how he then moves (Dervin 1998). Issues of emotions and dreams are not to be discounted or omitted from analysis. Instead they are to be elicited from respondents and valued as part of their processes of making sense (Dervin 2003).

Finally, Sense-Making assumes that each individual is an expert on and theorist of her own world and experience of it. Since each individual is involved in developing strategies for bridging her own gaps, each individual consciously or unconsciously theorizes why certain strategies are appropriate or useful for her. A researcher using the Sense-Making Approach must take care to frame research questions and gather data in such a way that the expertise of the individual participant in the research is uncovered and her theories elicited (Dervin 2003).

APPLIED TO PIM

In summary of the previous section, Sense-Making's model of the individual human assumes three things: (1) each human and his behavior may vary or stay the same as he moves through time and space; (2) a human has many facets and ways of reacting; and (3) each human is the expert and theorist of his own experience.

Some cross time/space categories for users PIM research have been developed. I have discussed some of these above as "PIM Personalities." Some research aims to understand PIM behavior based on individual difference criteria[40]. A Sense-Making approach to PIM would not be interested in these sorts of categorizations. Instead, it would attempt to uncover whether there are relationships between how people see specific situations and what PIM activities they do in those situations.

The former approach would have trouble explaining the PIM practices of someone whose office is a massive drift of piled paper, while their work computer's desktop contains only a handful of neatly arranged icons and their mp3 collection at home is obsessively tagged with metadata painstakingly gathered, and categorized into a complex set of genres and playlists. Is this person a Piler or a Filer?

Sense-Making suggests those categories are irrelevant because it assumes people will do different things in different situations. It would hypothesize that the great differences observed in this person's PIM practices are related to differences in the way the person sees and experiences the situations and contexts surrounding those practices. It would look across groups of people for patterns of similar practices in similarly construed situations instead of expecting each person's PIM practice to be consistent across time and space.

[40] Gwizdka and Chignell (2007) present a recent review of this work, concluding that changes in context and type of information being managed appear to influence a person's PIM style or personality in different situations. This suggests that a Sense-Making approach to conceptualizing the individual doing PIM may be useful.

The identification of patterns of PIM practice in response to different types of situations could greatly advance the study of PIM. Such findings could inform the identification of:

- Reference tasks and the compilation of test collections for conducting evaluation (Kelly and Teevan 2007);
- Requirements for PIM tools (or modes of these tools) for use in different types of situations;
- Teachable PIM strategies (Jones 2008a, 395).

A Sense-Making approach to PIM calls for attending to the whole person in PIM studies. Of course we want participants to speak about their PIM practices and the logical explanations for them. A Sense-Making approach would additionally mandate inquiry into how a participant's emotions, hopes, intuitions, and imaginings are involved in their PIM practices, as well as imaginings of what they would like their PIM processes to be.

Olsson (2005) identifies the research constructions of people in the role of information users. In most information behavior research to date, they are typically defined by their ignorance, uncertainty, and failures in the bulk of information behavior research to date. PIM researchers typically present the participant as the expert on his own information space and PIM practices; however, the focus of most studies remains primarily on problems and breakdowns in PIM practice rather than on successes or innovative solutions.[41]

A Sense-Making approach would position the participant to speak from a place of authority and familiarity about her processes of PIM--including difficulties and successes, problems and solutions. Sense-Making asks the researcher to trust that the participant, as expert theorist on her own experience, can identify and see beyond the barriers and constraints in her situations. She is asked not only about her PIM practices, but also about what gets in the way of optimal PIM practice, what assists PIM practice, and what she would like her PIM practices to look like. This sort of approach could leverage the creativity and expertise of many individuals in order to create new strategies and systems for doing PIM that are not “radical invention” (Whittaker, Terveen, and Nardi 2000).

Dalrymple (2001) states that "If one adopts the Sense-Making approach, clearly, one cannot focus on the system to advance understanding, but rather must concentrate on the user to interact with the system and make sense of what is obtained from the system." Sense-Making mandates allowing the user to speak from his viewpoint. Attempting to understand the processes of PIM by conducting studies focused on individual information formats or applications (e.g. email, bookmark, or contact) is an approach constrained by the capabilities of the system. Sense-Making provides options for learning about PIM in a broader way from a true user perspective.

[41] It may seem that a Sense-Making approach, with its assumption of continual gaps, is also focused on problems. In truth, an instance of discontinuity can be an opportunity or a problem. The outcome may be success, failure, or something in between.

Verbings, not nouns

Sense-Making conceptualizes information as the active construction of sense in gappy situations. Its model of the individual conceptualizes users as “actors navigating moments of situation-facing” instead of as “nouns ascribed with adjectives of our choosing” (Dervin 2006). Both of these changes involve moving from a focus on the static, to a focus on dynamic processes. In this way, Sense-Making is a process oriented approach.

