

**The Expanding Circles of
Information Behavior and Human–Computer Interaction**

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Abstract

This paper examines the historical expansion and convergence of the fields of information behavior (IB) and human-computer interaction (HCI), primarily in terms of the philosophy underlying each field. IB grew out of research in library service provision in the early 1900s, and HCI grew out of computer science and human factors engineering in the 1960s. While these two fields have had different origins, purposes and discourses, in recent decades they have begun to converge. In this paper, we map this convergence and consider implications for the future of the information field. We conceptualize their scholarly paradigms as expanding circles, and we show that the circles of IB and HCI are expanding in terms of ontology, epistemology and axiology—and moreover, they are beginning to overlap substantially. While the two fields continue to be largely separate in terms of scholarly discourses, we suggest that much could be gained by explicitly acknowledging their shared components. Some suggestions for this are discussed, and these are connected to the ongoing iSchool Movement.

Keywords: information behavior, human computer interaction, expanding circle, paradigm, iSchools

The Expanding Circles of Information Behavior and Human–Computer Interaction

I live my life in widening circles
that reach out across the world.
I may not complete this last one
but I give myself to it.

—Rainer Maria Rilke (1905/2005, p. 45)

Introduction

Information behavior and human–computer interaction are two well-known scholarly fields in the information and computer sciences. What are the differences and similarities between these two fields? How have they changed over time, and how do they continue to change? In this paper, we explore these questions. We describe the paradigms that have characterized these fields, and we propose that these fields, and perhaps other scholarly paradigms, can be regarded as expanding circles. To begin, we present a historical episode, a long-ago missed opportunity that in some ways foretells the trend we are witnessing today.

During World War II, Vannevar Bush (1945) articulated a vision for scientific research in the service of understanding rather than destruction. His now-famous essay “As We May Think” imagined new ways for humans to interact with information, most centrally by way of the Memex, a hypothetical machine that would help scientists and others access, share and create more knowledge. This essay has been influential throughout the field of information science and technology. It has been cited as a foundational work in information science writ large (Herner, 1984; Saracevic, 1999); an *Annual Review of Information Science & Technology* article demonstrates that Bush’s work has been taken up in any number of information disciplines, from archival science and knowledge management to psychometrics and information behavior (Houston and Harmon, 2007).

A naval technician by the name of Douglas Engelbart discovered “As We May Think” while stationed in the Philippines, and he was captivated by Bush’s vision for how machines might help researchers manage information and discover new connections (Madrigan, 2013). After the war, Engelbart went on to earn a Ph.D. in electrical engineering and later work at the Stanford Research Institute, where he was concerned with augmenting human intellect (Engelbart, 1962). His work contributed to the invention of the computer mouse, the development of hypertext and the introduction of the graphical user interface, among other innovations, which famously premiered in the “Mother of All Demos” in 1968 (Moggridge, 2007; Myers, 1998). Today, Engelbart is known as a, or perhaps *the*, founder of the field of human–computer interaction (HCI), which is concerned with the design and use of technology and the interfaces that mediate these interactions.

Engelbart’s name appears a few times in Houston and Harmon’s (2007) review article in the context of the history of hypertext and the World Wide Web, but the authors do not trace the influence of Bush’s ideas in the field of HCI. In fact, there is no mention of HCI anywhere in their review, though they do acknowledge that Bush’s article has “had a broad,

enduring impact throughout information science and technology” (Houston and Harmon, 2007: 55).

As we will discuss in this article, information science—we will focus on information behavior (IB) in particular—and HCI have been estranged, virtually never uttered in the same breath. (Granted, a few exceptions do prove the rule.) Though they came into the world together, the two seem to have been separated at birth. In the *Encyclopedia of Library and Information Sciences* entry on “Information Behavior,” Bates (2017b: 2079) mentions:

With the development of frequent interaction with microcomputers in the early 1980s, the already-thriving field of human–computer interaction research (HCI) exploded and became a still larger field. HCI paid little attention to LIS research, however, and LIS paid little attention to HCI research, probably to the detriment of both fields.

But history could have been different, and perhaps it almost was. At the 1960 meeting of the American Documentation Institute (now ASIS&T), Engelbart presented a paper that sought to “bring out a basic sort of relatedness” between work in information retrieval systems and “a separate discipline which is needed relative to the individual’s information-handling problems” (Engelbart, 1961: 121). This olive branch, evidently, was not accepted. Taking its description at face value, Engelbart’s “separate discipline” may seem to describe IB. And yet we know that Engelbart went on to develop not IB, but HCI, and he never again presented at or published with ASIS&T.

In this paper, we problematize this history. Given their shared heritage, why should IB and HCI be so separate? Bates (2017b: 2079), in trying to understand the “reasons for this mutual indifference,” implicitly refers to differences of scholarly paradigm: IB and HCI researchers asked questions in different ways, sometimes even different sorts of questions about different sorts of things, even though they were playing in the same ballpark. Such may have been the case in the past, but today change is in the air. We identify sites of convergence between IB and HCI, and we suggest that these two fields are beginning to overlap considerably; we suggest that more can be gained by explicitly acknowledging this and encouraging its continuance. To be sure, we are not the first to point this out (cf. Goggins and Erdelez, 2008); our contribution is in updating these discussions in light of their continued relevance.

First, we will define both fields and give an overview of their histories. Next, we will conceptualize the notion of scientific paradigm in terms of circles of concern, and then we will discuss how the circles of concern of IB and HCI are expanding and, indeed, converging.

Background: Defining the Fields

Some definitions are in order. We begin by defining information behavior (IB) and then human–computer interaction (HCI), giving attention to each field’s historical and paradigmatic development, as well as the relationship between research and practice in each field.

Defining Information Behavior

Information behavior (IB), also called human information behavior, is the study of how people need, seek, use and share information in various contexts. The term “information behavior” is sometimes interpreted narrowly to refer only to work done within

the behaviorist paradigm, i.e. researching human action in terms of observable and measurable stimuli and responses (see Savolainen, 2007; Wilson, 2009). Others, however, take “information behavior” to be a capacious umbrella term that includes all aspects of needing, seeking, searching for, encountering and using information, embracing all the paradigms within this research field (Bates, 2017b). Here we use the term in this latter, more expansive sense, which is necessary to give a historical account.

