An Arts-Informed Study of Information Using the Draw-and-Write Technique

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There are untold conceptions of information in information science, and yet the nature of information remains obscure and contested. This article contributes something new to the conversation as the first arts-informed, visual, empirical study of information utilizing the draw-and-write technique. To approach the concept of information afresh, graduate students at a North American iSchool were asked to respond to the question "What is information?" by drawing on a 4- by 4-inch piece of paper, called an *iSquare*. One hundred thirty-seven iSquares were produced and then analyzed using compositional interpretation combined with a theoretical framework of graphic representations. The findings indicate how students visualize information, what was drawn, and associations between the iSquares and prior renderings of information based on words. In the iSquares, information appears most often as pictures of people, artifacts, landscapes, and patterns. There are also many link diagrams, grouping diagrams, symbols, and written text, each with distinct qualities. Methodological reflections address the relationship between visual and textual data, and the sample for the study is critiqued. A discussion presents new directions for theory and research on information, namely, the iSquares as a thinking tool, visual stories of information, and the contradictions of information. Ideas are also provided on the use of arts-informed, visual methods and the draw-and-write technique in the classroom.

Introduction

"What is information?" is a perennial question in information science, of which we never seem to tire. In the entry entitled "Information" in the *Encyclopedia of Library and Information Sciences*, Bates (2010) asserts that the concept of information is of signal importance and a contested project about which any claim to a unified vision would be disingenuous. To start, this introduction reviews Bates's thorough survey of information as well as a seminal article on metatheory (Talja, Tuominen, & Savolainen, 2005) in order to prime readers expeditiously for what follows: an entirely different approach to the matter.

We are all indebted to two people for the ability to talk about information in the first place, says Bates (2010). Decades ago Norbert Wiener's (1961) breakthrough idea of cybernetics revealed how the mechanical and human are constantly, precisely, elegantly guided by feedback loops of information. Around the same time, Bell Labs scientist Claude Shannon (1948) invented a way to measure the amount of information going over a transmission channel and the impact of factors he called noise and redundancy. His work allowed information to be handled in quantitative terms, making it a decidedly less mysterious phenomenon. Together, the foundational discoveries of Wiener and Shannon brought information as a discrete entity into focus and generated an enormous surge of scholarly and popular interest in information.

Since then, dozens of definitions of information have been put forward. To bring order to the melee, Bates (2010) identifies seven main types, described next. In a *communicatory or semiotic* conception, information is that which changes an individual's knowledge structure, as crystallized in Brookes's (1980) "fundamental equation" of information science. *Information as event* is centered on an individual's mind, too, but focuses on the act or process of being informed; for instance, Pratt likens information to an "explosion" (1977). *Propositional* definitions of information draw attention to the circumstances that make something informational; an example is Dretske's statement that "information is what is capable of yielding knowledge" (1981, p. 45). *Structural* definitions orient us to the relationships between organization and information, and in this vein information is "the pattern of organization of matter and energy" (Bates, 2006, p. 1003). *Social* definitions draw attention to the ways in which information is constituted in communities through shared practices, culture, and history, an increasingly

popular perspective. *Multitype* information definitions acknowledge the dimensionality of the concept; the best known of this kind is Buckland's (1991) information-as-process, information-as-knowledge, and information-as-thing. Finally, *deconstructing information* entails critical or postmodern challenges; a prime case is Furner's (2004) argument to avoid the term information altogether in favor of a constellation of other more precise concepts.

In some circles, free-standing definitions of information, such as those surveyed by Bates, have been superseded by metatheory. Metatheory is ". . . the philosophy behind the theory, the fundamental set of ideas about how phenomena of interest in a particular field should be thought about and researched" (Bates, 2005a, p. 2). A metatheory establishes the nature of objects of study, including information. Finnish scholars have characterized three major metatheories at play in information science as constructivism, collectivism, and constructionism, and each manifests its own conception of information (Talja et al., 2005).

Constructivism in information science is also referred to as the *cognitive viewpoint*. This metatheory places emphasis on the way in which knowledge is actively built up within the individual mind in the form of a knowledge structure. Constructivism has been the platform for many studies of information behavior, information retrieval, and literacy. From a constructivist perspective, information is anything that produces a change in a knowledge structure, resembling what Bates (2010) calls *communicatory or semiotic definitions*.

The metatheory of collectivism holds that human experience and knowledge are shaped by social, cultural, and historical forces. Hence, analytical attention extends beyond the individual to the milieu or "collective." In information science, this metatheory has motivated many studies of information phenomena in social worlds, whether academic disciplines, professions, or hobbies. In collectivism, generally speaking, information is that which answers the questions specific to any community (Hjørland, 2007), aligning with Bates's social category of definitions.

Constructionism is a language-based metatheory that focuses not on mental but on linguistic processes. In this view, reality is constituted through the use of language, so discourses, literatures, and debates become objects of study. Proponents of constructionism have argued that the focus of information science should be conversations, not information (Tuominen, Talja, & Savolainen, 2003, p. 562), which is an example of deconstructing information, per Bates's (2010) typology.

The seven types of definitions named by Bates (2010) and the metatheoretical approaches (Talja et al., 2005) constitute a large literature and conversation about information that appear, at first, to be heterogeneous, especially when considered side by side, as they are here. However, the range of methodologies taken to engage the cardinal issue of information has really been quite narrow. Namely, the major contributions were generated through philosophical–analytical reasoning, the classical technique of the discipline

of philosophy that entails extremely rigorous analysis of ideas and propositions. The results have been statements about information in a traditional argumentative style that can be abstruse even when well-written. Such works favor readers with an affinity for philosophy and strong logical–mathematical intelligence, although there are many other audiences and forms of intelligence that can be tapped on the matter of information.

The study at hand explores the nature of information in an entirely different way. We place philosophical–analytical reasoning respectfully aside and opt for an arts-informed methodology (Cole & Knowles, 2008). This approach has roots in the arts and humanities, taps creative intelligence, often employs the visual medium, and honors the aesthetic dimension of information. Arts-informed methodology is well-established in other social sciences but is timely, indeed an imperative, for information science. Tufte's (1983) pioneering work on information design awakened many to the beauty of information in nontextual manifestations. Recently, the specialties of information arts and information visualization have moved into the information science neighborhood. These developments suggest a climate for a more artful and rounded conception of information, accessible through an arts-informed approach.

Using an arts-informed, visual, empirical research design, we collected drawings of information from iSchool graduate students. Advantageously, the chosen population occupies a borderland between information scholars and everyday citizens, and their ideas are a bridge to the popular imagination and the future. The data-gathering method of the draw-and-write technique (Pridmore & Bendelow, 1995) was selected for its power to capture unfettered visual conceptions of information, especially personal, pleasurable, and profound dimensions, which are increasingly relevant (Kari & Hartel, 2007). By asking students to engage in the creative and upbeat act of drawing, the study evinces the playfulness that infuses a great deal of information phenomena in our midst. In short, to the conversation on the signal matter of information, this project interjects a complementary voice that is artful, egalitarian, accessible, holistic, humane, and fun.

An alternative title for this paper could have been, "The Concept Formerly Known as Information," a riff on the antics of American singer–songwriter Prince, who in 1993 changed his name to an unpronounceable glyph and was called (for a short time) "The Artist Formerly Known as Prince." We seek a similar jolt to the status quo when the concept of information is transformed from word to image.

Theoretical Framework and Research Design

Arts-Informed Methodology

Arts-informed methodology is "the creative meshing of scholarly and artistic endeavors" (Cole & Knowles, 2008, p. 65). It combines the systematic and rigorous qualities of conventional qualitative methodologies with the artistic and

imaginative features of the arts. Pablo Picasso reflects the crossroads in the quip, "I never made a painting as a work of art, it's all research." This approach emerged from the discipline of education in the 1990s and has spread to other social sciences. Arts-informed methodology incorporates novel modes of inquiry into the research process, such as poetry, literary prose, playwriting, visual arts, dance, and music; hence, the outcomes are accessible to more people. As a flexible framework for inquiry, an arts-informed approach may complement a research design or function as a stand-alone methodology.

This project exhibits several tenets of arts-informed research. For starters, the research team[1] was interdisciplinary and included social scientists and artists. Essentially, the art form of drawing was the primary means of knowledge acquisition and representation. The analysis process, *compositional interpretation* (Rose, 2007, chapter 3), was imported from the humanities, specifically art history. The findings from the inquiry will be disseminated in unconventional channels across academe and beyond. To supplement publication and presentation in traditional peer-reviewed journals and conferences of information science (Hartel, Pollock, & Noone, 2012; Hartel, 2013a,b), there will be public exhibitions and an online gallery of iSquares accessible to all. In the participatory spirit of the arts-informed movement, anyone can follow the instructions in this paper to make an iSquare for research, education, or the promotion of information science.