Dervin calls these processes involved in gap-bridging "verbings." They are the foci of Sense-Making studies (Dervin 1993). The focus is on the individual's processes of making sense, working, changing, or creating. "Sense-Making assumes that it is only by focusing on changes across time and space and on the flows of events that we can search for and study patterns in the human condition without fixing them tautologically and a priori" (Dervin 2003).

Sense-Making does not preclude attention to nouns, but insists that they be examined outside the typical noun-based framework in which the bounds of the inquiry are drawn by researcher assumptions about and definitions of the objects of interest. Instead, Sense-Making conceives of nouns as being constructed by processes, and therefore as fluid and open to interpretation. For example, a structure is made and maintained by active structuring. Sense-Making says that asking about the process of structuring will produce picture of structure as the user sees it, instead of one that fits what the user thinks the researcher is asking about when he asks about structure.

To achieve this, the Sense-Making interview mandates "minimal intrusions and 'namings of the world' by interviewers. Except for eliciting attention to a set of critical situations, the Sense-Making interview is constrained to queries based on the Sense-Making metaphor with its emphasis on time, space, movement, gap, power, history, constraint, outcomes, repetition, and change," that is, open ended questions focused on allowing the respondent to communicate her process (Dervin 2003).

An example of a verbing approach is that used by Ross (1999). She uncovered information behavior and uses encountered in pleasure reading by first asking not about information, but about the processes of reading and choosing books to read, including how these actions brought value into the lives of respondents. A rich description of many types of information and information behavior emerged from user descriptions of their processes and activities involved in pleasure reading. A noun approach, such as initially asking what information people get from reading for pleasure, would have resulted in very different findings. The techniques of verbing-focused interviewing are examined in more detail below.

APPLIED TO PIM

PIM appears to be attuned to both nouns (email, bookmarks, files, and folders) and verbs (finding, reminding, filing, piling, keeping, organizing, managing, and re-finding). Unfortunately, research into the verbs is most often conducted in terms of nouns. For example, a study designed to investigate organizing information in the office which analyzes snapshots of the number of files and piles in the physical space, the directories or documents on the desktop, the messages in their email inbox, and the number of bookmarks is actually focused on the nouns (the information objects and existing structures) instead of the verb (organizing--the process of creating those structures and working with information objects within them). Such an approach defines a priori what organizing the researcher is interested in.

In contrast, a verbing approach might involve asking the office worker to think of the last time they were engaged in organizing at work, and what actions they took. A Sense-Making interview might ask them to describe their actions step by step. This sort of approach is more likely to allow new knowledge about PIM practices the researcher may have never thought of to emerge.

Attention to power

Fidel et al. (2004) criticized Sense-Making as being one-dimensional, interested only in the internal individual processes of cognition, which cannot be fruitfully examined out of social context. However, Dervin has increasingly discussed assumptions of and attention to the power, constraint, culture, and community in Sense-Making as it has evolved over time (Dervin and Frenette 2001; Dervin 2003). While each individual is ultimately the active constructer of her own sense, she is never truly solitary or free in this action. We are embedded in a social context, which shapes us. It provides some opportunities while taking others away. In the world we encounter "energy and forces that impel, assist, and facilitate movement, as well as constrain, hinder, and limit" our Sense-Making (Savolainen 2006).

Issues of power and constraint involve forces and players outside the individual's process of cognition, but from the individual's perspective, and Sense-Making is interested in how the individual understands this context. Dervin (1992) writes that "because we have sought only across time-space understandings, we have missed so much of the whole range of human existence that involves struggling with, breaking with, coming to terms with, and changing whatever structure the human finds himself in." This range of existence recalls Certeau's image of the everyday creative tactical movements of the ordinary person within through a strategic landscape constructed by larger social and economic forces (de Certeau 1984). Uncovering these processes requires a verbing approach when defining "social context," which is constantly being made and interpreted by the actions of all involved.

Dervin (1991) writes that "whether a given user is constrained or free in a given situation is accounted for by some combination of how the user constructs that situation and the forces that other entities exert on that situation and the interaction between the two." This is supported by Nilan's (1985) findings that Perceived Relative Status (measuring whether an individual felt higher or lower status than others in the situation) and Perceived Openness of Communication (measuring whether the individual felt that it was possible, safe, and acceptable to communicate in a situation) contribute to predicting information behavior above and beyond the Sense-Making Situation Movement State variables. Sense-Making mandates paying attention to the various manifestations of power in the individual's process, allowing for consideration of the social and its influence, without allowing external forces to obscure the individual's agency.

APPLIED TO PIM

A Sense-Making approach to PIM would require attention to issues of power, constraint, culture, and community in the processes of PIM. An employee required by his employer to use an email client he wouldn't otherwise choose for himself is an example of the influence of power in PIM practice. An overwhelmed email user who spends lots of time filing email, but doesn't know how to set up rule-based filtering in her email client, or that such a thing is possible, is an example of PIM practice constrained by lack of technical knowledge. There are many kinds of constraints including the lack of time, money, or other resources. A person who decides to organize his photos using Flickr because it seems cool and his friends are sharing photos there is an example of a PIM practice influenced by culture and community. What if he cannot afford the $25 for a year-long "Pro" subscription? He will be limited to an account that will only display the 200 most recent photos. How will this limitation influence his use of Flickr?