According to the book-length review by Case and Given (2016), IB began in the early 1900s with the study of information artifacts, most notably printed materials in libraries, but also with interests in the unfolding possibilities of mass media. As research progressed, IB increasingly emphasized the seeking of information as facilitated by information systems. In Case and Given’s view, this research did not conceptualize the human side of information, resulting in strong assumptions about people’s motivations, needs, habits and behaviors. But by the 1960s and 70s, improved methods for the study of human behavior from other fields trickled into IB, resulting in an emerging user-centered paradigm which was focused on the individual rather than the system (Dervin and Nilan, 1986). Within this paradigm, large-scale studies were conducted on the social aspects of scientific communication and information use, as well as on information seeking and library use by specific social identity groups (Bates, 2017b).

On Case and Given’s (2016) account, this paradigm shift also entailed a shift from a focus on information “needs” to information “behavior,” signaling an interest in broader questions at the intersection of people and information beyond merely “seeking” (to include, for instance, avoiding and using). In this regard, Ford (2015) notes that, historically, IB research has moved from considering only specific groups of people to investigating quite complex and diverse populations—and also new forms of information (Bates, 2017a). In this climate, IB has been studied in any number of human roles and contexts, including diverse professionals, citizens, hobbyists, patients, students, immigrants and more (Case and Given, 2016). We have also seen a move from investigating only library-based, scholarly and work-related information to “everyday life” information in IB (Savolainen, 1995, 2008), and the recognition that IB is not just involved in life’s problems but also in its “higher things,” such as pleasurable and profound life experiences and projects (Kari and Hartel, 2007). Recent work in this trajectory has explored the emotional and affective aspects of IB (Nahl and Bilal, 2007), the role of the human body in IB (Cox et al., 2017; Keilty and Leazer, 2018), and the first-person experience of becoming informed (Bruce et al., 2014; Gorichanaz, 2020).

Since its origin, IB has become a sizable research field. In terms of research impact, a citation analysis by Lund (2019) finds that, though particular theories of IB are not as highly cited as theories in other fields, theorists’ h-indexes are indeed on par with those in other fields. Beyond academe, IB research has had practical implications for library reference service, information architecture, and the design of information retrieval systems (Bates, 2017b; Morville, 2014; Smith and Wong, 2018). In a small study meant to ascertain the impact of IB research, Koh, Rubenstein and White (2015: 3) find that “IB research plays a significant role in designing and developing user-centered information systems and services.”

However, the practical impact of IB studies may be declining. In his review of the state of IB research, Wilson (2010) observed that the shift from large-scale, quantitative research to primarily small-scale qualitative research in IB resulted in “little evidence of the

impact of research on either policy or practice” (p. 31). An ongoing challenge for IB will be for its research to continue to have both scholarly and practical impacts (Given, 2018).

Defining Human–Computer Interaction (HCI)

Human–computer interaction (HCI) is the study of how people use technology, how technology affects people, and the interfaces that mediate these interactions. Beyond these characteristics, HCI is somewhat amorphous and difficult to define. It is worth noting that some have distinguished “human–computer interaction” (HCI) from “computer–human interaction” (CHI). Grudin (2011), for example, wrote of HCI as an umbrella field that encompasses human factors, information systems, computer science, and library and information science, and of CHI as “a narrower focus” within HCI, one associated primarily with the ACM Special Interest Group on Computer–Human Interaction (SIGCHI) and the topics under discussion in their annual conference, *Human Factors in Computing Systems*, often simply referred to as *CHI*. However, even within SIGCHI discourse, the term “HCI” is used virtually universally.¹ In this paper we will use the term “HCI” to refer to what Grudin (2011) called “CHI,” as today “HCI” is far more common. We reserve the term “*CHI*” to refer to the annual conference by that name (with italics).

According to Grudin (2017) and Wania et al. (2006), HCI represents the convergence of several distinct yet related fields: human factors, management information systems, computer engineering, cognitive psychology, computer science, design, and social science, among others. Shneiderman (2017) describes the emergence of HCI as a “paradigm birth” rather than a “paradigm shift,” which came about amidst the rapid technological innovation beginning in the 1960’s. Research labs such as Xerox PARC and institutions like the Stanford Research Institute formed new communities of scholars dedicated to understanding how computers could be designed to make air traffic control, military, and medical systems more effective. Soon thereafter, workshops and conferences sprung up. Principles, theories, and guidelines; articles, books, and journals; and degrees, departments, and colleges formed rapidly.

Characterizing HCI in terms of its historical development, Harrison, Sengers and Tatar (2007) identified three distinct conceptualizations of the term “interaction” that bespeak different eras of HCI’s development and imply different types of research questions and methods, i.e., paradigms: 1) “interaction” as human–machine coupling, 2) “interaction” as information processing and communication, and 3) “interaction” as phenomenologically situated.

The first paradigm of HCI, which understood “interaction” as human–machine coupling, was a fusion of engineering and human factors and unfolded from 1965 to 1980 primarily in big business and government (Harrison et al., 2007). The primary goal of HCI in this era was Tayloristic: making efficient use of expensive machines. Such optimization involved identifying problems and finding pragmatic and objective solutions. As Rogers

¹ An alternative explanation of the difference between these terms appears in a 2011 *Quora* post in which it was asked, “CHI or HCI: Which acronym is preferred?” (<https://www.quora.com/CHI-or-HCI-Which-acronym-is-preferred>). A respondent suggested that both were in use at the field’s genesis, with “HCI” more common in Britain and “CHI” more common in America, but gradually “HCI” won out, perhaps because it puts “human” first, which is a conceptually distinguishing feature of the field, by whatever name.

(2004) writes, theories during this era were used informationally, predictively and descriptively.

