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48.2 Visible Language



Visible Language

48.2 Design Research Journal

Special Edition:
Finding Our Way Through Environmental Communication



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August 2014

ISSN 0022-2224

Mike Zender Editor

University of Cincinnati, School of Design Publisher

Oscar Fernández Guest Editor

Shelby Murphy Designer

Sheri Cottingim Circulation Manager

Merald Wrolstad Founder

Website

visiblelanguagejournal.com

Postmaster

Send address changes to:

Sheri Cottingim

Office of Business Affairs

College of Design, Architecture, Art, and Planning

University of Cincinnati

PO Box 210016

Cincinnati, OH 45221-0016

sheri.cottingim@uc.edu

Published tri-annually in January, May and October

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Before there was reading there was seeing. Visible Language has been concerned with ideas that help define the unique role and properties of visual communication. A basic premise of the journal has been that created visual form is an autonomous system of expression that must be defined and explored on its own terms. Today more than ever people navigate the world and probe life's meaning through visual language. This journal is devoted to enhancing people's experience through the advancement of research and practice of visual communication.

If you are involved in creating or understanding visual communication in any field, we invite your participation in *Visible Language*. While our scope is broad, our disciplinary application is primarily design. Because sensory experience is foundational in design, research in design is often research in the experience of visual form: how it is made, why it is beautiful, how it functions to help people form meaning. Research from many disciplines sheds light on this experience: neuroscience, cognition, perception, psychology, education, communication, informatics, computer science, library science, linguistics. We welcome articles from these disciplines and more.

Published continuously since 1967, *Visible Language* maintains its policy of having no formal editorial affiliation with any professional organization – this requires the continuing, active cooperation of key investigators and practitioners in all of the disciplines that impinge on the journal's mission as stated above.

cover photography: Patricia Cué

Visible Language journal wishes to thank the following for kindly serving as readers for this special issue on environmental communication.

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Prepayment is required. Make checks payable to University of Cincinnati *Visible Language* in U.S. currency only, foreign bands need a U.S. correspondent bank.

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ISSN 0022-2224

Published continuously since 1967

Index included in last issue of volume year.

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Finding Our Way Through Environmental Communication

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Whether with fingertip, legs, or by vehicle, people navigate dynamic seamless environments. Along the way, volumes of information instantly becomes accessible. Seeking to either play, purchase, learn, socially interact, or wayfind, environmental communication serves all human needs. Whether destinations be physical or virtual, the built environment traversed is increasingly being integrated with immersive and customizing technologies. The human experience is being affected in profound and accelerated ways.

Planning for effective environmental communication has always required holistic thinking, an inclusive design process and empathy for people's spatial narratives. Designing for environmental communication has provided the convergence of several related fields: architecture, landscape architecture, graphic design, industrial design, interaction design, anthropology, and cognitive science. Environmental communication is about building positive human experiences that provide people a sense of place, vital information accessed, comfort in spaces inhabited, and destinations found.

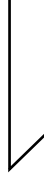
For design curriculum today, how are they adjusting to accommodate and sufficiently prepare students? How shall communication design education develop a necessary knowledge base, new pedagogical methods, more inclusive design process, and elevate human centered priorities? This special issue on environmental communication begins to explore these questions.

Beginning with *Map Design for Complex Architecture*, co-authors, Karen Cheng and Sarah Pérez-Kriz report on the design and testing of a hand-held map helping patients wayfind within a large medical complex. The second article, *The Environment is not in the Head*, Ashley Walton, provides another wayfinding viewpoint. She proposes that static representations of experience (like maps) may fail to capture the interactive idiosyncrasies within specific environments across time and provides an alternative. In *Learning Design by Designing Learning Experiences*, Lisa Fontaine, shares classroom findings where strategic critical thinking skills are developed through the design of interactive museum exhibitions. The last two articles explore the interrelationships between environmental communication and sociocultural elements. With, *On the Wall*, Patricia Cué, analyzes the dynamics that operate behind vernacular design and their capacity of defining the shape and use of public and private spaces. Lastly, *Rebuilding Perceptions*, Andrew Schwanbeck, explores the potential value that environmental communication design can create to help promote and improve perceptions of a neighborhood within a segregated urban landscape.

Hope you enjoy this special issue.