Visual Research

Simultaneously, in its production of drawings, this study is an instance of visual research (Prosser & Loxley, 2008), a well-established approach in anthropology and sociology that is now making its way into information science (Hartel & Thomson, 2011). Visual research employs images to learn about the social world and provides an alternative or complement to inquiry based on words or numbers. Images can feature in social science research designs in many ways, namely, (a) images can be produced by participants as data; (b) found or existing images can be used as data or springboards for theorizing; (c) images and objects are useful to elicit or provoke other data; (d) images can be used for feedback and documentation of the research process; and (e) images are useful as a mode of interpretation and representation (Weber, 2008). Here, we employ the first and fifth modes, in which images are produced by participants as data and are used for interpretation and representation of the results.

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[1]Two research assistants helped to implement this study. Karen Pollock is a graduate of the Master of Information program, and Rebecca Noone is an artist and graduate of the Museum Studies program, both at the Faculty of Information, University of Toronto. Karen made a special contribution at the analysis stage. Rebecca Noone provided creative input throughout and helped to conceptualize an exhibit based on the iSquares. References to "we" throughout the paper refer to this research team.

The Draw-and-Write Technique

The draw-and-write technique is one arts-informed, visual research method. Participants are prompted to perform a drawing activity along with a writing exercise, interview, or focus group (Pridmore & Bendelow, 1995). It was first developed in the United Kingdom during the 1980s for studies of children's health. Typically, the draw-and-write technique is administered to children by teachers or researchers in the classroom.

Variations of the draw-and-write technique have also been used in research on adults. As a mode of communication for adults, drawing often takes the form of diagramming or graphic ideation, that is, the process of quick, freehand sketches to increase self-understanding (McKim, 1980). In studies like the one at hand, it can be difficult to control the outcomes, and participants may generate drawings or diagrams (Varga-Atkins & O'Brien, 2009). In an analysis of these two visual formats, Kazmierczak (2000/2001) differentiates images from diagrams, the former being a tool of art-making and the latter being tools of information design. For this paper, we will not focus on the differences among drawings, images, and diagrams and place all under the banner of *graphic representations* (to be defined shortly) per Engelhardt (2002).

Advocates of the draw-and-write technique assert that it is compatible with a variety of research interests, can be used to triangulate other forms of data, is a relatively easy form of data collection, and is often enjoyable for participants to perform. Above all, it generates an unusually rich and unique visual data set, "Drawings offer a different kind of glimpse into human sense-making than written or spoken texts do, because they can express that which is not easily put into words: the ineffable, the elusive, the not-yet-thought-through" (Weber & Mitchell, 1995, p. 34).

Problems with the draw-and-write technique have also been registered (Brackett-Milburn & McKie, 1999). One critique pertains to validity, that is, the degree to which the activity measures what it is meant to measure. Subjects may draw what is easy to depict, may be affected by the proximity of others, or may desire to please the researcher. There is evidence, too, that the drawing exercise is experienced as unpleasant by a minority of subjects. The strongest objection to the draw-and-write technique concerns the analysis and interpretation of the resulting visual data, which can be time consuming (Umoquit, Tso, Burchett, & Dobrow, 2011). Mair and Kierans (2007) assert that studies thus far have taken naive positivist or interpretivist analytical approaches. Finally, there are open questions about ethical protocols related to consent, privacy, and the use of the images during and after the study.

Literature Review

A multidisciplinary, systematic review of the draw-and-write technique (and similar research designs involving the creation of diagrams) identified 80 studies between 1986
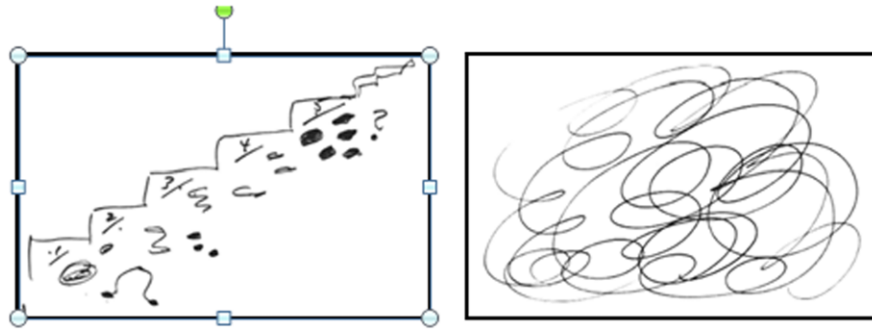
FIG. 1. Drawings of "menopause" (Guillemin, 2004). [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

FIG. 2. Data from the study entitled "Drawing celebrity" (Gauntlett, 2007).

and 2010, with a substantial increase after 2006 (Umoquit et al., 2011). The approach is more common to the field of education and is also used in health care, engineering, environmental science, geography, industrial design, and psychology. Next, the most significant precedents of an arts-informed, draw-and-write technique are reviewed to convey their flavor, and then related applications in information science are noted.

Australian researcher Marilys Guillemin (2004) employs drawing to explore women's experiences of health and disease. She believes that drawing is best used as an adjunct to other social research methods. After conducting a survey or an interview, she asked women to draw their understanding of menopause or heart disease (Figure 1); then she analyzed the data for themes. Guillemin is an advocate for the sensitive and ethical use of the draw-and-write technique, because health topics can be upsetting to participants. Many of her research subjects found the exercise liberating and therapeutic, though.

According to communications scholar David Gauntlett (2005, 2007), visual methods are the appropriate medium for communications research because most mass media exists on a visual plane. In his project entitled "Drawing celebrity" (Figure 2), he explored how young people think about celebrities. One hundred teenage students were asked, "Draw a star, celebrity or famous person who you would like to be . . ." and were reassured that their drawing skills were of no concern; then, the youths completed a single-page questionnaire. The thoughtful, emotionally reflective (not macho) responses from male teenagers suggested to Gauntlett that young masculinities are changing.

From the field of education, Sandra Weber and Claudia Mitchell (1995) used drawings to understand better the conceptions of teachers. They collected more than 600 drawings of teachers by teachers from around the world (Figure 3). In a workshop setting, participants were invited to "Draw a teacher (any teacher)" and were then given paper and colored pencils. Later, they were interviewed and asked to "Tell me about your picture." The researchers interpreted the images through the lens of a critical feminist pedagogy, using a semiotic and dialectical style of interrogation. The findings illuminated the stereotypes and contradictions that exist in teaching practice, such as classroom actions that are nurturing and controlling.

In an effort to access the epistemological beliefs of undergraduates in Belgium, researchers in educational psychology enlisted several hundred students to draw "knowledge" in 5 minutes (Briell, Elen, Depaepe, & Clarebout, 2010). Later iterations of the study supplemented the drawing exercise with an interview or a written statement, and all the data sets were analyzed from a grounded theory approach. The students conveyed knowledge as internal entities, external objects, or a combination of the two. The addition of interviews and written statements improved the researcher's ability to code the drawings.
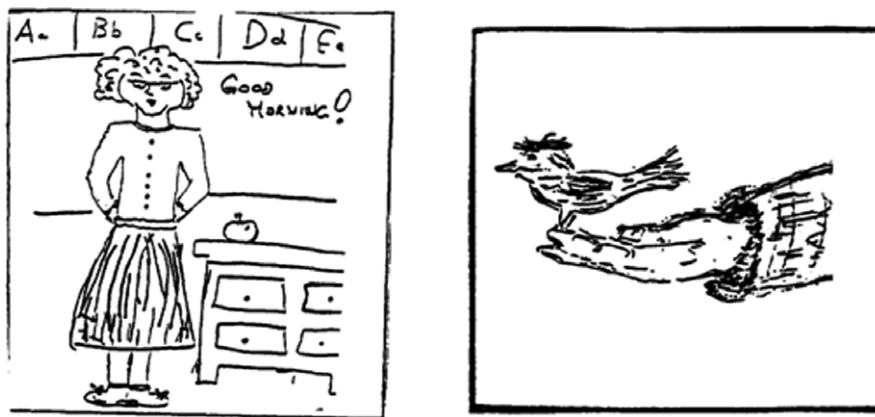
FIG. 3. Literal and metaphorical drawings of "teacher" (Weber & Mitchell, 1995).

Just a few scholars from information science have utilized drawing or diagramming as a data-gathering method and largely in an exploratory manner not linked to the aforementioned precedents and methodological literature. One study sought to understand how people initially envisioned the Internet and how these representations changed over time (Scull, Milewski, & Millen, 1999). Ten participants were interviewed and asked to sketch a timeline of their Internet experience and then an early and current "map" of the Internet as they understood it. More recently, a masters thesis by Caroline Norrby (2011) at the Swedish School of Library and Information Science used a drawing exercise to examine children's perceptions of libraries and librarians. Norrby interviewed 14 children between the ages of 8 and 12 years; after the interview, children were given the option to draw the librarian. Using a modified version of semiotics, Norrby found that "children experience librarians to be an older woman with glasses who is calm but sometimes muddle-headed" (p. 3). A dissertation by Laura Jankevièiûtë (2011) broached representations of the Internet in the world of preteens and sought to characterize youth digital culture. Her thesis involved 160 youth from two schools in Bordeaux, France. In a creative adaptation of the draw-and-write technique, she gave subjects mock-paper laptops onto which they illustrated "their Internet." Describing her approach Jankevièiûtë writes, "Children are not adults and the methods used in the research should be appropriate" (p. 2).