A Sense-Making approach to PIM would also requires attention to the affordances and constraints introduced by the formats of information objects and the capabilities of systems to manipulate them. If a participant's process for managing digital photos is to download each batch into the default folder on her desktop, is this because this process works well for her? Or is it because it is tedious and time consuming to structure the photos in some other way, and the disadvantages of the default method do not outweigh the annoyance and time required to do things differently?

Here one might also identify clever tactics used by people to subvert the organization strategies embedded in the system or tool (de Certeau 1984). An example is achieving a desired non-alphabetical ordering of folders by adding numbers or special characters to the beginning of a file name (Jones et al. 2005c). The system strategy (arrangement only by alphabetical order) is still in effect, but the user has creatively implemented a tactic for getting the effect he wants.

Researcher reflexivity

Finally, Sense-Making requires reflexivity on the part of the researcher. Researchers are first and foremost people, which means they use their own experiences, biases, theories, understandings, and hunches to make sense of their world and their work. Sense-Making requires the researcher to acknowledge this and reflect upon how it may affect her research. It also requires that the researcher ensure that studies using the approach are framed in such a way that participant has the opportunity to share his own experiences, biases, theories, understandings, and hunches, and that these will be considered and represented in the analyses and reporting (Dervin 1997). Ford (2004) identifies Sense-Making’s ability to uncover hidden and untested biases on the part of the observer as a strength of the approach, for these can be turned into testable research questions. This assumption applies in much the same way regardless of the topic of the research.

The Sense-Making Metaphor

These assumptions and mandates are summarized and visually represented in the graphical Sense-Making metaphor shown below. This shows the individual, continually moving through situations and contexts in time and space, coming upon a gap or discontinuity of some sort. The active verbing processes of making sense enable the individual to bridge the gap, leading to outcomes. The "Sense-Making triangle" of Situations-Gaps-Outcomes, used to direct questioning in the Sense-Making interview, is embedded in the metaphor.

Figure 2

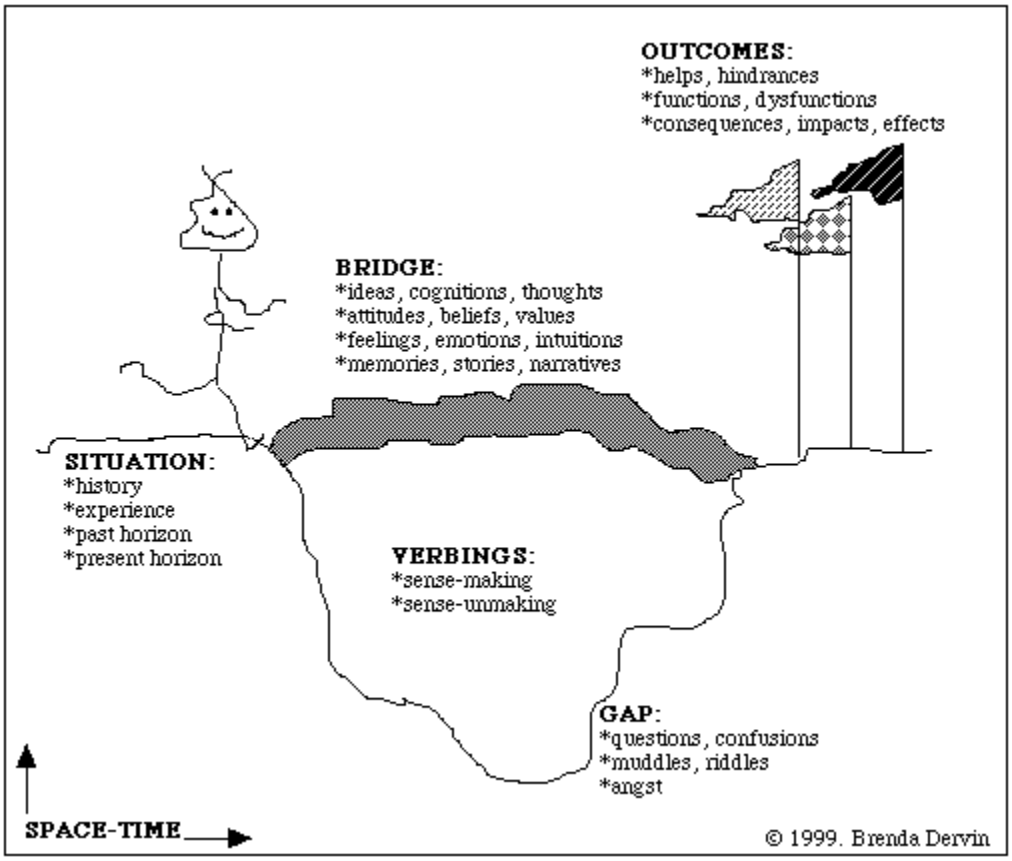

Figure 1: Core Sense-Making Metaphor (Dervin and Frenette 2001)