The second paradigm, which saw “interaction” as information communication, emerged in the 1980s with the rise of personal computers. Powerful, low-cost microcomputers such as Apple Lisa and IBM PC that supported interactive and discretionary use by non-programmers. Cognitive psychologists were fascinated by this phenomenon, and their interests underlay the second paradigm of HCI: “how does information get in’, ‘what transformations does it undergo’, ‘how does it go out again,’ ‘how can it be communicated efficiently” (Harrison et al., 2007: 4). They employed laboratory-based methods and relied on a positivist epistemology. In 1982 the first *CHI* was attended by over 1,000 people; both cognitive psychologists and human-factors researchers were well represented, yet Vannevar Bush was not cited in any of the 633 references of the 58 papers.

As Harrison et al. (2007) write, the third paradigm of HCI grew out of the commercial success of the graphical user interface, which led to a disruption within HCI. Computer scientists with expertise in computer graphics system design began to dominate HCI as the driving force in interaction design. The cognitive psychologists’ rigorous experiments gave way to less precise heuristic assessments (Nielsen, 1989). Computer use became increasingly common in organizational settings, leading to the birth of computer-supported cooperative work (CSCW), which is now considered a subfield of HCI. The first public CSCW conference was held in 1986, hosted by SIGCHI. HCI and CSCW began to emerge as fields distinct from their origins as human factors researchers left HCI and information systems researchers left CSCW: “Most IS researchers left CSCW in the early 1990s. IS submissions to CSCW that bristled with acronyms and terminology unfamiliar to SIGCHI reviewers were rejected” (Grudin, 2017: p. 63). Simultaneously, ethnographers studying organizational technology use in developed countries had become marginalized in traditionalist anthropology departments, and they found a home within CSCW and HCI. By the mid-2000’s, a suite of additional perspectives had entered HCI, including feminist theory, gender studies and critical theory; thus HCI became increasingly involved in the social realm. This marked the start of the third paradigm of HCI, in which “interaction” is seen as phenomenologically situated. This paradigm focuses on conceptual, qualitative, and participatory design methods. Eschewing notions of scientific objectivity, such methods focus on critical, contextual perspectives and the imagining of new futures. According to Rogers (2004), these imported theories were not used to inform, predict and prescribe (as during the first paradigm), but to describe, account, analyze, form and generate (pp. 126ff).

Since its inception, HCI has become a large research field with significant real-world impact. Publications within HCI increased 150-fold from 74 in 1980 to 11,165 in 2014 (HCI Bibliography, 2018), across 25 journals and 100 conferences (Shneiderman, 2017). Throughout its history, HCI research has informed the design of hyperlinking, graphical user interfaces, embedded menus, touchscreens, social media websites, virtual/augmented reality, and voice user interfaces, among myriad other applications (Myers, 1998). It has also given rise to the User Experience (UX) profession now prevalent in nearly every large technology-oriented company, employing thousands of individuals across over one hundred different roles (Rosala and Krause, 2020). The UX profession not only funded HCI research within academia but also created demand for new HCI researchers (Shneiderman, 2017).

Research Questions and Approach

The first author is a scholar of information behavior working in an iSchool, and the second author is a scholar of human-computer interaction working in a computer science department. Having observed certain similarities between our respective research areas, we sought to better understand the points of connection between IB and HCI.

Our purpose in this research was to offer a way of regarding the fields of IB and HCI that would be *illuminating*, first in the sense of showing the existing space, and second in the sense of guiding future progress. Thus we did not seek to be exhaustive, only illustrative. What's more, answering our second research question was a matter of design as much as discovery; in this sense, we engaged in conceptual design, a method in philosophy of information (Floridi, 2019).

The research presented in this paper responds to two linked questions:

- What is the nature of the relationship between information behavior and human-computer interaction?
- How might we describe the ongoing changes within these fields?

Our inquiry proceeded from our initial observations and conversations as a hermeneutic literature review (Boell and Cecez-Kecmanovic, 2010). In this method, researchers begin with one or more open questions that are continually reformulated as literature is retrieved and read. Each new formulation of the research question(s) leads to further literature searching and retrieval as the nature of the research is better understood. Addressing our research questions involved surveying the literature in IB, HCI and allied fields, such as information retrieval and design. However, the shifting names and fuzzy boundaries of these fields made a traditional systematic literature review less likely to be effective. Thus, pursuant to the hermeneutic literature review method, our research process proceeded organically over a period of several months during which we met regularly to discuss and make sense of our findings.

Along the way, we developed a framework for describing scholarly paradigms (described below), and we adapted a metaphor (expanding circles) to describe paradigmatic change. This provided a framework for our continued research and consequently the present paper, in which we show how the metaphor applies to each aspect of our framework. Regarding our use of metaphor, we drew inspiration from recent work in the information field on the analytical applications of metaphors (Hartel and Savolainen, 2016; Nord, 2019).

Paradigms as Circles of Concern

Guba and Lincoln (2005: 22) define a paradigm as “the net that contains the researcher’s epistemological, ontological, and methodological premises.” We agree with this definition, but we suggest that there is more to a paradigm than just these three elements. In his originary definition of the term, Kuhn (1962) defined a paradigm as “an entire constellation of beliefs, values, techniques and so on, shared by a given community” (p. 175). Organizing and building upon this definition, we describe an academic paradigm as manifest and evidenced on three levels:

1. **Philosophical** – including ontology (what exists and how categories are made), epistemology (what we know and can know, and what constitutes evidence), and axiology (our goals and values in research)
2. **Methodological** – including what research questions can be asked and what methods can be used to answer them
3. **Practical** – including professional associations, funding bodies, publication venues and so on

The philosophical level is the foundation that supports the methodological and then practical levels. However, these levels do not constitute one-way dependencies; changes at the practical level, for instance, could lead to philosophical shifts. These dimensions afford and constrain the activities of a scientific community. In a given paradigm, then, researchers can observe some objects and not others, and in particular ways; and researchers can build theories regarding those objects, perhaps make changes to them, etc. To identify a paradigm, one should look to the concerns of a community; and to identify a paradigm *shift*, one should look to the way those concerns are changing.