Within information science, a home-grown version of the draw-and-write technique is a method to investigate information seeking, known as the information horizon interview (Sonnenwald, Wildemuth, & Harmon, 2001). Grounded in Sonnenwald and Iivonen's (1999) theoretical framework for human information behavior, the process assumes that within a situation is an "information horizon" in which people can act and that includes information resources. It is further assumed that people can articulate the information horizons in a graphic and verbal manner. Research subjects are interviewed about an information-seeking episode and then asked to draw a map of his or her information horizon and its information resources. The drawing (Figure 4) then serves as a graphic elicitation device to probe further on the subject of information behavior. The resulting data, in the form of images and text, can be analyzed in a quantitative manner or through social network analysis. Savolainen and Kari (2004) further developed Sonnenwald's approach to study information seeking, enhancing it with the concepts of information source horizons, zones of source preferences, and information pathways (Johnson, Case, Andrews, Allard, & Johnson, 2006). Enlightened by these precedents, and mindful of the benefits and methodological problems that have been identified, we developed an arts-informed, visual research design utilizing the draw-and-write technique to engage the concept of information afresh.

Data Collection

Participants in this study were graduate students at the Faculty of Information, University of Toronto, a North American iSchool. The majority were pursuing a Master of Information degree with concentrations in library and information science, archives, information system design, knowledge management, and critical information studies; a minority were enrolled in the Master of Museum Studies program within the faculty. The age of participants ranged from 22 to 58 years (most being between 24 and 32 years). Given the involvement of human subjects, the Office of Research Ethics at the University of Toronto approved the research design.

The materials and instructions used during the draw-and-write exercise are a means for the researcher to control and constrain the outcome (Varga-Atkins & O'Brien, 2009). We provided smooth, heavy, white drawing paper of a premium quality that invited thoughtful illustration. The relatively small (4- by 4-inch) paper size and 10-minute time frame
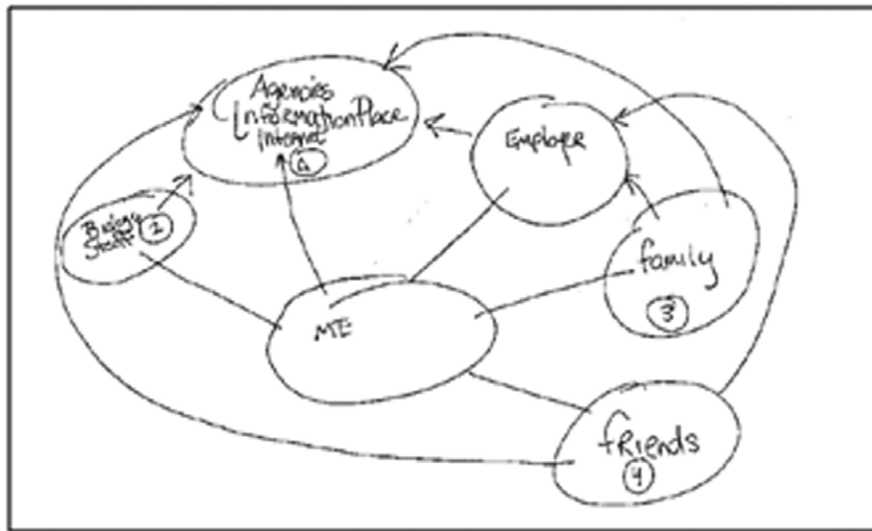
FIG. 4.   An "information horizon" map (Sonnenwald, Wildemuth, & Harmon, 2001).

ensured that the images would not be overly sprawling or complex. The "front" side was left blank to facilitate the drawing portion of the activity; the "back" side was stamped with the phrase "Information is . . ." to lead students into the writing portion of the exercise. Demographic prompts for age, gender, and area of study were also stamped on the back side, to establish participant profiles, although there was no intention to link these variables with outcomes. We provided high-quality, black, uniball-style pens for use in the activity, to limit the visual expression of information to shape, not color. The research assistants made sure that our supplies were used exclusively, to produce a consistent and reliable result.

The data gathering occurred during a summer semester. Employing a convenience strategy, we solicited all active instructors via e-mail for clearance to visit their course; several agreed. The activity was scheduled for the start of class time when students were most alert and was framed as an upbeat learning opportunity for all. Students were not told of the exercise beforehand, because we wanted spontaneous responses. Upon arrival in the classroom, research assistants introduced the study, obtained verbal consent, and explained ethical protocols. As an incentive, a healthy snack was offered to those who completed the activity.

The class was asked to respond to the question "What is information?" by drawing on the front side of the iSquare. Then, they were directed to complete the statement "Information is . . ." on the back side of the iSquare using a single short sentence and to respond to the demographic prompts. Participation rates were high (estimated 95%) in the six classes visited. All instructors seemed pleased with the episode, and some made informal remarks to relate it to a course topic. Students appeared interested and amused throughout.

After the data-gathering session, an identifying number was placed on the back, lower right corner of every iSquare. Each one was photocopied on both sides so that the original

was archived, and data analysis occurred on a duplicate. The iSquares were also scanned and stored in a password-protected online folder. It was initially a goal to collect 300 iSquares. The figure was adjusted downward when we learned that precedents average 32 pieces of data (Umoquit et al., 2011). We ended the data-gathering with 137 iSquares.*[3] Mindful of the influence of context during data gathering, research assistants also wrote descriptive field notes (Emerson, Fretz, & Shaw, 1995) to characterize each class visit.

Data Analysis

Our data analysis process was inspired by the arts-informed methodology and the handbook *Visual methodologies: An introduction to researching with visual materials, 2nd ed.* (Rose, 2007). According to this source, all images have three potential sites of analysis. First, there is the site of production; in our case, that is the drawing activity in the classroom setting. Second, there is the site of the image itself, which entails the iSquares as visual artifacts. Third, there is the site of the audience; which includes the display of iSquares in journals, books, or exhibitions in conjunction with the viewers' responses. Although all three sites are interesting and the three are interconnected, our analysis focused on the second site, the iSquare image itself.

An analytical technique for examining the image itself is *compositional interpretation* (Rose, 2007, chapter 3), that is, "a way of looking very carefully at the content and form of images" (p. 39). Compositional interpretation examines images for "what they are" rather than "what they do" (p. 36). Put differently, analytical attention is placed on the

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*The complete corpus of iSquares can be viewed at www.iSquares.info, along with additional background information on the study, including a detailed protocol to replicate the research.

formal qualities of images instead of their social construction or cultural impact. Rose considers this kind of analysis important in its own right and also a logical starting point for studying the other sites. Because compositional interpretation focuses on the image as a discreet entity, the participant responses to "Information is . . ." on the back of the iSquares and the field notes taken during class visits did not factor heavily in the analysis process (addressed under Methodological Reflections).

Compositional interpretation is the traditional analytical strategy of art history and art criticism and has most often been applied to paintings. In practice, an expert relies on visual connoisseurship to judge the images in terms of the conventions of the genre. To illustrate, compositional interpretation could be applied to the exhibit "Italian Futurism, 1909–1944: Reconstructing the Universe," at the Solomon R. Guggenheim Museum in New York in 2014. Futurism was an artistic and social movement that originated in Italy in the early 20th century. It glorified themes associated with the future, including speed, technology, youth, and violence. As a genre of painting, Futurist works had a signature subject matter and use of abstraction, distortion, motion, pointillism, and color. An art historian or art critic, being versed in the ideals of Futurism, would apply compositional interpretation to the Guggenheim exhibit by evaluating how each artifact in the show manifests the characteristics of the genre.

To apply compositional interpretation to our study, we had to determine the genre of the iSquares and the conventions of that genre. Subsequently, it was necessary to become connoisseurs of and experts on that genre. The iSquares, generally speaking, are drawings. More specifically, we deemed them to be graphic representations per *The Language of Graphics: A Framework for the Analysis of Syntax and Meaning in Maps, Charts and Diagrams* by visual scholar Yuri Engelhardt (2002). (All references to Engelhardt that follow are to this text.) According to this authoritative[3] source, a graphic representation is "a visible artifact on a more or less flat surface that was created in order to express information" (p. 2). Graphic representations have been around for millennia; examples are cartoons, maps, charts, and timelines.