Oscar Fernández





Map Design for Complex Architecture:

A User Study of Maps & Wayfinding

Karen Cheng & Sarah Pérez-Kriz

The following study seeks to determine if a printed, paper map can aid visitors in navigating through complex architectural environments. Specifically, we report on the design and testing of two different paper maps intended to help patients find dental clinics and related offices within a large medical and health sciences center. As part of an iterative design process, we first identified a variety of design factors that influence the cognitive aspects of using maps during wayfinding, and redesigned an existing map of the environment based on those principles. We then conducted user testing to further determine what information should be included or excluded on the map and to see if changes in format enhanced or detracted from communication goals. The results show that maps can indeed assist visitors in finding their way through complex buildings, but that there are limitations to their ability to overcome architectural barriers.



Healthcare facilities are often housed in complex, confusing, and difficult to navigate environments. Their spatial problems typically develop over time when existing units are renovated or relocated, or when new wings are built to contain advanced technology and new areas of practice. Unfortunately, given limitations of both time and budget, most medical centers build where they can, with little consideration of the most logical routes for public circulation. As a result, many healthcare facilities are decentralized and disorganized—adding wayfinding difficulties to the burden of patients who are already anxious, pressed for time, and physically impaired.

Ideally the structure of a building itself should facilitate the movement of its occupants. Numerous studies have examined the architectural factors that can influence spatial legibility. Research has shown that wayfinding is facilitated when: locations are visually differentiated (an area or zone looks different from others); travelers can see views inside or outside the structure, including interior, exterior and global landmarks; the floor plan and spatial configuration are simple and regular; and there are fewer decision points and corridor intersections (Best, 1970; McKean, 1972; Passini, 1980; Weisman, 1981; Bronzaft and Dobrow, 1984; Peponis, Zimring and Choi, 1990).

In addition to the architectural factors inherent in a built structure, directional signs and room numbers have been proven to help people find their way (Weisman, 1981). Researchers have determined that people made fewer wrong turns in settings with signage than in those without (O’Neill, 1991), and the presence of signs significantly reduced perceived crowding, discomfort, anger, and confusion amongst visitors to a correctional center (Wener and Kaminoff, 1983).

However, signage alone has not been able to overcome the navigational problems caused by an illegible building (Arthur and Passini, 1992). Similarly, Carpman, Grant and Simmons (1984) found that in a specific hospital corridor, wayfinding performance decreased as the number of signs increased.

Perhaps when signs are not enough, maps might be able to provide the necessary assistance to travelers. In a 1993 study by Wright, Hull and Lickorish, a paper sketch map was given to participants to supplement an inadequate signage system; this map was found to significantly reduce backtracking in a hospital setting. Additionally, maps have proven to be effective in other ways. Subjects who used a schematic map were able to find the most efficient routes to a destination (Bartram, 1980), and handout maps in museums were able to successfully orientate visitors (Hayward and Brydon-Miller, 1984). Furthermore, people view maps as effective and desirable sources of information when traveling to new destinations (Devlin and Bernstein, 1995).

There is significant evidence that maps are a unique mental aid to navigation. Numerous environmental and spatial cognition studies have examined how maps work in the mind, and it is generally accepted that maps can help people to create or develop a spatial mental model known as a “cognitive map.”

A cognitive map (as originally defined by Tolman, 1948) is an internal, mental representation of an environment. The term should not be taken as a literal metaphor; cognitive maps often contain errors and are more likely to be coarse, not-to-scale representations of general spatial relations rather than precise, map-like constructs that can be mentally examined at will (Tversky, 1993). Nonetheless, there is broad agreement on the three types of spatial knowledge that are the basis of a cognitive map: landmark knowledge, route knowledge, and survey knowledge (Siegel and White, 1975).

Landmark knowledge allows people to determine where they are by using natural or man-made features that are easy to see and recognize (for example, a building, monument, lake, etc.) Route knowledge is the next level of understanding when landmarks can be mentally connected into a sequence (for example, “turn left at the church and go past the cemetery until you see the lake.”) Survey knowledge is the highest form of spatial cognition when a combined understanding of how landmarks and routes are connected enables individuals to infer new paths they have not previously traveled (such as shortcuts and detours). Survey-level knowledge is often described as the ability to envision an environment from a bird’s-eye view—the vantage point of most cartographic maps.