CRITIQUE

Savolainen (2006) has critiqued the Sense-Making metaphor as both a strength and a weakness of the approach and cautions against confusing the metaphor with the phenomenon at hand. On one hand, metaphors are powerful ways to help humans understand phenomena. However, any metaphor is one view of a phenomenon, highlighting certain aspects while ignoring others. Morris (1994) found that most people "easily understand the notion of information in the Sense-Making approach after it has been explained to them. However, they do not see it this way without having it explained." Davenport, Higgins, and Sommerville (2000) point out that people do not necessarily approach or describe their experience in "narratives of breakdown and discontinuity," as required by Sense-Making, and claim that forcing respondents into the Sense-Making metaphor framework the researcher deprives them of their voices.

Throughout the development of Sense-Making, Dervin has continually stated that the Sense-Making metaphor is just that--an abstract metaphor. Its linear construction is not meant to imply that the reality of communication and sense making is always linear, logical, or purposive, or that individuals naturally conceive of these processes through the lens of this metaphor (Dervin and Frenette 2001). It is meant instead as "a highly abstract methodological tool, a way of looking" in order to focus the efforts of researchers on previously overlooked aspects of phenomena of interest (Dervin 2003). How this is put into practice will be covered below.

APPLIED TO PIM

Looking at PIM practice through the Sense-Making metaphor for any amount of time tends to draw me into an endless recursive loop of different ways the metaphor could apply. In nearly all cases, viewing PIM practice through the metaphor at least slightly shifts the conception of what PIM practice is. I'll briefly describe a few possibilities.

As described above, the most obvious is that each decision or other stopping point in PIM practice is an instance of Sense-Making as represented in the metaphor. The gap opens up in a particular situation stopping movement. Through a sense-making process using various bridging materials such as cognitions, values, and feelings about the situation, one bridges the gap and moves forward. This process may have various outcomes.

Taking a step backward, one can ask how different activities of PIM practice might be framed in this metaphor.

Keeping practices may be seen as opportunities for the present self to provide bridging materials for gaps faced by the imagined future self. Bridging gaps in keeping involves not only imagining a future self, but also imagining likely future gaps and what will be helpful in bridging them. The outcomes of bridging keeping gaps may not be known until an item is wanted in the future.

Organizing practices are also ways for the present self to communicate with and provide bridging materials for and imagined future self facing imagined future gaps. The creation of structures or the placement of information objects within such structures is a way to bridge gaps of disorganization or lack-of-sense in the present. These structures are also representations-of-sense-made that act as bridging materials for in instances of future re-finding.

Re-finding information in a personal information space becomes a process of present self in dialog with past self, using previously constructed representations-of-sense-made to bridge gaps of information need in a situation of knowing one has seen the information before.

Meta-level PIM practices such as management require the present self to move between past, present, and future. The present self must interpret the representations-of-sense-made created by the past self and answer additional gappy questions such as: Does this still make sense? Does my routine of practices work? Does it serve my future self? If not, how can I improve my practices?

GENERAL CRITIQUES OF SENSE-MAKING

Above, I discussed critiques directly related to Sense-Making's assumptions. Next, I discuss a few further judgments of Sense-Making as an overall approach. Hjørland and Albrechtsen (1995) refer to the Sense-Making approach as "the communication paradigm," one of four main research approaches in IS. They review Sense-Making in light of their domain analytic approach, finding that Sense-Making's attention to epistemological questions indicates it could possibly contribute to the domain analytic approach. However, they found the consequences of Sense-Making’s epistemological questions unclear and possibly not fruitful. I see a fundamental mismatch between the two approaches. Sense-Making foregrounds the individual experience, assuming useful patterns can be found in all of the variations therein. The domain analytic approach focuses on knowledge domains, rejecting infinite individual subjectivity as a useful grounding for information systems (Hjørland 1997). The two approaches can be viewed as complementary approaches to understanding information phenomena.

The broadness and flexibility of Sense-Making is one of its strengths. Pettigrew, Fidel, and Bruce (2001) named Sense-Making as a model that can be applied to almost all situations of information behavior. Fisher, Durrance and Hinton (2004) mention it as one of the few common approaches to studying information behavior that does not omit information use. Savolainen (2006) also highlights the increasing attention to information use behavior in the development of Sense-Making, but points out that the practical application of the approach to these matters has not yet been discussed in detail by Dervin. The approach is, as it has been since its birth, under development by Dervin and those who use the approach in their own work.