Shifting Paradigms

Tang et al. (2021), in an essay heralding a special issue of *The Journal of the Association for Information Science and Technology* (JASIST), discuss the meaning of shifting paradigms. They begin by arguing that the dynamism of our present historical moment demands a reassessment of paradigms and conceptual models across the information field. They frame their discussion in terms of four questions, offering preliminary answers to each. First, why shift paradigms? As they write, new technological developments and sociocultural exigencies demand that scholarly fields evolve and emerge to stay relevant and engaged with the world; as we will describe below, this eminently characterizes IB and HCI. Second, what new paradigms are available? They mention a suite of emerging paradigms suited to new social contexts and making a broader impact. Third, how do paradigms shift? As they write, paradigms shift as a field is opened up to new views, engaging with others across disciplines. And fourth, who shifts paradigms? Their answer is, in short, all of us. Though Tang et al. do not refer to any subfields in particular of information science, we contend that their framework describes well the ongoing dynamics of IB and HCI, as we discuss below. Moreover, in this paper, we build upon their discussion by adding an additional lens through which to consider shifting paradigms: the metaphor of expanding circles.

The Notion of Expanding Circles

The moral philosopher Peter Singer published *The Expanding Circle* in 1981. The central metaphor of the book is that humankind's moral concerns take the form of an expanding circle. That is, humanity's moral paradigm has grown more and more capacious over the centuries; we have grown more and more concerned with others who are more and more different from ourselves. Singer writes:

The circle of altruism has broadened from the family and tribe to the nation and race, and we are beginning to recognize that our obligations extend to all human beings. The process should not stop there. ... The only justifiable stopping place for the expansion of altruism is the point at which all whose welfare can be affected by our

actions are included within the circle of altruism. ... The expansion of the moral circle should therefore be pushed out until it includes most animals. (Singer, 1981: 120)

The expansion of the circle is tied, in Singer's argument, to the human capacity to reason. As we put forth and test new arguments over time, we realize that the circle of moral concern must be expanded, if only for logical consistency. Singer was concerned with expanding the circle to include ("most," as he says) animals; a recent argument for expanding the circle even further is Floridi's (2013) argument that all forms of information ought to be subjects of moral concern; for example, we should protect books and hard drives inasmuch as these can inform human beings (see also Van der Veer Martens, 2017).

Singer was not the first, of course, to use the circle metaphor to describe a space of concern. American civil rights activist Pauli Murray (1945: 24) famously wrote, for example: "When my brothers try to draw a circle to exclude me, I shall draw a larger circle to include them." And though today many usages of the "expanding circle" trace back to Singer, the notion also appeared, apparently independently, in sociolinguistics; Braj Kachru (1985) described the diffusion of the English language as an expanding circle, as English is now spoken in countries where it had no official historical role, such as Russia and Sweden.

In this paper, we adopt the metaphor of the expanding circle to describe the shifting paradigms in IB and HCI. As discussed above, IB has always been part of information science; today, both IB and HCI are considered, at least by some, to be co-participants in the information field. The boundaries between these fields, and the way they fit into their parent fields (if such fields indeed exist), are still being negotiated. What we argue, at least, is that both can be described as expanding circles; and in our estimation, these circles are beginning to overlap substantially.

Before moving on, we offer one point of clarification. Though we draw the metaphor from moral philosophy, we do not wish to imply any moral force in our use of the metaphor to describe scholarly paradigms. That is, we suggest these paradigms are circles of concern, but not necessarily circles of *moral* concern. Considering the extent to which they are moral circles would be an interesting topic for further research. The question would arise, for instance, whether researchers would have a moral obligation to examine new issues in order to aid their paradigmatic circle in expanding.

The Expanding Circles of IB and HCI

As discussed above, a scientific paradigm can be described on philosophical, methodological and practical levels. A paradigm shift constitutes a major change within a scientific community along these dimensions. Sometimes, elements of older paradigms are entirely left behind. Older theories are proven false, research centers close, and proponents of particular viewpoints pass away. Such was the case with the shift from the Ptolemaic to the Copernican cosmology. But in other cases, a paradigm shift signals an expansion rather than a replacement. Something like this happened in physics with the development of quantum mechanics; Newtonian or classical mechanics was not entirely discarded, but rather was recontextualized as an approximation of quantum mechanics, and it is still used in many contexts today. This form of paradigm shift also happened in the histories of IB and HCI; as new paradigmatic elements have been introduced, the fields have not so much "shifted" as grown more capacious and variegated.

To better understand this expansion, here we describe how IB and HCI have changed over the years in terms of their underlying philosophical positions. Given the space constraints of a single article, we examine in detail only the philosophical level of the paradigms, but we consider the other levels to some extent in our closing discussion. As mentioned above, the philosophical level contains ontology, epistemology, and axiology; and these topics structure the following subsections. Under each topic, we first discuss IB and then HCI.

Ontological Expansion

Ontology is the question of what exists. In science, it is the question of the objects of concern to a field. Both IB and HCI are centrally concerned with human beings, and so it is illuminating to consider how human beings have been conceptualized throughout the histories of these fields. We discern two ways to approach this question: first, human scale; and second, social worlds. By “human scale,” we mean how the human being is conceptualized and what aspects of human beings are of interest in the field. In terms of human scale, both IB and HCI began conceptualizing human beings as brains with eyes and fingers, but over time have come to engage with the whole body of an individual, and then dyads, groups, organizations and societies. By “social world,” we mean those spaces of human organization and interaction that are constituted by interpersonal communication (Unruh, 1980). In terms of social worlds, both IB and HCI began concerned narrowly with information technology in the workplace, but have since expanded their concerns to other settings in the human lifeworld. In this section we also consider the other major phenomena of interest to each field—respectively, information and interaction—finding that the conceptualizations of these phenomena, too, have been expanding.