Given the unique characteristics of maps, the following study seeks to determine if a printed, paper map can aid visitors in navigating through a large, complex medical center. From a financial point of view, the design, production, and distribution of a paper-based map represents a significant cost savings when compared to the revision of physical signs or alterations in the built environment.

A paper map can easily be mailed to patients prior to their appointment or downloaded online and printed at home. Travelers can use the map to plan their trip in a relatively calm and unhurried manner, perhaps with the assistance of family or friends who will accompany them. Paper maps are portable, and can be consulted en-route, reducing the need for users to memorize a lengthy sequence of actions. A paper map can even be highlighted and annotated by the patient or healthcare staff to clarify or provide specific directions.

However, although paper maps offer the advantages described above, it may be overly optimistic to assume that a single building map, no matter how well designed, can eliminate the navigation errors that stem from architectural barriers. Maps are a single component of an integrated program

of wayfinding. An effective wayfinding system should take advantage of multiple elements that reinforce one another—including building maps, floor plans, signs, information desks, and in-person volunteer guides/es-corts. Additionally, maps are not equally helpful to all travelers, because map reading is an acquired skill that varies in the population (as summarized by Carlson, Hölscher, Shipley, and Dalton, 2010), and may be declining due to the increased use of GPS devices (Klippel, Hirtle, and Davies, 2010).

THE RESEARCH SETTING

To investigate the potential benefits and limitations of handout maps in assisting visitor navigation in a complex building, we examined two different paper maps intended to help patients find dental clinics and related offices within a large medical and health sciences complex at the University of Washington.

The dental clinics are located within the single largest university building in the United States, the Magnuson Health Sciences Building—a complex with a total floor area of approximately 5,740,000 square feet. The building houses the University of Washington Medical Center, a teaching hospital, and five academic units—the School of Dentistry, School of Medicine, School of Nursing, School of Pharmacy, and School of Public Health.

Due to its large size and complexity, the building is difficult for visitors to navigate. There are more than 20 wings that were built during a period of over 50 years. When additions were made, administrators opted to fully connect all interior hallways, resulting in an irregular, asymmetric configuration—a spatial form known to present wayfinding difficulties.

The building complex is generally divided into two zones—the hospital (the University of Washington Medical Center) and the academic area. Both of these zones are further subdivided into a series of wings. The hospital names their wings with double letters (such as AA, BB, CC, etc.), while the academic units use single letters (A, B, C, etc.). Letter sequences do not necessarily follow alphabetical order—for example, the T-Wing stands for the “Teaching Wing” and the RR-Wing indicates the “Research Wing.” Additionally, some wings are named after compass directions—for example, in the hospital, the NE-Wing is the name of the “North East Wing.”

The building does not have a unified signage program. There are three sets of signs that dental patients must sift through in order to find their way. The first signs seen by most dental patients are for the hospital because the majority of visitors enter the building through the main hospital entrance. The hospital signs are, in general, well designed; they are typographically legible, visually consistent, logically placed, and properly maintained. However, the

hospital signs do not include information about the dental clinics because the dental clinics are not officially part of the hospital but instead are managed by the School of Dentistry, an academic unit.

Therefore, in order to guide dental patients and other academic visitors through the hospital, an additional set of signs with a competing visual identity has been designed and installed. These signs tend to be located in somewhat out-of-the-way positions because more prominent areas are taken up with official hospital signage.

As patients pass through the hospital and move toward the dental clinics, the secondary set of signs disappears, and a third signage system emerges. This last set of signs is part of an older system that is used by all academic units in the building, including the dental clinics and the School of Dentistry. These older signs are less well maintained and their positioning is, at times, questionable. In places the text within the signage system is inconsistent (for example, a covered exterior path is labeled as an “outdoor walkway” on the second floor, but as a “bridge” on the third floor).

The administrators of the School of Dentistry have consistently received complaints from patients who have difficulties navigating to the dental clinics. Therefore, in 2011 the School of Dentistry commissioned our design team to develop a new building map. This new map would replace an existing map (*figure 1*, next page) that they felt was too cluttered and too complex. Additionally, staff members believed that the current map did not adequately help visitors to understand: 1) that the building is organized in a series of wings; 2) that the dental clinics are located in the B-Wing and D-Wing; and 3) that the building is built on a sloped site, with the entry floor on Level 3.