Whether the assumptions of Sense-Making and the results of studies using the approach can be put to practical use is an enduring question. Savolainen (1993) found no clear answers, but an examination of Sense-Making studies uncovers some examples of its practical use. The Sense-Making informed design of information resources, campaigns, and services has been described (Dervin 1989a; Dervin and Frenette 2001). Dervin (1991) imagined ways in which Sense-Making could inform the design of retrieval systems, journalism, software applications, documentation, and more. Since the publication of that paper, some of these ideas have since come into being, at least in part, though they haven't necessarily been explicitly based on Sense-Making. An obvious example is the rise of social tagging. In tagging systems, each user can assign terms describing each information item in terms of what the item means to him, how and in what contexts it may be useful, and affective response. A system populated by such tags can then be navigated in many different ways.

The Sense-Making approach has also been used to elicit user activity models to inform the design of an NSF grant submission system (Nilan and Fletcher 1987), a desktop publishing help system (Nilan et al. 1989), an online public access catalogue (OPAC) (Hert and Nilan 1991), and a geographic information system interface (Ju and Gluck 2005). The approach has also been fruitful in designing and evaluating library and information center services (Dervin 1977; Dervin and Fraser 1985; Dervin and Clark 1987; Morris 1994; Gluck 1995; Gluck 1996; Pettigrew, Durrance, and Vakkari 1999; Downs and Friedman 1999; Pettigrew, Durrance, and Unruh 2002; Durrance and Pettigrew 2002; Durrance and Fisher 2003).

Finally, in a review of the work of Dervin and Douglas Zweizig (to whom Dervin's work owes a large debt), Dalrymple (2001) outlines its contribution to library and information science:

- Greater attention to conceptualizing the problems in library and information science to avoid oversimplifying them.
- Greater familiarity with the armamentarium of methodologies to select them carefully, apply them appropriately, and remain aware of their limitations.
- Greater persistence in fully exploring the fundamental problems in library and information science.
- Dedication to a dispassionate approach to research, recognizing that investigations do not always produced the result deserved, and that fundamental assumptions must also be examined if work is to advance.

USING SENSE-MAKING

I summarized the metatheoretical assumptions of Sense-Making, its central metaphor, and critiques of the approach above. In this section, I turn to how the metatheory has been translated into method and used in research. First, I review the broad research areas to which Sense-Making methods been applied, inside and beyond information seeking in context. Then I summarize the main methods of data collection that have evolved, giving examples of how these have been modified and expanded in various studies. Finally, I summarize some Sense-Making approaches to data analysis.

Areas of application

Sense-Making has been put to practical uses in creating user activity models, and in creating and evaluation library and information center services. It has also been heavily used in the study of information behavior (specifically in information needs, information seeking, and information use). Though it is more difficult to draw direct practical applications from many of the following studies, this is the area with which Sense-Making is most strongly associated in LIS. The following summary is by no means complete, but is intended to give an overview of the extent of the use of Sense-Making in this area.

Some of these studies are general, allowing respondents to speak about information behavior as it may manifest in any part of their lives. Populations studied have included California residents (Atwood and Dervin 1981) and African-American inner city gatekeepers in a community (Agada 1999). Most studies, however, have a narrower focus such as the information behavior in a specific situation, or on a specific topic.

Sense-Making has been used heavily in the study of health information behavior. Nilan, Peek, and Snyder (1988) and Halpern and Nilan (1988) used Sense-Making to explore evaluation criteria for information in both everyday life and health situations. Dervin et al. (1980) examined the information needs of patients communicating with their doctors in a health context. Montgomery and Amos (1991) studied the nutrition information needs of cardiac patients and their spouses. Baker (1998) investigated the information needs and use of women experiencing an attack of multiple sclerosis. Dervin, Harpring, and Foreman-Wernet (1999) researched the information needs of pregnant drug-addicted women, and the barriers to the information needed. Wathen (2006) examined women's information seeking while making decisions about hormone replacement therapy.

Sense-Making has also been used to explore information behavior in a wide range of other specific situations such as: completing job tasks (DeMartini and Whitbeck 1986; Cheuk 1998), using a university information system (Nilan and Pannen 1989), using information systems in colleges and universities (Dervin et al. 2006a; Dervin et al. 2006b), learning word-processing (Newby, Nilan, and Duvall 1991), using a full-text multi-file database (Jacobson 1991), completing Internet training (Hert et al. 1995), seeking weather information (Barry and Schamber 1998), and making career choices in high school (Julien 1999).

Despite its association with information behavior research, the use of Sense-Making is not limited to this topic. Shields' 1994 dissertation work used a Sense-Making approach to explore responses of male and female respondents to gender depictions in magazine advertisements. Dervin and Shields (1999) examined people's experiences of telephone-related privacy violations. Ross (1999) did not describe her study of pleasure reading as a Sense-Making study, but the research question and design were heavily informed by the Sense-Making approach. Trepagnier (2002) assessed the effectiveness of learning and using cognitive mapping in the classroom using a Sense-Making approach. Hepworth (2004) used Sense-Making to test a framework developed to collect and understand the information needs of a community. Finally, Foreman-Wernet and Dervin (2005) investigated and compared the arts and popular culture in students' experiences.