Human Scale. In IB, humans have been conceptualized for the most part in terms of only their logico-mathematical mental activity (Case and Given, 2016); Hartel (2019) suggests that to this day, this “cognitive” orientation remains the field’s nexus. Over the past 30 years or so, some corners of IB have conducted research on the affective dimensions of information seeking (Kuhlthau, 1993/2004; Nahl and Bilal, 2007) and information literacy (Bruce, 1997). A growing minority of researchers have become interested in the role of the whole human body in IB since about 2009 (Keilty and Leazer, 2018; Lueg, 2015; Olsson and Lloyd, 2017). These developments notwithstanding, Cibangu (2015) has argued that information science theory has overlooked the bigger picture of what it means to be human and flourish, including elements such as justice, education, shelter and freedom; while there have been some isolated inquiries into these topics in IB, they remain even today to be linked to IB theories. However, their existence at all suggests a broadening scope of the IB field. As a final point, IB research has tended to consider individual human actors, but since the 1990s the sociocognitive approach has proliferated, considering IB at the level of discourse, institutional practice, etc. (Hjørland, 2002). An example of early work in this vein is that of Chatman (1996).

At the inception of HCI in the 1960s, the predominant human–computer relationship was many humans to one computer, and HCI design was tuned to that relationship. Multiple operators, managers and programmers were jointly responsible for the maintenance, programming, and operation of a single mainframe computer. As computing technology diversified and proliferated during the 1900s to the early 2000’s the dominant human–

computer relationship became one-to-one; and later many computers (of various types and sizes) to a single user. By the mid-2000s, it was many-to-many (Abowd, 2016). Consonantly, the HCI field saw the emergence of computer-supported cooperative work in the late-1980s (Ackerman, 2000; Grudin, 1994), which explored how humans interact with each other through computing systems. Over this timespan, HCI also saw changes in how the human person was conceptualized. Early in HCI's history, people were abstracted away; a caricature of the field's conceptualization of the human being at this time shows an eyeball with a finger (Igoe and O'Sullivan, 2004). That is, other aspects of the human body and the context were not important (Klemmer et al., 2006). However, a paradigm of embodied interaction gradually took root (Harrison et al., 2011), which emphasized the physical and processual nature of interactions, phenomenological philosophies and methods (Dourish, 2001), and a more holistic consideration of the human body (Klemmer et al., 2006).

Social Worlds. In the first half of the 20th century, IB research was largely focused on the social world of the library. After World War II, the field also came to focus on the work of scientists in dealing with the academic literature. Over the past 50 years or so, the field has progressively come to embrace more and more social worlds as being of interest, such as various professional occupations (from journalists to artists), students, citizens, consumers and so on (Case and Given, 2016). Chatman (1996), for instance, turned her attention to the information worlds of prisoners and other societal outsiders. Most recently, IB has embraced everyday life, a catch-all term for social worlds that are of theoretical or practical interest but which do not have a clear label as yet (Savolainen, 2008); however, the literature in this area has been critiqued for not being expansive enough (Ocepek, 2018a).

In the 1960's and 70's, the high cost of computing hardware for businesses led to greater interest in efficiency and safety. In 1973, James Martin published *Design of Man-Computer Dialogues*, one of the first widely-read surveys on interfaces for computer operators. In it, Martin noted the increasingly important role that humans would come to play within computing systems: "The terminal or console operator, instead of being a peripheral consideration, will become the tail that wags the whole dog" (Martin, 1973: 3). Since then, HCI has gradually expanded its scope, including but not being limited to, the following (see also Zhang et al., 2009):

- Professions outside of computing, such as teaching (Gautam et al., 2017), journalism (Venkatagiri et al., 2019) and medicine (Mentis et al., 2012)
- Interpersonal issues, including the home (Wolf et al., 2019), relationships (Brereton et al., 2015; Moser et al., 2017), privacy (Ackerman and Mainwaring, 2005), ludic engagement (Gaver et al., 2004).
- Community issues, such as community art (Jacobs et al., 2016), community policing (Israni et al., 2017) and urban design (Mahyar et al., 2016)
- Societal issues, such as development (Dell and Kumar, 2016), politics (Kuznetsov et al., 2011) and sustainability (DiSalvo et al., 2010)

Phenomena. A key phenomenon of interest in IB is information (Bates, 2017a; Case and Given, 2016). This term, of course, has been in use since long before the birth of IB, with roots in pre-Christian Latin and Greek (Capurro and Hjørland, 2003). In terms of its use with relevance to IB, the concept of information was employed in the library context since at least 1891, and discussions about information arose in work on digital computing and signal transmission early in the 20th century, which gave rise to information science; information

science and librarianship joined by the 1970s (Shapiro, 1995). Throughout the last century, controversy on the concept of information burgeoned, and it remains to this day. To speak of what is considered as information in IB research, though, we can see an expansion. Originally, “information” in this context referred to the epistemic content stored predominantly as text in books, articles and so on, as well as those items themselves (Buckland, 1991). As new forms of information technology have emerged and discussions in the philosophy of information have progressed, however, a wider range of phenomena have been considered as information in IB, including those in everyday life settings, such as hobbies (Hartel, 2005) and shopping (Ocepek, 2018b). On Buckland’s (1991) framework of the three types of information, the field has gone from considering information-as-thing to also considering information-as-knowledge and information-as-process. For example, “human information interaction” (HII) has been proposed as something of a successor field to IB, having a more ecological embrace and focusing on interaction rather than information (Fidel, 2012; Marchionini, 2008; Toms, 2002). The subject of HII appears again in our discussion section below, as it illustrates well the overlap in the expanding circles of IB and HCI.

In HCI, a key phenomenon of interest is interaction (Harrison et al., 2011; Hornbæk et al., 2019). As discussed above, this term has been conceptualized in three distinct paradigmatic ways throughout the history of HCI: first in terms of human–machine coupling and information processing, and later in terms of embodied interaction, or “the creation, manipulation, and sharing of meaning through engaged interaction with artifact” (Dourish, 2001: 126), in which use context and experiential factors become essential to consider (Harrison et al., 2007, 2011). In our view, this progression from the first to the third paradigm constitutes an expansion in the notion of interaction. This assertion is further supported by the work of Hornbæk et al. (2019) who, in a review of over 4,000 papers in HCI, find that the usage of the term “interaction” is increasing and diversifying.