In Engelhardt's view, graphic representations are socially and culturally constructed yet simultaneously manifest "general principles of visual languages" that are universal (2002, p. 4). At this point, a primer is in order on a few general principles of graphic representations as related to this study. The 4- by 4-inch surface of the iSquare is a

graphic space (p. 21) in which the drawings of information reside. The graphic space may be relatively spare and contain an *elementary graphic object* (p. 23), such as an illustration of a book, or the graphic space may be busier and hold a *composite graphic object* that is an amalgamation of any number of graphic *subobjects*. In composite graphic objects, the subobjects can be involved in different relations (pp. 30–53) with each other. In the data, there were graphic subobjects involved in *linking* (connected by arrows), *containment* (words placed inside a speech bubble), and *superimposition* (a label in front). Given the constraints of the classroom drawing activity (especially its spontaneous nature and limited time), most of the iSquares are elementary graphic objects, although there are some composite graphic objects as well.

The general principles named by Engelhardt are the foundation for a classification system of 10 primary types of graphic representations, namely, *map*, *picture*, *statistical chart*, *time chart*, *link diagram*, *grouping diagram*, *table*, *symbol*, *composite symbol*, and *written text* (2002, chapter 4). The research team performed compositional interpretation on the iSquares by invoking general principles and the classification system from Engelhardt's treatise. The process had two stages. First, each iSquare was individually contemplated and classified as one of the 10 primary types. For many iSquares, this determination was obvious; if not, the differing views were discussed by the research team until a single type was agreed upon. All conclusions were documented on a spreadsheet. Second, the drawings were viewed in sets based on their major type. For example, we pondered the iSquares that were symbols, recorded their general principles, and documented associations with existing conceptions of information from the literature of information science. (The linkages made between select iSquares and prior conceptions of information are not mutually exclusive; multiple interpretations are possible. Arts-informed methodology welcomes participation, and the reader is invited to discover associations of his or her own.)

Findings

Arranged in rows on a library table, the 137 iSquares altogether look like a sprawling checkerboard, a patchwork quilt, or a school of fish in military formation. The data are identical and repetitive in their quaint size, square shape, and black-and-white palette, yet, amidst the consistency, each drawing is striking. A handbook of the visual arts explains that "because of the directness of their execution drawings often give a particularly clear indication of an artist's vision" (Taylor, 1957, p. 70). Compared with drawings made with pencil, charcoal, chalk, pastel, or crayons, those created with a steel pen are especially firm and precise because of a steady ink flow. As a result, students generated bold lines; very few attempted subtle tones using the technique of crosshatching.

In terms of Engelhardt's classification system, the iSquares exemplify different types of graphic representations,

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[3]Engelhardt's (2002) framework was a logical resource for this research. The framework is "comprehensive" (pp. 7–8) because it integrates structural, semiotic, and classificatory aspects of graphic representations, and it can be applied to the complete spectrum of graphic representations. The framework is also "unifying" because it analyzes and relates the "existing jungle of terminology for discussing graphics proposed by other authors" (pp. 9–10). Furthermore, Engelhardt's treatise includes many illustrations that proved a crucial means by which to analyze and classify the iSquares.

summarized in Table 1. Half of the images are pictures (72); there is a significant number of link diagrams (33); and there are notable occurrences of grouping diagrams (10), symbols (nine), and written text (eight). There are few tables (two), and no instances of composite symbols, statistical charts, time charts, or maps. Three iSquares were left blank by students and are classified as other.

Picture

The majority of the iSquares (72) are pictures. A picture is "a graphic representation that serves to represent the physical structure of physical objects" (Engelhardt, 2002, p. 139). To expand, an iSquare that is a picture involves a literal correspondence to its referent in the world, which is usually a physical object or scene. According to Engelhardt, pictures may be situated on a continuum from realistic to schematic rendering (2002, p. 119). A realistic picture would be a photographic portrait of a person; a schematic version of the same notion might appear as a smiley face of the simplest kind. Because the research participants were not all artists and because of the constraints of the drawing exercise, most of the iSquares that are pictures are quite schematic. When performing compositional interpretation of the pictures, an important matter is their content (Rose, 2007, pp. 40–41). Put as a question: In their effort to visualize information

literally, what did students draw? Just as the Futurist painters mentioned earlier employ favorite themes, so too did participants in this study.

One recurring motif is the brain (Figure 5), which is relatively easy to draw. Lumpy, variegated, and roundish, these images might be mistaken for a rock, scone, or sea anemone if encountered outside the context of the study. These iSquares are reductive, anatomical relations to conceptions of information associated with the mind and individual, discussed shortly.

Again and again, the iSquares that are pictures feature individual human beings. Persons are illustrated as faces, heads, busts, or stick figures (Figure 6). In viewing this group of drawings, it is impossible not to be charmed. They resemble cartoons with characters engaged in serene contemplation. A dynamic mind is revealed through wide-open eyes and thought bubbles. While some actors appear alone in an uncluttered graphic space, others are surrounded by the documents, technology, or scenery that support information practices. Of relevance to information scholars with an interest in gender, the figures in many cases are androgynous. Most look cheerful and enlightened, suggesting a pleasurable or profound information experience (Kari & Hartel, 2007).

It is not difficult to associate these anthropocentric iSquare pictures with prior conceptions of information. Those with thought bubbles are apt illustrations of Buckland's (1991) information-as-process and Brookes's "fundamental equation" in which information changes the structure of knowledge in the mind. The iSquares of a person with books nearby or documents in hand also depict constructivism (Talja et al., 2005), a metatheory about the individual as a processor and seeker of information. Talja (1997) states that constructivism is an individualistic approach centered on the "information man," and these images could very well be his (or her) mug shot.

Another common picture manifestation is a twosome engaged in communication (Figure 7). Partners, often mirror images, are turned to each other in conversation via speech bubbles. (Ironically, students took pains to show the mouth speaking, though most figures lack ears for listening.) The substance of the conversations is not apparent, except in Figure 7 (right), which captures a reference interview. A

TABLE 1. Summary of the major types of graphic representations in the data.

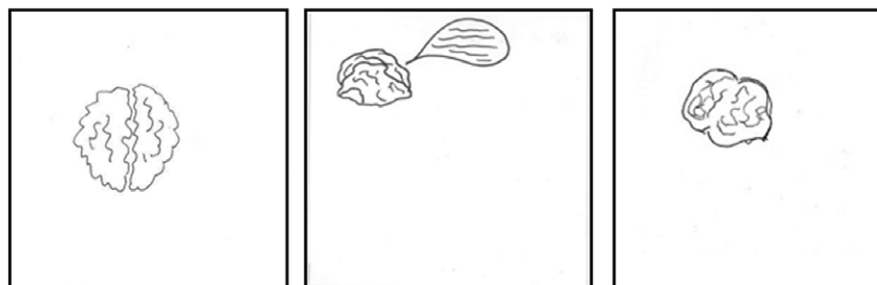| Graphic representation	No.op	Percentage
Picture	72	52
Link diagram	33	24
Grouping diagram	10	7
Symbol	9	7
Written text	8	6
Table	2	2
Composite symbol	0	—
Statistical chart	0	—
Time chart	0	—
Map	0	—
Other (blank)	3	2
137		100

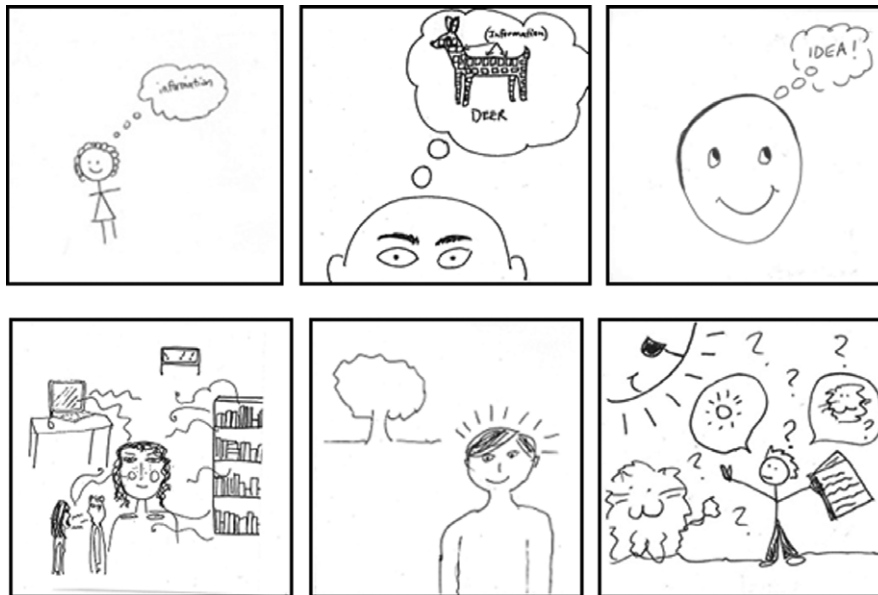FIG. 5. Examples of pictures featuring the brain.