Methods

DATA GATHERING

The primary and core method for data gathering in Sense-Making is the Micro-Moment Time-Line Interview. This technique has been developed over time and is described at varying levels of detail, with examples, in various publications (Dervin 1983b; Dervin 1992; Dervin 1999). In addition, extensive examples of Sense-Making interview instruments and transcripts are available online (Dervin 2005b).

The basic process of the Micro-Moment Time-Line Interview "involves asking a respondent to detail what happened in a situation step-by-step in terms of what happened first, second, and so on. Then, for each step (called a Time-Line step), the respondent is asked what questions he or she had, what things he/she needed to find out, learn, come to understand, unconfuse, or make sense of" (Dervin 1983b). Then, for each of these questions or gaps, the respondent is asked questions designed to elicit his experience and understanding of the three points of the Sense-Making Triangle: Situation-Gaps- Outcomes. These questions vary with the purposes of the study at hand. A full Micro-Moment Time-Line Interview takes, on average, two hours to complete.

Dervin (1999) writes that "since Sense-Making provides only a theory of the interview and not a script, actual implementation may take myriad forms, depending on the purpose of the study." There are several variant techniques based on the full Micro-Moment Time-Line Interview. The Abbreviated Time-Line Interview goes into detail on only one time-line step (Dervin 1992). Abbreviated Time-Line Interviews have further been modified by focusing on a subset of initially elicited Time-Line steps chosen by respondents based on various criteria (e.g. most important, most recent, most problematic, best remembered). Another shortened form of the interview may focus on a particular type of situation, or on particular aspects of gaps or gap-bridging (Dervin 1989a).

Though most Sense-Making interviews begin by asking about a certain type of situation, interviews may also open by asking respondents to focus on a certain type of gap, or a certain type outcome. Follow-up questions then complete Sense-Making triangulation. Some forms of Sense-Making interviewing gather additional information. In a Helps Chaining Interview, answers about Outcomes are investigated in depth using subsequent queries about how each outcome further helped or hurt.

The Message Q/uing variation asks the respondent to make sense of and respond to a particular message. As the respondent steps through the process of making sense of the message, each stopping point and question asked is noted. These questions and stops are later triangulated using the Sense-Making Triangle questions. A variation of this that has been used in LIS is to ask a respondent to complete a task such as using a desktop publishing tool (Nilan 1992) or OPAC (Hert and Nilan 1991). Each stopping point is noted aloud by the respondent in the process of completing the task. These stops and questions are then triangulated. One further variation of this type captured logs of respondents' database searching. These detailed logs were later used as time-lines in Sense-Making informed interviews (Downs and Friedman 1999).

In areas where the typical situation types or states, gap types, or outcomes have been previously established, close-ended Sense-Making questionnaires can be developed to facilitate larger scale data collection, quantitative analysis, and hypothesis testing (Dervin 1983b). For example, Atwood and Dervin (1981) collected data using a blend of open-ended interviewing and closed-ended interviewing in which respondents chose information sources they had used from a list. In asking about respondents' last visit to a library, Dervin and Fraser (1985) asked some open-ended questions, but users were asked to choose from a list of 16 ways the visit helped them.

These are the main variations on the method, but many other variations have been used. Some of the more unusual variations are briefly described below. Nilan and Pannen (1989) turned the Time-Line into a truncated storyboard of four panels. The first and last panels were the first and last things that happened, and the respondent was free to choose two other steps to populate the remaining panels. Questions were elicited for each panel, and then each question was triangulated. Bergeron and Nilan (1991) elicited particular steps from respondents who had recently learned word processing. The steps were: When you first realized you would be learning to use word-processing software, during the training, the first time you used word-processing software after you learned it, and the last time you used word processing software. Each of these steps was examined as per the usual Time-Line Interview.

Sense-Making informed data gathering is not limited to face-to-face interviews. Some of Dervin's own studies have utilized telephone interviews (Shields and Dervin 1993; Dervin and Shields 1999; Dervin et al. 2006b). Other studies have used written questionnaires which ask respondents to write answers to Sense-Making questions (Nilan 1985; Montgomery and Amos 1991; Hert et al. 1995; Gluck 1995; Gluck 1996; Julien 1999). Using a combination of respondent diaries and a series of interviews, Julien and Michels (2000; 2004) gathered data on sources and their selection and use in everyday life. The researcher-provided personal diary sheets consisted of Sense-Making informed questions, which served to get the respondents thinking about their information behavior in between interviews.