Research studies from several fields (including environmental and spatial psychology, cognitive psychology, human geography, architecture and urban planning) provide some guidance for how to best construct a map that facilitates wayfinding. The following considerations governed our initial choices for both the form and content for new dental clinic map addressing the concerns identified above (*figure 2*, next page).

Figure 1: Original Map (double-sided 8.5" x 11")

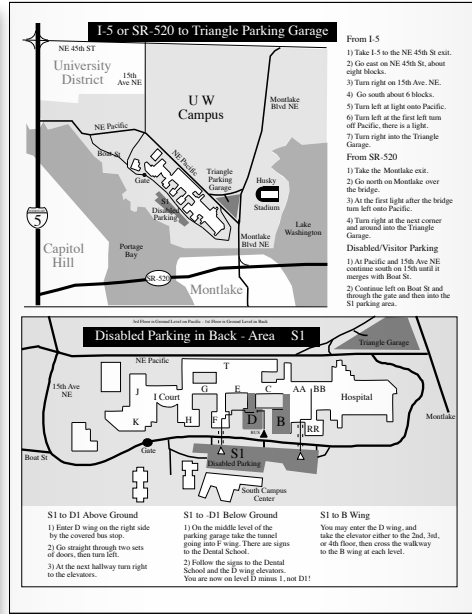
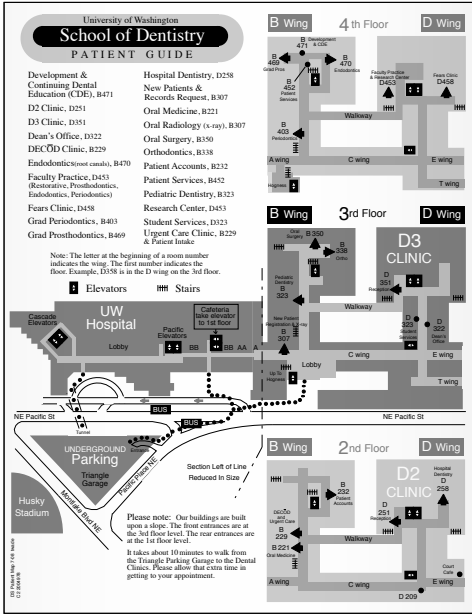
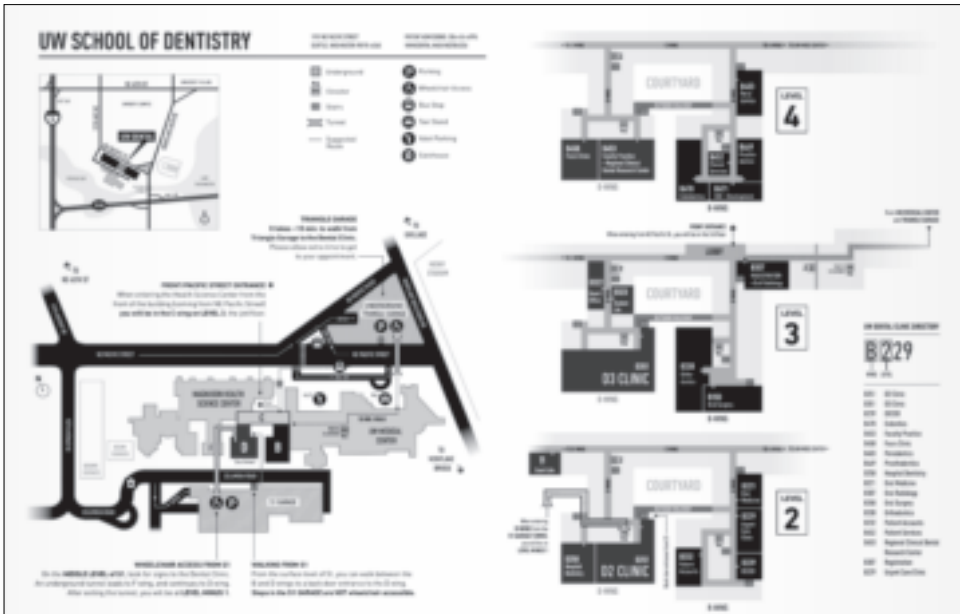


Figure 2: First Revision Map (single-sided 11" x 17")





1 Reducing Visual Clutter

Typographers and legibility researchers generally agree that “white space” aids in the readability of documents. Surrounding certain elements with negative space helps to establish a visual hierarchy of information where the reader’s eye is directed to specific information in a logical sequence. White space can be also be used to lessen the density of large blocks of text, which makes long passages less intimidating to readers and easier to scan.