Epistemological Expansion

Epistemology is the question of knowledge or understanding. In science, it includes questions of what sort of evidence is admissible, how contributions are judged, and so on. In science, epistemology may be seen as the crux of a paradigm. It is also perhaps the most clearly connected to methodology. The epistemology of a paradigm entails what is considered as knowledge, what it means to be true, and the role of the researcher in knowledge-generation. On one hand, positivist and post-positivist paradigms may consider knowledge to be a representation of reality wherein truth depends on an absence of falsification and the researcher is considered a separate observer of knowledge in the world; on the other hand, interpretivist and critical paradigms may consider knowledge as a construction to aid practical action in the world, wherein truth depends on contextualization and the researcher is considered a constitutive part of the knowledge-generation process (Williamson, 2018).

As a sociotechnical meta-discipline, information science is necessarily multidimensional in terms of epistemology. As Bates (1999) writes, it draws both from the social sciences and engineering sciences. “This is one of the reasons we have failed to coalesce as a field around one standard methodological paradigm” (Bates, 1999: 1049). To speak of IB specifically, early work was large-scale and positivist, but over time IB began to

accommodate more interpretivist and critical epistemologies (Case and Given, 2016). Most recently, Clarke (2018) argues for the adoption of a design epistemology in the field. This prescription also seems to be borne out in the literature; based on a Web of Science search² for the proportion of IB research that engages with design, we found that before 1999, only 3% of the IB literature engaged with design, while in the period of 2010–2019, 21% of the literature did. A notable recent contribution in this vein is the inaugural virtual special issue of *JASIST*, which appeared in November 2020, on the topic of “information informing design” (Makri, 2020). This special issue collected articles at the intersection of information science and the design of information systems with the aim of “build[ing] bridges between Information Science and computing disciplines and mak[ing] contributions that transcend its discipline boundaries” (p. 1402). We hasten to note that the epistemological evolution of IB has been a process of *expansion*, not replacement. As Bates writes:

These new techniques simply add to and enrich the armamentarium of techniques available to the information scientist for studying the subject matter of our field. ... In mid-20th century social science we have had a series of waves of methodological fashion—each wave declaring the prior approach to be hopelessly bankrupt and inadequate. It is to be hoped that it is finally recognized that all of these methodological approaches can be powerful and useful—especially in information science. (Bates, 1999: 1049)

Relatedly, Polkinghorne and Given (2021) reflect on IB’s move toward “holism” in recent decades. In the context of this article, we can understand attention to holism as evidence of an expanding circle. Though Polkinghorne and Given argue that most mentions of holism are more rhetoric than substance, they call for a genuine embrace of holism across IB, including being more inclusive and expansive epistemologically.

HCI, too, is a sociotechnical meta-discipline that is an agglomeration of several different fields, and thus multiple and overlapping epistemologies (Blackwell, 2015; Olson and Kellogg, 2014). Early on, human factors and cognitive science played a large role in HCI, and with it, their empiricist and positivist underpinnings. Computer science research in HCI largely belonged to the same paradigm, but introduced the artifact or system as a research contribution (Wobbrock and Kientz, 2016). According to Harrison et al. (2007), this epistemic focus on objectivity represented the first two paradigms within HCI, each with distinct axiologies and methodologies. The first paradigm was practically-oriented and lacked a theoretical foundation, while the second paradigm involved experimental, lab-based studies and the use of theory. The third paradigm began with the introduction of sociology, design and critical theory into HCI, and focused on situated knowledge and subjective experience. Like IB, the third paradigm did not replace the first two, but instead expanded HCI’s epistemology:

And when paradigms clash, the overlap of ways of seeing taken with conflicting epistemologies results in a miasma of legitimacies. HCI has always been a hybrid discipline and therefore has used either the intersection or union of legitimate practices from its constituents. (Harrison et al., 2007: 16)

² To retrieve IB literature, we used the query TOPIC: ("information behavior*" OR "information seeking" OR "information practice"); to retrieve that engaging design, we appended AND TOPIC: ("design").

Axiological Expansion

Axiology is the study of value and value judgments (Schroeder, 2016). While the boundaries of axiology as a philosophical field are debated, here we use the term to refer to the value of academic research, which is related to its purpose. What is our research good for? Why do we do it? Does it achieve these aims? Karamuftuoglu (2006) writes of axiology in terms of the questions that a piece of work sparks for further research; these questions may range from the superficial to the metatheoretical. We conceptualize axiology to include this as well as the real-world intentions and effects of the research, which might be called its moral or ethical values.

As discussed above, IB has a twin history of emerging from post-World War II information science on one hand and the older tradition of librarianship/bibliography on the other. The postwar work in information science proceeded in practical terms without any explicit moral objectives, while librarianship had from the beginning a service orientation and an interest in empowering the underprivileged (Bates, 1999). It is worth noting, though, that Paul Otlet (1868–1944), one of the forefathers of information science, worked explicitly to aid information sharing and access because he thought that would contribute to human flourishing and even world peace (Otlet and Rayward, 1990). In any case, when information science and library science merged into “LIS,” beginning around 1970, IB research found itself with both axiological orientations. Expressions of social betterment in IB continue to diversify; recent work has focused, for instance, on improving service for minorities (racial, sexual, linguistic, etc.) as well as community-led research. This is evident from scanning any recent table of contents of *The Library Quarterly*, for instance, as well as in the discussions at the 2019 ASIS&T SIG-USE Symposium on the theme of impact and engagement (Gorichanaz, Afzal and Mabi, 2019).

Similar to postwar information science, HCI developed at first without respect to moral considerations; its chief concern was for usability engineering (Gould and Lewis, 1985). It bears noting, however, that there was always a moral component in the background, namely Norbert Wiener’s foundational work on cybernetics (Wiener, 1948, 1950), which proposed that sociotechnical systems ought to embody and express justice. Still, it wasn’t until the turn of the 21st century that moral concerns began to constitute a major focus of HCI in the so-called “third wave” of HCI research (Bødker, 2006). This wave has included the proliferation of participatory design, value sensitive design, user experience design and other frameworks that are concerned with the in-context lives of users (Bødker, 2006; Harrison et al., 2011). In the past few years, design ethics and morality have become major issues within HCI research, particularly in the context of algorithmic systems. Scholars have also called for more consideration within the HCI field to questions of worth (Cockton, 2006) and ludic engagement (Gaver et al., 2004), and the existentialist themes of death, identity, isolation, freedom and meaning (Kaptelinin, 2018; Mekler and Hornbæk, 2019).