Regardless of the form it takes, the Sense-Making interview is focused on verbings or processes, mandating "minimal intrusions and 'namings of the world' by interviewers. Except for eliciting attention to a set of critical situations, the Sense-Making interview is constrained to queries based on the Sense-Making metaphor with its emphasis on time, space, movement, gap, power, history, constraint, outcomes, repetition, and change. No other noun-based questions are asked" (Dervin 2003). In this way the researcher is prevented from narrowing the scope of the research to particular objects he has pre-defined as salient. The subject is asked about a specific process or situation and may speak, unconstrained by perceived researcher expectations, about whatever actions, objects, and thoughts are important to her.

CRITIQUE OF DATA COLLECTION METHODS

The Micro-Moment Time-Line Interview and its derivatives have been widely used because they are neutral, flexible instruments that gather rich, detailed data from the user's perspective (Nilan, Peek, and Snyder 1988; Jacobson 1991; Shields 1994; Bystrom and Jarvelin 1995; Barry and Schamber 1998; Hepworth 2004). However, all methods of data collection have some weaknesses. A main disadvantage of the time-line interview is its labor and time intensiveness for both researchers and participants. The process of conducting a full Micro-Moment Time-Line interview can be very long, leading to interviewer and respondent fatigue which can affect the quality of responses. The format of the interview may become redundant to the respondent, leading to frustration and lower response quality (Sonnenwald and Lievrouw 1991). Dervin (1983b), however, claims that Sense-Making interviewing in general is characterized by high respondent and interviewer interest and involvement.

Designing the structured interview schedule is complex and difficult, as care must be taken in developing the wording of the items to maintain a process orientation and avoid introducing biases that may be difficult for the researcher to identify (Schamber 2000). In some cases, the open-endedness of the interview questions may trigger the respondents to continually wander off topic. Baker (1998) reported some difficulties in using the technique because her respondents tended to talk about their attacks of multiple sclerosis in a non-linear way and to compare over time. Finally, proper administration of the interview, including probing and chaining, requires in-depth training of multiple interviewers if a large number of respondents are to be included (Schamber 2000).

Schamber (2000) assumed “that users’ self-reports are valid indicators of their perceptions about their situations.” This assumption is at odds with some critiques. Jacobson (1991) points out general concerns about the validity of the time-line interview, given its reliance on self-reported verbal recollections. Self reporting is fairly ineffective for explaining the cognitive processes that actually occur in the brain. Often these are not even known to the person (Nisbett and Wilson 1977; Bargh and Chartrand 1999). However, Sense-Making does not purport to uncover some objectively defined “actual” cognition at a level of interest to cognitive scientists; its goal instead is to uncover how individuals consciously interpret and interact with their world--how they consciously make sense of it and communicate about it. As a communicative, dialogic approach it allows respondents to verbalize their conscious understandings of themselves and their world.

Barry (1997a) cautions that "Relying on oral reports of participants views, without attempting to marry them to actions can lead to inaccurate explanations." Similarly, Bystrom and Jarvelin (1995) state that questionnaires and interviews "in general, have problems of reliability and completeness when data collection occurs long after the activities being described." Sense-Making researchers claim that the visual cues of the index cards used to represent steps, and the overall focus on moving step-wise through time facilitate respondent recall in a great deal of detail (Nilan, Peek, and Snyder 1988; Barry and Schamber 1998; Schamber 2000). The Time-Line interview will only elicit data on memorable or significant situations, so if smaller or more day-to-day tasks are of interest, other methods should be used (Hepworth 2004). Sense-Making assumes that the experiences and memories of respondents are “real” to them, so external judgments of accuracy are inappropriate. Every data collection technique comes with strengths, weaknesses, and assumptions. For this reason, triangulation of methods is important.

DATA ANALYSIS

The typical analysis method in Sense-Making studies is content analysis. Sometimes this is quantitative content analysis used for hypothesis testing, but more often it is qualitative and exploratory. Over the development of Sense-Making, some sets of content analysis categories have been developed to describe people's processes of making sense while moving through time and space. These sets of categories follow the Sense-Making Triangle and have been used as variables in quantitative Sense-Making studies. They are designed to be general and content-free insofar as they can be applied in studies of different populations and phenomena.

The first set describes the way respondents see the situations they are in. The core variable used in Sense-Making has been Situation Movement State--the way respondents describe their movement through a situation. Examples include "Wash-out" and "Decision." There are 11 Situation Movement States (Dervin 1984), but this scheme has been simplified for analysis in some studies. Respondents are most often asked to choose the Situation Movement State that best describes their situation, but in some studies researchers have coded respondents' situation descriptions into the categories. A number of other situational variables have been used when appropriate to a particular study (Dervin 1983b).

A second set of categories schemes focuses on gaps. These describe the different types of questions people have in their situations. Various category schemes have been used to describe gaps, but the core set of gap categories used in Sense-Making research describes the focus of the user's question. The categories are:

- 5W question (who, what, when, where, why)
- Question regarding time (past, present, or future)
- Question about valence (goodness, badness, neutrality)
- Question involving an entity (self, other, processes, objects, etc).