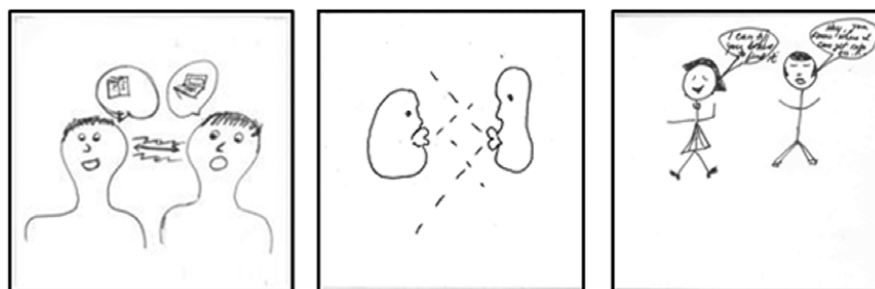FIG. 6.   Examples of pictures featuring individuals.

FIG. 7.   Examples of pictures featuring communication between people.

man says, "Hey, do you know where I can get info on . . ." and a woman (perhaps a librarian in a neat skirt and sensible shoes), responds, "I can tell you where to find it."

The iSquare pictures of dyads might be seen as vignettes of one information man encountering another. Hence, these chatterers could be additional instances of information-as-process (Buckland, 1991), Brookes's (1980) "fundamental equation," the metatheory of constructivism (Talja, et al., 2005), and the cognitive viewpoint. However, a more compelling resemblance is found to the language-based metatheory of constructionism (Talja et. al., 2005). Constructionism focuses the attention of the conversations between people that accumulate into large idea systems called discourses, seen as the sources of information in society. These drawings do not capture discourses at their social level but rather are snapshots of their origins in an intimate tête-à-tête.

Apart from people, numerous iSquares of the picture type show print documents of various kinds (Figure 8). When viewed alongside all other iSquares, these drawings make an old-fashioned and stolid impression. There are fanciful glimmers, though; one iSquare exhibits winged papers in flight (Figure 8, bottom, left). This batch of iSquares casts information as physical, objective, and contained within documents. What we have here are unabashed and loyal expressions of information-as-thing (Buckland, 1991), the longstanding material epicenter of information science.

Some iSquares that are pictures present information technology. There are many drawings of hardware: desktop and laptop terminals, handheld devices, and their peripherals. In only 1 case among 137 is information visually reduced to the physical shell of a computer with its mouse (Figure 9, left). Other iSquares successfully express the immaterial elements of information technology, which are abstract and therefore difficult to draw. For instance, an iSquare (Figure 9, middle) shows software (binary code), content (a book), connectivity (cables), and the Internet (www), all essential ingredients of our wired society. One especially novel technology to appear is not of the digital age: a hybrid lightbulb–bullhorn (Figure 9, right). Prior definitions of information based on words do not make explicit mention of information
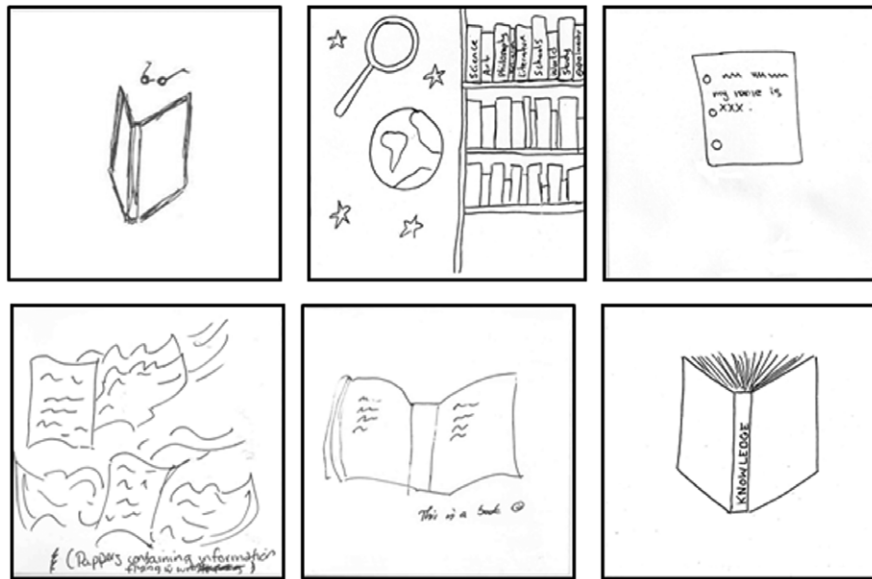
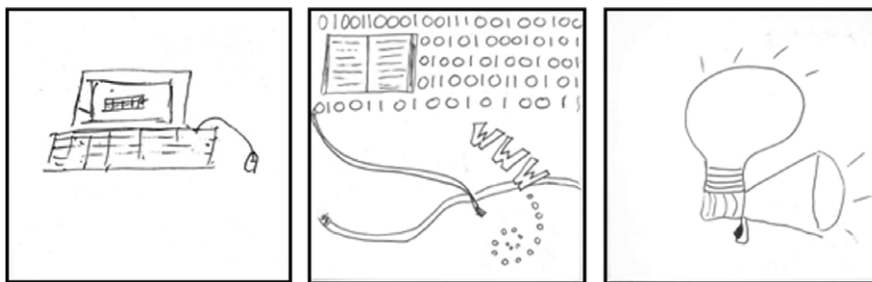FIG. 8.   Examples of pictures featuring print artifacts.

FIG. 9.   Examples of pictures featuring information technology.
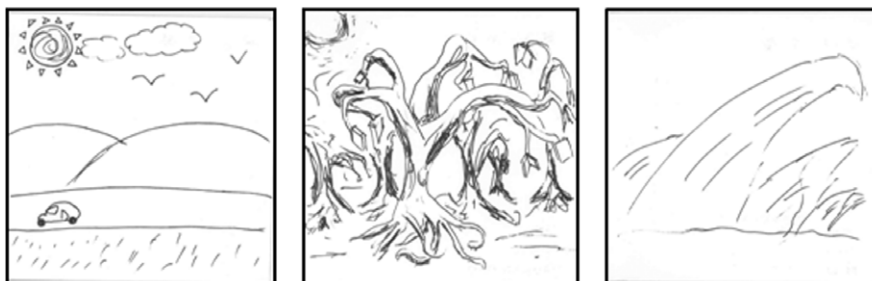
FIG. 10.   Examples of pictures featuring landscapes.

technology and its components, perhaps because it is the invisible, sometimes boring, and taken-for-granted infrastructure of the "information age" (Star, 1999).

Also among the iSquares that qualify as pictures are landscapes, that is, a depiction of an expanse of natural scenery (Figure 10). Because they are not suggestive of any specific geography nor realistic in scale, these do not qualify as the major type of graphic representation known as maps

(Engelhardt, 2002, p. 138). As an analytical strategy, compositional interpretation does not focus on the meaning of a work. We can put it aside temporarily to speculate that students associate information with a sunny road trip (Figure 10, left), a forest where books grow (Figure 10, middle), or a stormy sea (Figure 10, right). The landscapes are especially evocative, or a stormy sea; other interpretations are left to the reader's imagination.

The most prevalent landscape pictures are the earth as seen from outer space, which appear in seven iSquares (Figure 11). No other entity is drawn with such visual consistency. For the record, an otherworldly landscape of even greater magnitude, the universe, is not present on any iSquare. The earth drawings usually include additional informational forces, such as swirling symbols (Figure 11, middle) or a bright light (Figure 11, right). Existing conceptions of information rarely invoke the natural world at a planetary scale, barring Bates's (2005b) evolutionary approach, that places information in the context of the development of life on earth.

Eleven drawings within the picture set feature an arresting style that approximates wallpaper (Figure 12). Such iSquares contain a repeated motif or pattern that fills the graphic space entirely and with an electric dynamism. Being quite intricate, one suspects the idea struck students right away and then every available minute was used to bring the vision to fruition. It is a stretch to fit these iSquares within Englenhardt's definition of a picture, because their "literal correspondence" to the physical world would require that vision be enhanced or modified somehow, as through a microscope. The highly abstract wallpapers bring to mind the earliest conceptions of information by Wiener (1961) and Shannon (1948), respectively), involving signals, noise, redundancy, and feedback loops. The wallpaper iSquares also resonate with structural definitions of information such as "the pattern and organization of matter and energy" (Bates, 2006, p. 1033).