In order to recover white space from the original map, we replaced text with symbols wherever possible because icons generally take up less space than their corresponding words.

We selected the symbols designed by the AIGA (American Institute of Graphic Arts) for the US Department of Transportation in 1974–79, a system widely used both nationally and internationally and likely to be familiar to dental patients.

2 Reducing Information Density

To simplify a map, designers must consider how much information to include. The concepts of “route knowledge” and “survey knowledge” described earlier can be used to define the poles of an information continuum. A minimalist approach involves designing a “route map,” which shows only the relevant landmarks and the path segments that connect them. A maximalist approach favors the design of a “survey map,” which provides a broad overview of an environment by depicting all information in a selected area.

The main advantage of a route map is the direct focus on the path to be taken. Each decision point on the route can be shown clearly, with turn-by-turn instructions. Because route maps are simplified in form and content, providing only the smallest possible set of information that is needed for people to find their way, they require relatively low cognitive effort—they are easy to understand and use.

However, route maps have a significant disadvantage. If a person using a route map deviates from the path by mistake, there is no information to help them re-orientate and get back on the route because this style of map does not show the surrounding environment. Therefore, once the travelers are off the route, they are lost.

The alternative to a route map is a survey map, which does show an entire environment in detail. The broader scope of a survey map makes it more efficient than route map because the same survey map can show multiple routes (a single survey map can direct many individuals who come from different origins to different endpoints).

Figure 1 (left top)
The original map for patients of the University of Washington Dental Clinics. The map measures 8.5”x11”, and is offset printed in two colors on both sides. Administrators felt that the original map was too cluttered and too complex, and that the map did not adequately help visitors to understand: 1) that the building is organized in a series of wings; 2) that the dental clinics are located in the B-Wing and D-Wing; and 3) that the building is built on a sloped site, with the entry floor on Level 3.

Figure 2 (left bottom)
Initial redesign of the dental clinic map. The map is 11”x17”, and is offset printed in two colors on one-side. We increased white space on the map by replacing text with symbols, and by reducing overall information density. We also attempted to clarify the wing system by introducing a simplified building diagram with color-coding (offices in the D-Wing are shown in blue, while those in the B-Wing are in black).



In principle, survey maps should enable a better understanding of a place than route maps; a viewer builds survey knowledge by seeing routes in the context of their larger surroundings. However, researchers believe there are limits to how much graphic information can be absorbed from a map. Once a critical point of visual density has been reached, comprehension may decline (Dobson, 1980). This is the main disadvantage of survey maps—extracting, understanding and keeping track of a route within a dense and visually cluttered map can be cognitively demanding (Phillips, 1979; Rosenholtz, Li, and Nakano, 2007).

In the design of the new dental clinic map, our goal was to compromise and create a hybrid “schematic map” that would blend the two map archetypes described above. Schematic maps are simplified versions of survey maps that may distort certain spatial characteristics in order to emphasize and clarify specific aspects of a route and its environment. In this case, we hoped to focus attention on a central route that begins at the patient parking garage and continues through the hospital toward the dental registration office (typically the first destination for new patients). Several additional destinations would need to be shown on the map (such as specific clinics, patient services, etc.), but these would be subordinate in importance.

3 ___ Communicating the Wing System

To facilitate the understanding of building’s wing system and to clarify the location of the dental clinics, we created a simplified building diagram that highlighted the position of the B and D-wings. Because the map is offset printed in two colors, we were able to color-code these spaces (offices in the B-wing were shown in black, while those in the D-wing were shown in blue).

We wanted viewers to progress from this simplified diagram to a more detailed floor plan that showed the locations of all dental facilities on three floors. By first showing the simplified diagram, we hoped for a controlled, progressive disclosure of information that would avoid overwhelming the navigator. This strategy follows the broader psychological phenomenon of “chunking,” where limits on the human capacity for processing information are extended by grouping similar items together in a “chunk” (Miller, 1956). The technique also makes sense given that people have been shown to mentally divide maps for “conquering”—by partitioning a map into sections, learners create manageable “chunks” that can be further examined individually for more information (Thorndyke and Stasz, 1980).