Finally, Sense-Making proposes a taxonomy of outcomes, defined as including both helps and hurts. (Dervin and Fraser 1985) present a list of 16 outcomes. These include "kept going when it seemed hard," "got ideas and understandings," and "got out of or avoided a bad situation." This list includes no hurts; at the time outcomes were conceptualized as uses, which had a narrower scope.

One weakness of all of these category schemes is that they have primarily been developed through information seeking studies. Savolainen (1993) expresses concern that the category schemes of gap types and outcomes may not in fact be as global as Sense-Making claims. Different activities may have different types of situations, gaps, and outcomes.

Sense-Making does not mandate the use these specific categories, but requires analytic attention at the levels of situations, gaps, and outcomes. When specialized category schemes are developed, more detailed description of a specific topic or population is gained, but the ability to compare these findings with other Sense-Making studies is lost. A number of studies have developed different typologies of situations, gaps, and outcomes more appropriate to each study. Some of these are presented in the tables below.

Table 7: Category schemes of domain-specific situations

Citation	Domain	Situation Categories
Jacobson, 1991	Using multi-file database system	Decipher; used help; made progress; read screen; tried; tried again; emotion
Hert et al., 1995	Internet training	Working toward goal; getting frustrated; lack of personal understanding; making mistakes; evaluating results of search; getting confused; attempting something on system; message interpretation; computer malfunction; lack of information on screen; system inconsistency; having instructions/lecture; lack of instructions/lecture
Cheuk, 1998	Job tasks of engineers	Task initiating; focus formulating; ideas assuming; ideas confirming; idea rejecting; ideas finishing; and passing on finished ideas; moving between other situations

Table 8: Category schemes of domain-specific gaps or needs

Citation	Domain	Gap/Need Categories
Bergeron & Nilan, 1991	Learning word processing	Access to equipment; file management; format; initial concerns; hardware concerns; instructional learning issues; navigation within documents; personal concerns; printing; other; and missing data
Jacobson, 1991	Using multi-file database system	Library or file choice; navigation; search string; display; system behavior
Hert et al., 1995	Internet training	Problem, questions, or uncertainties with: locating information; understanding applications; application malfunction; not able to use resource; not understanding where things go wrong; determining if application or information is useful; utility of class/internet/exercises; system responses; other
Baker, 1998	Multiple sclerosis	Physical symptoms precipitating an attack; emotional reactions to the disease; lack of information about drugs and treatment
Savolainen & Kari, 2006	Web searching	No relevant material; confusion; inaccessible content; overload; no access; crossroads; no links; wrong way; badly organized material; no search terms; technical problems

Table 9: Category schemes of domain-specific outcomes

Citation	Domain	Use Categories
Hert et al., 1995	Internet training	Had insights about: effective use of resource; utility of resource; relationships among resources; the application; a way to improve resource; using the internet; other
Cheuk, 1998	Engineers	use or choice of information source; judgment of information relevance; choice of information organization strategy; choice of information presentation strategy; changing feelings; changing perceptions

CONCLUSION

Sense-Making can be used wholesale as a set of methods and analysis methods. I have endeavored to demonstrate the ways a Sense-making approach could contribute to the study of PIM. Successful use of the Methodology in PIM would also be a great contribution to the development of the Methodology, demonstrating its usefulness in a new area of inquiry. If a Sense-Making approach were fruitful for PIM, it could be extended into other questions in the organization of information that could benefit from a more user-centered perspective. Because of the way my plans for the proposed study have developed since I began this literature review, I do not believe a full Sense-Making approach is a good match for my questions. However, my questions and thoughts on method have been heavily influenced by my exploration of Sense-Making.

My goal in this review[42] was to express my view of how the questions I am asking in the proposed study fit into the current LIS landscape and may bridge (or at least drive some piles into or do some surveying of) existing gaps in knowledge in that landscape. I hoped to describe many of the ways in which I see these topics connecting to each other and my questions, while avoiding the creation a confusing mess. I hope I have succeeded.

[42] Aside from just getting done with comps, already. ☺

I committed to the topics covered in this review fairly early in my conceptualization of what I wanted to do in my dissertation work. Were I to design the review from scratch again now, I would of course change my approach in some ways. I would look less at issues of cognitive conceptual structure and category representation, spending more time on human memory and embodied cognition. I would cover in more depth the topic of digital preservation for personal collections and the role of such collections in institutions. I might take a broader look at methods that could be appropriate for my questions. Perhaps these realizations are part of the point of this exercise--it was invaluable in helping me define, shape, and situate my questions, and some change in focus is to be expected. I take heart in a lesson learned in this process that I expect to hold true for the work done here: no work is ever wasted, and knowledge gained will almost always be useful later--if you can find where you saved your notes on it.[43]

[43] Everything comes back to PIM in the end!

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