The 72 iSquares that qualify as pictures make up half of the data set and merit a summary before continuing. To restate, an iSquare that is a picture involves a literal correspondence to its referent in the world, which is usually a physical object or scene. Human beings are the most common motif and manifest as cartoons of the brain, face, head, bust, or body or a twosome. The documents or technologies that carry information also appear as common touchstones. Nature itself, visualized as a landscape or the earth, embodies information for some students at the iSchool. Several "wallpapers" show information artfully as an abstract and mysterious pattern. Overall, the pictures have a humanist sensibility in their straightforward relation between information and world around us.
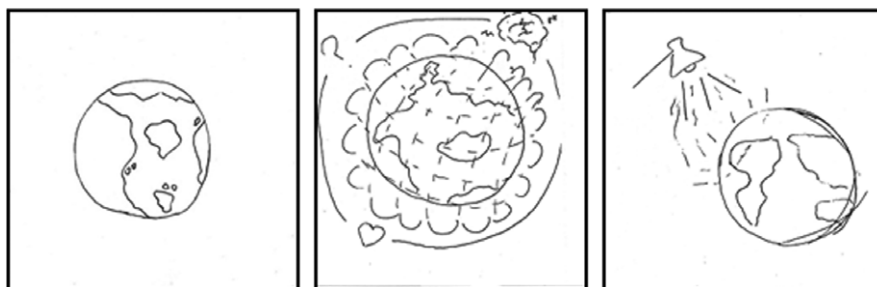

FIG. 11.   Examples of pictures that were landscapes of the earth seen from space.
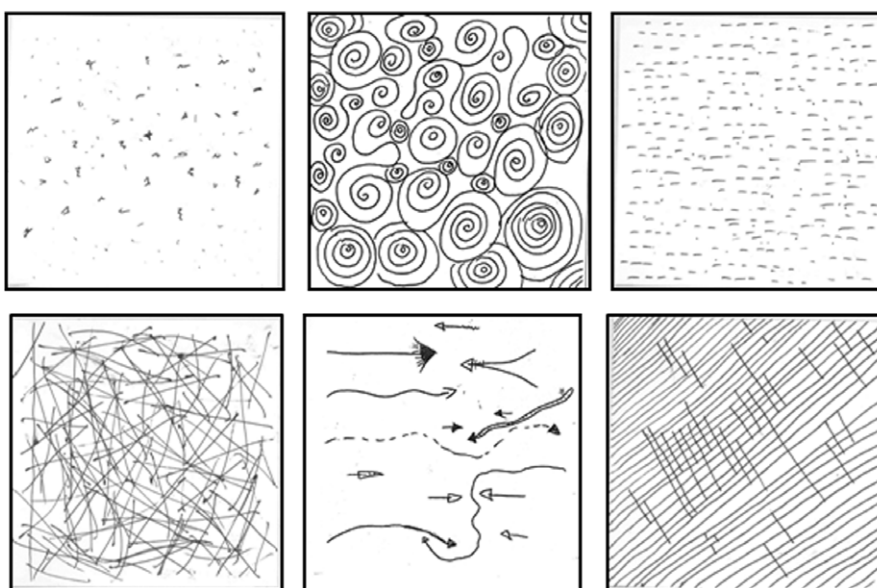

FIG. 12.   Examples of pictures that resemble wallpaper.

Link Diagram

A link diagram is one of the 10 major types of graphic representation, and it involves the relation of linking together graphic subobjects (Engelhardt, 2002, p. 140). This proved a popular means of illustrating information; there were 33 link diagrams in the data set. To be precise, a link diagram features one or more *nodes* joined by a *connector*, usually an arrow or line (pp. 40–43). For example, the link diagram in Figure 13 (top, left) has two nodes of a question mark and house, and the connector is a long and tangled arrow between the two. Across the iSquares that are link diagrams, nodes are persons, documents, technology, buildings, symbols, mundane objects, or content of some kind (e.g., music, numbers, weather information). A variety of connectors ($\Leftarrow, \Leftrightarrow, \leftarrow, \rightarrow, —, +, =$) suggest that the movement of information between these entities may be one-way or reciprocal, straightforward or convoluted. There are two noticeable trends among the link diagrams.

One group of link diagrams is relatively simple, with a pair of nodes joined by a single connector (Figure 13). These showcase information flow within or between an individual and another entity. Engelhardt identifies four kinds of linking, *linear chain*, *circular chain*, *tree*, and *network*, and these sorts were linear chains, a structure that involves no branching. This set of iSquares illustrates individual information encounters and, like many of the previously reported pictures of human beings, can be associated with information-as-process (Buckland, 1991), Brookes's "fundamental equation," the metatheory of constructivism (Talja et al., 2005), and the cognitive viewpoint. Stylistically, the nodes and connectors have a mechanical quality that resembles models of information behavior, such as berry-picking (Bates, 1989) or sense-making (Dervin, 1983).

(Indeed, a smiling stick figure with a triangular head who leaps over a gap on the space–time continuum would be at home on an iSquare of this kind.)

Other link diagrams involve a greater number of nodes and connectors (Figure 14). Having a busier graphic space than the link diagrams that are linear chains, these are networks (a configuration in which there is more than one possible route for moving from one node to another; Engelhardt, 2002, p. 40). Containing many people, such iSquares are markedly macrosocial. One example (Figure 14, top, left) displays many smiling people, a library, and a school interconnected by arrows, suggesting an information environment of a town or city. Because they locate information phenomena at the community level, these iSquares reflect a social definition of information (Bates, 2010) and the metatheory of collectivism (Talja et al., 2005). In collectivist approaches today, the nature of the collective is disputed (Palmer, 1999; Tennis, 2003) and may entail a profession, discipline, hobby (Hartel, 2010), or cultural group of any size. The social formations illustrated in the iSquares are likewise abstract or ambiguous about such details.

Grouping Diagram

A grouping diagram is a type of graphic representation that expresses the categorization of a set of elements (Engelhardt, 2002, p. 141); there are 10 grouping diagrams (Figure 15). All are illustrated lists of information phenomena. Sometimes labels are used to identify graphic subobjects, underscoring the intent of enumeration. An example of a grouping diagram is Figure 14 (top, middle), which is an array of information and communication cultures: oral,
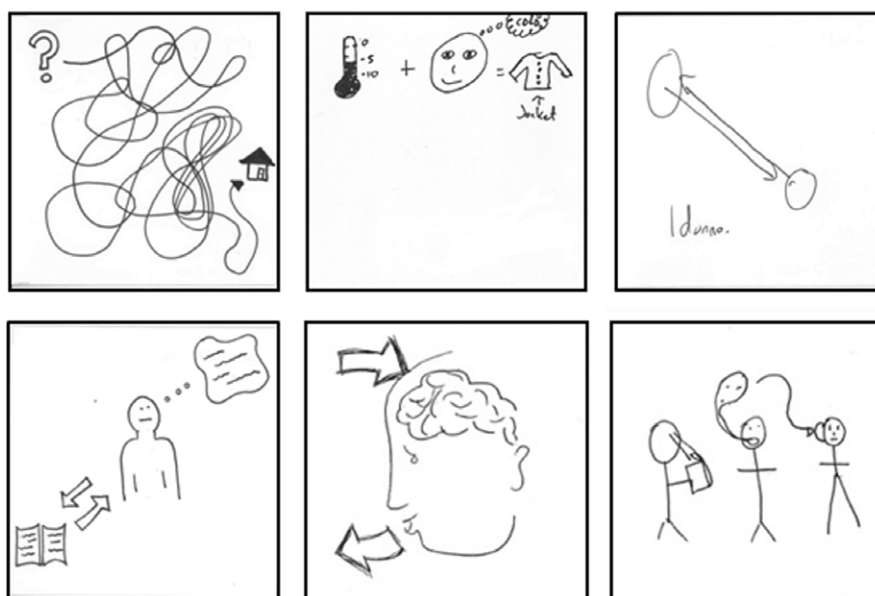

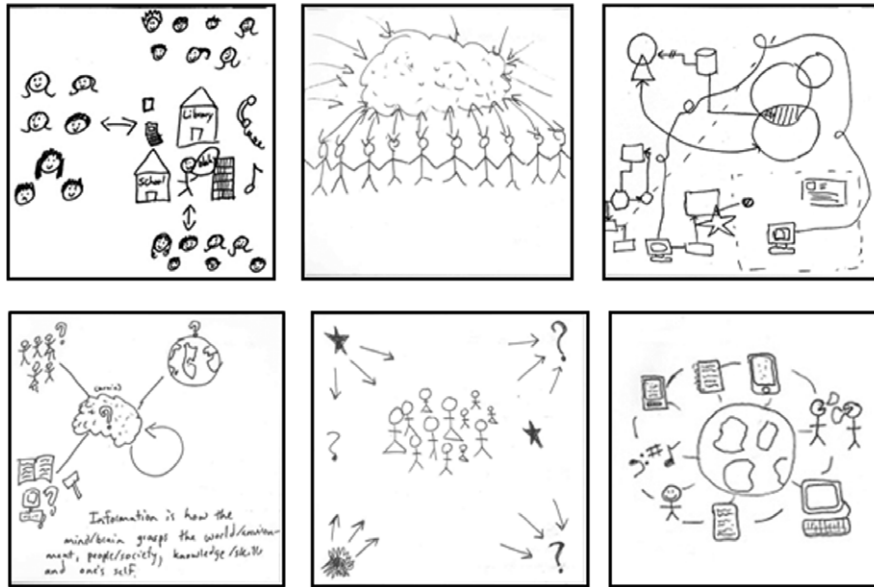FIG. 13.   Examples of link diagrams featuring microsocial, linear chains.