Discussion: Time to Unite?

The technology of information management has become significant for practically all areas of life. The Internet is used at home to locate health information or compare prices on products; it is used in the workplace for the recovery of task-related information; it is used to support leisure activities; and it is used in educational institutions at all levels to provide information to support teachers in delivering class

materials and to support students in their study activities. In other words, the existence of the technology itself has been a driver for change in the way people think about how to look for information. (Wilson, 2010: 31)

In this paper, we have articulated the circles of concern of information behavior (IB) and human-computer interaction (HCI) at the philosophical level, in terms of ontology, epistemology and axiology. We have found that, within each of these dimensions, the circles of concern of both fields are expanding. Based on the discussion above, it is evident that not only are these circles expanding, but that they are beginning to overlap significantly. Perhaps this is a signal that it is time for IB and HCI to unite. In a 2006 *JASIST* article, Karamuftuoglu traced the histories and foundations of the fields of information science and information arts and asked, in the title of his article, “Time to unite?” In like spirit, we have considered the similarities and points of connection between IB and HCI, and we pose a similar question here. Though Karamuftuoglu does not explicitly define what he means by “unite,” we take it to be a matter of joining forces in pursuit of a shared mission, rather than having one field subsume the other.

It seems clear that IB and HCI have such a shared mission. IB is concerned with humans and information, and most of the information the field is concerned about is mediated by technology—increasingly so, as Wilson (2010), quoted above, has observed. HCI is concerned with humans and their interactions with and through technological systems. These statements suggest that IB and HCI have mutual interests in humans and technology, and these mutual interests are likely to converge even further in the era of artificial intelligence and big data, the emerging technologies of which present challenges and opportunities that neither IB nor HCI can avoid.

Considering Human Information Interaction

Indeed, we can consider the research area of human information interaction (HII) as further evidence of this potential. The term was coined as far back as 1995 and adopted by the information retrieval (IR) research community as a way to attend to the human element in IR and connect IR efforts to the emerging possibilities of the web (Morville, 2005: 58). For example, the HII perspective shifted IR from a model of simple retrieval of documents to one considering “how people interact with information throughout search sessions, in collaboration, and across sessions” (Marchionini, 2008: 173). HII emphasizes an ecological perspective; rather than looking at individual people and information, HII strives to consider people’s interactions with diverse forms of information and technologies, and it has a continual eye on implications of its research for system design (Fidel, 2012).

How does HII connect with IB and HCI? Fidel (2012) considers HII an umbrella term encompassing IB as well as a number of other fields, though she suggests that HII is distinct from HCI in this way:

Researchers in human information interaction ... focus on the relationships between people and *information*, rather than on those between people and *technology* (as in human-computer interaction) or between people and the information *agency* (as in librarianship). (Fidel, 2012: 17)

However, Marchionini (2008), another major proponent of HII, observed “a strong shift in the HCI community toward focusing on interaction with information rather than computers” (p. 173). We assert that this shift has only continued: as part of its expansion, HCI

is more and more concerned with how people interact with information, just as HII and IB are.

As a case in point, we can consider the *CHIIR* conference, sponsored by the ACM Special Interest Group for Information Retrieval (SIGIR) in collaboration with SIGCHI. The annual conference has been running since 2016, when it resulted from the merger of two prior successful events: the *Information Interaction in Context* conference (*IliX*) and the *Human Computer Information Retrieval* symposium (*HCIR*). According to CHIIR's homepage: *IliX* has traditionally attracted more attendees interested in information searching behavior and interactive IR, and *HCIR* has traditionally been more focused on search user interfaces. CHIIR builds upon the combined strengths of these events, placing an emphasis on human interaction with information, information seeking contexts, and user-centered approaches to information retrieval, access, and use.³

Going even further, we suggest that the concepts of “information” and “interaction” overlap in deep ways that have not yet been fully appreciated. Interaction has been defined in terms of meaning (Dourish, 2001), and meaning is also central to definitions of information in IB (Budd, 2011). Lately, a turn to meaning was articulated in the field of HII as well (Ruthven, 2019). As well, the notion of interaction implies a process, evoking the definition of information in the sense of information-as-process (Buckland, 1991). As such, it may be said that IB and HCI overlap in their shared interest in information-as-process, which is expressed in terms of sense-making, meaning-making, information creation, becoming informed, and so on (see also Gorichanaz, 2020).

Why Unite?

What might be gained by joining forces? That is, what challenges could be solved by unifying the two fields? First, it would result in closer connections between theory and practice. For example, HCI can provide a site for testing and extending theories of IB, and IB can provide HCI with a deep well of theory on how people engage with information systems and sources. Unification may also draw clearer connections between work on digital and analogue forms of information; while HCI predominantly studies the digital (but see Rosner, 2018), IB has from its inception included non-digital forms of information. Also, researchers in both fields would more thoroughly build upon existing knowledge by drawing upon findings from both fields (that is, research published in venues traditionally associated with both fields) rather than just one or the other. All this leads to more coherent and ecologically valid theorizing, and not to mention a clearer view of each field. Some examples of this already happening can be found; for instance, Zhao et al. (2021) adapt the concept of affordance, well developed within HCI, to the study of people's information practices, part of IB as we define it in this paper.

Though we can point to examples of a nascent unification, it can be asked why a more wholesale convergence of IB and HCI has not happened already. This may have more to do with the methodological and practical layers of these fields' respective paradigms than with the philosophical layer. For instance, the lack of scholarly venues that are “a good fit” for publications in both fields (there is no overlap between the two lists on Google Scholar of “top publications” in Library & Information Science and Human Computer Interaction).