To encourage users to view the simple and detailed diagrams in a linear sequence, we placed them side-by-side. This composition required revising the original, double-sided 8.5x11” format to a single-sided tabloid sheet (11x17”). We were concerned that patients would find this tabloid map awkward to hold; we tried to alleviate this issue by folding the map in half

to letter size, and positioning elements around the fold. We anticipated that this larger format could be printed at home on letter size paper by using “shrink to fit.”

To further clarify the wing system, we also created a small diagram that explained the room numbering scheme used in the building. We hoped that this diagram would be easier to scan and understand than the explanatory text caption currently used on the original map.

4__ Communicating Floor Levels

Because the building is constructed on a sloped site, visitors entering from the front-facing street arrive on Level 3. At the back of building, street level entrances are on Level 2.

On the original map, the text label identifying the 3rd Floor is relatively small and easily overlooked. On the new map, we enlarged all floor labels and emphasized them via enclosure in a ruled box.

DESIGN DECISIONS REQUIRING USER TESTING

In any design project, there are questions that can only be answered through empirical evaluation. In this case, we hoped to resolve the following issues in map content by observing individuals using a map to perform wayfinding tasks in the actual environment.

1__ Entry Points

It would be helpful to know which entrances to include and/or emphasize on the new map. There are three main entrances that could be used by visitors: a hospital entrance, an academic entrance, and an intermediate wing entrance. Staff members suspect that the hospital entrance is the most popular, and that the intermediate wing entrance is not used by visitors. However, the administration had no data to confirm this assumption.

2__ Landmarks

In a five-year study of three American cities, urban planner Kevin Lynch found that people understand their environment through five elements: paths, edges, nodes, districts, and landmarks (Lynch, 1960). All of these elements are typically visualized on maps, but the last element, landmarks, is particularly important when navigating with maps.

A number of studies (as summarized by Davies and Peebles, 2007) suggest that people prefer to use a landmark strategy when using a map. Specifically, to orient themselves, travelers look for conspicuous landmarks in the environment that can be matched to visual representations on the map. In fact, this procedure is recommended by several instructional guides on “how

to use a map” such as the *Boy Scout Handbook* (2009). Therefore, to design a successful map, one must include the landmarks that people are likely to notice.

Certain features of our particular setting provide obvious and effective landmarks, but unfortunately, this building (and many other health care settings) consists mainly of long, featureless corridors. In such an environment, empirical evaluation may help to determine what objects or structures travelers use as landmarks.

3 ___ Off-Route Information

It is not clear how much information should be included on the new map to help travelers who make wrong turns at decision points. Extensive context might be necessary to help them re-orientate and recover from mistakes—but adding excess detail may complicate and clutter the map.

Researchers, cartographers and design practitioners (Arnheim, 1976; Southworth and Southworth, 1982; Tufte, 1983; Arthur and Passini, 1992) generally suggest that maps should be as simple as possible to avoid cognitive overload. However, this advice fails to address the specifics of content inclusion in this particular context.

TEST PROCEDURE

To better understand how paper maps are used during wayfinding in a complex building and to answer specific questions regarding content inclusion on a patient map, our team recruited 24 paid adult volunteers who were unfamiliar with the building and its surrounding area. Participants were met by a researcher at a campus café and escorted to the pedestrian tunnel in the main parking garage of the medical center. Here participants were asked to wear a head-mounted camera that would record video from their lines of sight.

Using a head-mounted camera to capture user behavior was a novel aspect of this study. The camera tracked participants’ gazes and visual focuses as they navigated through the environment, allowing the research team to analyze how and when participants consulted the map and environmental signage during their wayfinding experiences. Additionally, the head-mounted camera allowed the participants to navigate through the environment independently, without having to be accompanied or followed by an observer.

After helping the participants put on the camera, the researcher gave the participants a dental clinic map. Twelve participants received the original map, and twelve participants received the revised map.

Each participant was then asked to independently proceed from the parking tunnel to the Dental Registration Office (B-307). At the entrance to the Dental Registration Office, the participant was greeted by a second member of the research team. This second researcher then asked the participant to walk to the D-2 Dental Clinic. The researcher provided verbal directions that were considered typical from a script that was written by the Director of the Dental Patient Registration Office .