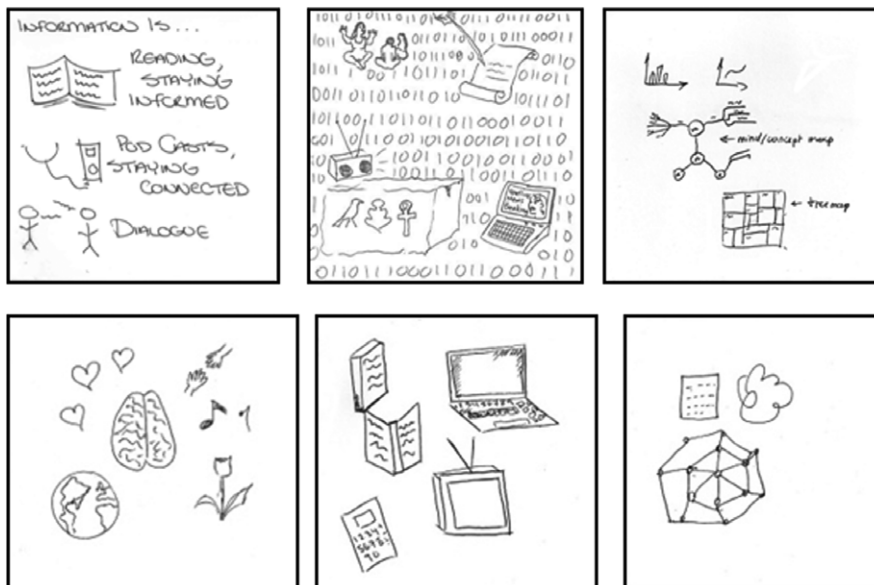FIG. 14.   Examples of link diagrams featuring macrosocial networks.

FIG. 15.   Examples of grouping diagrams.

manuscript, mass media, and personal computing. Figure 14 (top, right) illustrates and names three information structures: a Cartesian plane, a concept map, and a tree map. This set of iSquare echoes the multitype definitions of information (Bates, 2010) or offers a new and plural take on Buckland's (1991) notion of information-as-thing*s*.

Symbol

A symbol is one of the 10 major types of graphic representations (Engelhardt, 2002, p. 142). A symbol is an element of communication intended to represent or stand for a person, object, group, process, or idea (Concise Encyclopedia Online; http://www.merriam-webster.com). With this definition, there are nine symbols in the data set: dot (three times), question mark (twice), brackets, dollar sign, fountain, and globe (Figure 16). The nature of symbols is paramount in semiotics, a well-established methodology for the study of images (Rose, 2007, chapter 5), but a semiotic interpretation of the iSquares will not be developed here. Despite the fact that a dot appears three times and a question mark is drawn twice, this set of iSquares suggests there is no
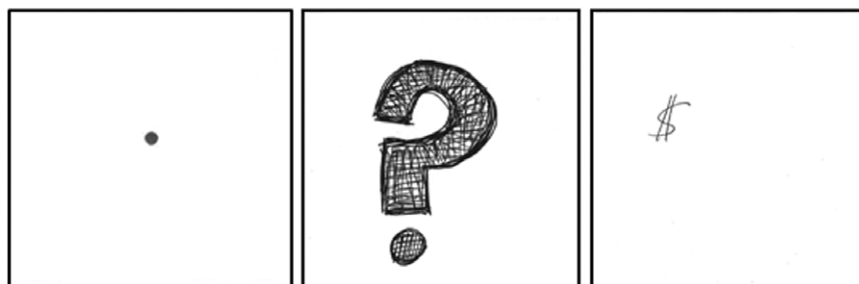
FIG. 16.   Examples of symbols.

TABLE 2.   The transcribed text of the eight iSquares that were written text.

1. oral traditions medicinal herbs rare "goods" no value to community that produce them → value to those who steal it archive it + store it
2. 010010010110111001100110111011100100110110101100001011110110100101101011011110110110
3. . . . endless
4. Info
5. River of . . . ABX#TM photos drawings numbers facts textbooks recordings movies images accumulated senses emotions behaviours → life
6. Information provides missing numbers to complete a 1–10 numbering. 1 3 9 0
7. ? + Answer = Information
8. Deliberately left blank. Subject to interpretation, vagueness, ambiguity

widely held symbol for the concept of information. Surprisingly, within the 137 iSquares is no lowercase "i," a symbol that sometimes points to a tourist information center or a help desk and is a favorite piece of clip art in information science. Students who opted to draw symbols may have been attracted by their ease and economy; a minimum of pen strokes convey powerful (but imprecise) ideas.

Written Text

According to Engelhardt, written text is a special case of graphic representation involving human language that is lined up in the graphic space and ordered though grammar (p. 142). Eight iSquares in our study qualify as written text. Many more than eight instances of text appear across the data set within word bubbles, thought bubbles, and labels (see Figures 15, top, left and right). However, in such cases the text is one element within another type of graphic representation. The iSquares that qualify as graphic representations of written text feature language prominently or exclusively. The iSquares that are written text are transcribed in Table 2 and have different rhetorical strategies: a single word (3 and 4), short phrases (1, 5, 8), a sentence (6), numbers (2, 6), and an equation (7). Throughout, conventions of punctuation, capitalization, and grammar are mostly abandoned. This group of iSquares raises methodological questions: Did some students resist or perhaps misunderstand the drawing assignment? Does this outcome confirm a report that some participants find a drawing exercise to be difficult or unpleasant? As enthusiasts of arts-informed visual research, it is sobering to be reminded that some people may always prefer words to images.

However, in a few instances, the preference for written text does not come across as resistant or uncreative. Students apply graphic design principles to text to achieve a striking effect that we call *word art* (Figure 17). In these cases, the placement of the words within the graphic space and the font are manipulated artfully. Such iSquares raise the possibility of a hybrid conception of information that blends image and text.

Another occurrence related to written text is a marking that we call *scrawl* (Figure 18). Scrawl consists of scribbled lines that give the appearance of text without any meaning attached. This effect is *not* classified as the graphic representation of written text, which by definition entails human language; rather, most of the iSquares with scrawl are counted among the 72 pictures (as pictures of text). These iSquares bring to mind constructionism (Talja, et al., 2005), which focuses on discourses, articulations, and vocabularies. iSquares with scrawl endorse the constructionist idea that conversations (not information) serve as the focus of information science.

Table, Composite Symbol, Statistical Chart, Time Chart, and Map

Not all of Engelhardt's 10 major types of graphic representations occurred in abundance or at all in the data set. For reasons that elude us, only two iSquares were examples of a table, a type of graphic representation with a "simultaneous combination of horizontal separations and vertical
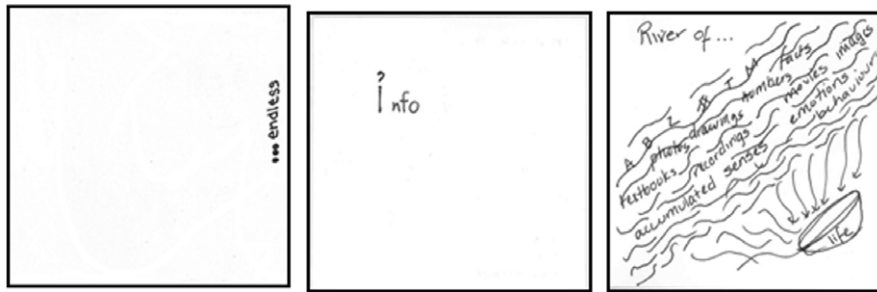
FIG. 17. Examples of written text that were coined "word art."

FIG. 18. Examples of "scrawl" as it appears on a picture (scrawl was not considered written text).

FIG. 19. The three blank iSquares classified as other.

separations" (p. 141). The composite symbol, a more elaborate form of symbol, is apparently not in the visual vernacular of the students. Finally, there were no instances of statistical chart, time chart, or map. These three types of graphic representations require more time, information, and precision to produce and therefore are unlikely outcomes of a 10-minute, spontaneous classroom activity.

Other

Three students participated in the study by answering the written prompts on the back of the iSquare but refrained from drawing, leaving the graphic space on the front of the paper unmarked (Figure 19). These spotless iSquares fall outside Engelhardt's classification and are treated as other. Akin to the graphic representations of written text, these may represent a rejection by some students of the arts-informed, visual approach and the draw-and-write technique. Alternatively, the blank iSquares may qualify as deconstructing information (Bates, 2010, p. 2358) and illustrate information studies without the concept of information (Furner, 2004).