³ <https://chiir.org>, retrieved February 23, 2021

Additional barriers may include historical departmental siloing and the use of different terms for similar concepts (e.g., “information” vs. “interaction” and “sense-making” vs. “meaning-making,” as discussed above). There is also the question of size: simply, HCI is a much bigger field than IB, and it is growing faster.

But beyond these issues, we should remember that while the circles of IB and HCI have been expanding, they did not always overlap. Considering the merger of library science and information science circa 1970, Bates (1999) writes that this could happen because both fields at heart shared a concern with information, i.e. form rather than content. “Other fields with which information science might have been thought originally to have much in common, such as computer science ... did not, in fact, prove to be good matches” (Bates, 1999: 1046). Bates goes on to define information broadly, citing other fields that she sees also having a shared interest in form rather than content: systems theory, game theory, and information theory—she cites Wiener (1950) as a luminary in these fields. Even if computer science *tout court* was not a “good match” for information science and consequently IB, it seems that HCI very well may be. In a paper introducing HII, Toms (2002: 857) remarked that the GOMS theory, once prevalent in HCI, was not appropriate for the unstructured and complex problem solving inherent to information interaction. But as we have shown, there is much, much more to HCI than GOMS. In our view, it is time to reconsider such claims.

Ongoing Unification and the iSchool Movement

As we have seen so far, there is evidence that significant unification between IB and HCI is already underway. We have seen how the philosophical layer of these fields’ paradigms are expanding and overlapping, and we have discussed the emergence of HII as a case in point. A few more observations here may suffice to further make the point. A search in the SIGCHI literature⁴ shows a growth in IB-related literature, on par with the growth of the total literature. Buckland (2009) writing in *Interactions*, a publication of SIGCHI, shows that the seeds of HCI were planted long before Bush’s (1945) article; Buckland has called figures such as Paul Otlet the forgotten pioneers of HCI. Next, “HCI” has been listed as a submission topic in the call for proposals for recent *ASIS&T Annual Meetings*, and the theme of the 2020 *ASIS&T Asia-Pacific Regional Conference* was “Human Information Behavior and Human–Computer Interaction.” Paul Dourish, a well-known HCI scholar, gave a keynote address at the 2018 installment of *Information Seeking in Context (ISIC)*, the premier IB conference. Finally, it is notable that more and more, both IB and HCI scholars are finding homes in iSchools.

The iSchool Movement calls for a bit more discussion. It is a truism that today’s biggest problems require interdisciplinarity; and the iSchool Movement intends to maximize human potential precisely through interdisciplinarity, namely at the confluence of people, information and technology (Dillon, 2012). Information Schools are characterized by wide-ranging course offerings and faculty with diverse educational backgrounds and research interests (Luo, 2013; Wu et al., 2011). Prior to the iSchool Movement, IB generally had its

⁴ SIGCHI sponsors or co-sponsors over 40 publication venues, including journals, conferences and other services, and these are indexed in the ACM Digital Library (ACM DL). Note that the SIGCHI literature itself has been growing in a nonlinear way: There were 51,704 SIGCHI publications in total through 2019; 34,984 of these are from 2010–2019; 10,855 from 2000–2009; and 5,233 from earlier.

home in LIS departments (by whatever name), while HCI was generally housed in computer science departments, with strong ties to the technology industry. We suspect that this is one of the reasons for the “parallel tracks” development of both fields.

Today, though, researchers within both fields are finding homes in iSchools. Thus we envision the iSchools as an emerging platform for further collaboration between IB and HCI. However, even if researchers in allied fields are working side by side, there is no guarantee they will collaborate. Tactics to further promote interchange and convergence, some of which are already being implemented, may include: offering courses in IB and HCI to students in both fields; conducting “activist” research, e.g., explicitly comparing theories in IB and HCI (Goggins and Erdelez, 2009) and making a conscious effort to include relevant articles from both IB and HCI in reviewing the literature; explicitly welcoming both IB and HCI contributions in relevant venues; holding IB workshops at HCI conferences and vice versa; holding mutual special issues; and instituting incentives for collaboration between researchers in IB and HCI. These suggestions may be low-hanging fruit, but that doesn’t mean they won’t be effective. Such solutions may serve at least as a starting place, resisting the temptation to skip to “vaulting ambition,” to quote Macbeth, “which o’erleaps itself and falls on the other side” (Act I, Scene 7).

Conclusion

Within the broad realm of information science and technology, two distinct research fields have emerged: information behavior (IB) and human–computer interaction (HCI). In this paper, we have sought to better understand the similarities and differences of these fields, as well as how they have changed over time. While the two fields began with quite different origins, purposes and discourses, we have observed that, in recent decades, the two fields have begun to converge. We have suggested that this convergence can be conceptualized in terms of expanding and overlapping circles of concern. Beyond our discussion of IB and HCI, the metaphor of circles of concern could, with further refinement and validation, be used to describe scholarly paradigms of all sorts. As a provocation, we have suggested that it is time for IB and HCI to unite.

To be sure, there are aspects of each field that are still genuinely different. Even if IB and HCI have a set of shared interests and concerns where they overlap, each field likely has concerns that are of no interest to the other field. These are the places on each circle furthest from the area of overlap. Even supposing IB and HCI were to combine entirely, we would not want to forget the unique histories of each field, for example. Moreover, we should remember that information is not limited to digital forms; drawing a distinction between IB and HCI may help us remember that. Still, it is interesting to note work in HCI that examines non-digital crafting (e.g., Rosner, 2018). A limitation of this discussion is that we have taken an Anglo-American view on these fields; other cultural settings may present differences that we have not considered.

All this being the case, we close with a note of caution. Circles can only widen so far until they are so diffuse as to not be circles any longer. Already in 1999 Howard White called the field of information science “highly centrifugal” (p. 1052). In his famous poem “The Second Coming,” W. B. Yeats (1989) warns of what may happen under such circumstances: “Turning and turning in the widening gyre ... Things fall apart; the centre cannot hold.” We

contend that paradigmatic reflection and dialogue, such as we have done in this paper, is one way to help the center hold.

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