To review, this study generated 137 drawings of information (iSquares) from graduate students at the University of Toronto iSchool. The analysis process, compositional interpretation, focused on the form of the images and their nature as graphic representations. A theoretical framework of graphic representations by Engelhardt was consulted to explicate and classify the drawings. In the iSquares, information appeared most often as pictures of people, artifacts, landscapes, and patterns. There were also many link diagrams, grouping diagrams, symbols, and written text, each with distinct qualities. In short, students rendered information in many ways, although some major types of graphic

representation (table, composite symbol, statistical chart, time chart, or map) were not created given the structure of the classroom activity. An understanding of the dynamics within the graphic space helped in identifying linkages to pre-existing written conceptions of information in the information science literature. Some iSquares illustrate information-as-thing (Buckland, 1991) or the metatheory of constructionism (Talja et al., 2005) for example, and many other associations are possible. Not all drawings had counterparts made of words, suggesting that the arts-informed visual approach and the draw-and-write technique generate new views on information.

Methodological Reflections

Visual Versus Textual Data

True to the duality of the draw-and-write technique, each iSquare captures a drawing of information and a written response to the prompt "Information is . . ." (on its back side). Numerous users of the draw-and-write technique assert that the written portion of the exercise is crucial to understand the meaning of the drawing (Briell et al., 2010). In fact, some research designs consider the visual material to be secondary in importance to the more precise textual data. In a break with convention, we placed the 137 written responses to "Information is . . ." aside and analyzed the image exclusively, for reasons explained next.

Upon completion of data collection, the iSquare drawings struck us as more compelling than the written responses. Foremost, we aspired to showcase this visual data and its special qualities. Compositional interpretation (Rose, 2007), an analytical process centered entirely on images, provided a strategy to do so and superseded our original plan to perform thematic analysis of both drawings and text. The exhibit of Futurist works again serves as a helpful parallel: a meaningful assessment of that exhibition could target the paintings alone and exclude any personal writings by the Futurist artists.

Furthermore, after studying the responses to "Information is . . ." we doubted the claim that the written portion of the data holds explanatory power of an unproblematic nature, a conclusion also reached by Mair and Kieran (2007). In truth, we found the relationship between the front (visual) and back (textual) of the iSquare to be often confounding. Sometimes the writing neatly captioned the drawing. In many other scenarios, though, the writing had no discernible relation to the image or even seemingly contradicted it.

The problematic relationship between the drawings and text on the iSquares brings to mind a famous painting, "The Treachery of Images" by the Belgian surrealist Rene Magritte. In this masterpiece, a picture of a pipe is subtitled "This is not a pipe," a blatant incongruity. Foucault (1973) has argued that the pipe and its legend illustrate the tension between words and images and that one cannot be reduced to the other. There remains an opportunity in the future to study more carefully the relationship between the two

forms of data attached to the iSquares or to analyze the 137 written responses to "Information is . . ." independently.

Choice of Population and Setting

The conclusion of the study is an opportunity to revisit critically the choice of the sample population. We originally believed that graduate students at an iSchool occupied a boundary between scholars of information and the general public, thereby supplying a link to a popular vision of information. However, the data set contained many conceptions of information that were closely aligned with scholarly thinking. Perhaps this population came to graduate school primed in information or had already been indoctrinated into the topic in their early days at the iSchool. If so, the findings summarized here are not invalid but are less mainstream than anticipated.

On the bright side, this research design is a first step toward achieving a more popular conception of information. The draw-and-write technique worked well and can be repeated with other populations. A drawing activity could be staged at a public setting to gain a more heterogeneous convenience sample; shopping malls or art festivals are promising venues. On the other hand, select populations could be targeted individually and assembled into a unified view of the public; high school students or elderly recreation clubs are two examples of accessible slices of society that might participate in the research. Geographic diversity in visions of information could also be explored across countries or world regions. To this end, we invite scholars to replicate the research design outlined here and collaborate with us or with each other.

Discussion: New Directions

At this point the reader may harbor a desire for the 137 iSquares to be distilled or merged into a single summarizing image, or the reader may hope the drawings will finally be converted to a traditional conception of information made of words. These are natural impulses for a familiar scholarly end product. Instead, this project initiates new, visually oriented directions for the theory and conversation about information.

Interactive Thinking Tool

The iSquares altogether are presented as an artful, interactive thinking tool. Not a philosophical–analytic treatise, this alternative deliverable is made of paper and entails a hands-on experience. A material conception of information that must be touched may not appeal to people with strong logical–mathematical intelligence. However, it will be welcomed by a majority with other intelligences.

Communities such as iSchools can follow the instructions in this article to make their own set of iSquares. We believe that 50 drawings are enough to engage information

holistically and are relatively easy, quick, and inexpensive to produce. Then, the thinking tool is used by an individual (or group) in this way: All the iSquares are spread across a table to survey the diversity and breadth of visions of information, and drawings are gathered together to reflect further on themes or dimensions. For example, per this paper, the iSquares can be classified by their style, utilizing Engelhardt's framework or another schema, or images can be collocated based on human, technological, or natural motifs. The deck can also be sorted according to the profile of each illustrator, to examine potentially influential variables such as age or gender of the illustrator. Seeing, touching, moving, and discussing iSquares stimulates the user(s) to experience information as complex and dynamic. Metaphorically speaking, the iSquare thinking tool does not provide enlightenment like a single shining star (akin to prior definitions) but as a constellation of bright points that together establish a phenomenon and its boundaries.

Stories of Information

Alternatively, information can take the form of a story. Many hours with the iSquares helped us to discover visual narratives. One version of many that are possible, shown in Figure 20, spans from microsocial to macrosocial and from imperceptibly small to vast. The tale begins with information as energy and rudimentary patterns beyond our vision. Then, the human being appears in a reduced form, the brain, to make sense of the energy and patterns. Next, a whole person encompasses the brain and is capable of mindfulness and thought, which are at the heart of information. Subsequently, a dyad is the first step toward communication and a social experience of information. It follows that twosomes grow into communities that generate and share information, producing knowledge that is accessed through information systems. At an even larger scale, information is the foundation of culture and it is central to life on earth. Finally, in all its mystery, information is endless. Written definitions do not lend themselves to telling the story of information in the same evocative, accessible, and illustrative way.

Contradictions of Information

In an effort to create definitions, the contradictions within information might have been overlooked. When drawings of information are side-by-side, many striking oppositions become undeniable. Namely, that information can be organized and chaotic at once, as shown when an iSquare of neat dashes counters another that lacks any pattern whatsoever. Other iSquare combinations display information as pleasing and troubling, human and nonhuman, questions and answers, everywhere and nowhere at once, to name only a few juxtapositions. Seeming contradictions in our data set do not undermine its validity, because each drawing still rings true. Conceptions of information based on words do not accommodate such tension and diversity, which are the reality of information today.

Drawing in the Classroom

An arts-informed, visual methodology and the draw-and-write technique can enhance information science education, too (Hartel, 2014). Most academic programs begin with an introduction to the central concept through the literature. In addition to reading seminal papers, undergraduate and graduate students can be asked to respond to the question "What is information?" in the form of a drawing. Outcomes can be analyzed formally or informally by the instructor or by the students themselves.

A more advanced engagement with the arts-informed, visual approach is possible in a doctoral program. For example, in the fall of 2013, at the Faculty of Information, University of Toronto, doctoral students who enrolled in a course on foundations will replicate this study and collect iSquares from a population of their choice. The project will fuel discussions about the nature of information and provide experience in empirical research.

Conclusions

In a short article that appeared in the 50th anniversary special issue of the *Journal of the American Society for Information Science*, Howard D. White (1999) noted the diffuse and obscure quality of information science scholarship. He then voiced a call to action for "scientist–poets" to produce imaginative summaries of our big ideas, thereby synthesizing the sprawling literature and capturing the popular imagination. Surely "information" is our biggest idea and deserving of this treatment first. We agree with White's critique of information science scholarship and believe the research at hand is evidence that "scientist–artists" can join scientist–poets to reach the same positive end.
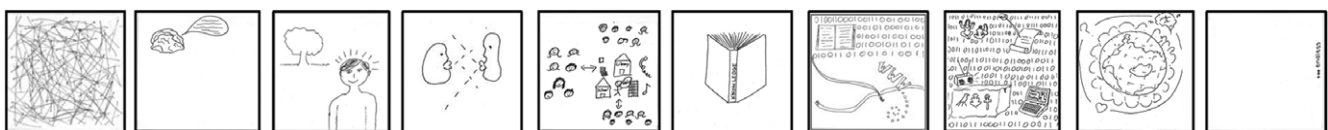

FIG. 20. An array of iSquares that tells a story of information.

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