After participants reached the D-2 Dental Clinic, the researcher escorted them to a nearby waiting area, and asked them to complete a questionnaire that: 1) rated their familiarity with the building and area prior to the experiment; 2) rated their overall sense of being lost during the experiment; 3) estimated their overall sense of direction (based on the Santa Barbara Sense of Direction Scale, as developed by Hegarty, Richardson, Motello, Lovelace, and Subbiah, 2002), 4) rated the map that they received; and 5) provided demographic information.

After completing the questionnaire, participants were asked to look at their map again and draw the two routes that they had traveled on the map (from the parking garage to the Dental Registration Office and from the Dental Registration Office to the D-2 Dental Clinic). Participants were also asked if there was anything that they would change about the map and if they had any suggestions for improving the map.

The recorded video from each participant was analyzed and coded to determine the frequency and length of time that each participant looked at either the map or a sign. Gazes had to last at least two seconds in order to be coded. Timestamps on the video were used to calculate the duration of each gaze. The total travel time for each route was also calculated from the video timestamps, as well as the duration of errors and stops.

PARTICIPANT DEMOGRAPHICS

Twelve participants received the original map, and twelve participants received the revised map. The age range of those who received the original map was 21–54, with a mean age of 28; this group contained four men and eight women. The age range of those who received the revised map was 18–59, with a mean age of 30; this group contained two men and ten women.

On a scale of 1-7 (with higher scores indicating a better sense of direction), those who received the original map had a mean score of 5.0; those who received the revised map had a mean score of 4.2. Neither group was familiar with the building or area prior to the experiment. The group that received the original map had a mean score of 1.0 (on a scale of 1-7, with 1 being “Not Familiar” and 7 being “Very Familiar”). The group with the revised map had a

mean score of 1.5 for familiarity. Statistical testing revealed no significant differences between the two groups in terms of age, gender, sense of direction, or building familiarity.

RESULTS



All participants were able to reach the two target destinations (the Dental Registration Office and the D-2 Clinic). However, 22 of the 24 participants experienced navigation difficulties during the course of the experiment, stemming from omissions of content in the map, architectural barriers, illogical site organization, and inadequate signage, as described below.

No significant differences were found between the two groups of map users. Specifically, there was no statistical difference between participants who used the original or revised map in terms of their overall time to the destinations, the number or length of wayfinding errors, the number or length of pauses en-route, or overall satisfaction ratings of the map. Given these results, our discussion will focus on the general wayfinding behaviors observed in the study and the issues of content inclusion, with map type noted where relevant.

1 __ Building Entrances

As described earlier, there are three main entrances to the building complex: an entrance to the hospital, an entrance to the academic area, and an intermediate entrance between the other two, which leads to the BB-Wing (*figures 3A and 3B*).

The hospital entrance is the most popular; 16 out of 24 participants (67%) used this entrance. The remaining eight participants were equally divided between the academic entrance and the intermediate BB-Wing entrance (each of these entrances were used by four participants, or 17% of the test group). These eight participants were all individuals who had chosen to exit the parking garage and continue on foot via the surface street. They later explained that they wished to avoid navigating inside the building complex; they thought it would be easier to avoid getting lost if they followed a street that runs parallel to the medical complex.

Unfortunately, on the new map we had removed the label to the intermediate BB-wing entrance because staff members believed that it was rarely used by visitors. As shown by the behavioral data, this assumption was not true. Although stakeholder input and opinions can serve as a valuable source of information, assumptions can sometimes be false. The wayfinding results underscore the importance of using a combination of user opinions and behavioral studies to determine how a space is actually used.

Figure 3A
The intermediate BB-Wing entrance.



Figure 3B
The first crosswalk by the main parking garage leads into the entrance to the BB-Wing. The academic entrance is not visible from this crosswalk.



All of the walking participants who had the original map used the BB-Wing entrance—possibly because this entrance is located directly opposite the main crosswalk near the parking garage. Participants did not continue towards the third academic entrance—perhaps because this entrance is set back from the street, and the building sign is not clearly visible from the crosswalk.

However, three out of four of the walking participants with new map did use the academic entrance. The remaining participant used the BB-Wing entrance. However, because the BB-Wing entrance was not shown on her map, she was confused and deliberated for ~1 minute before entry.

Similarly, of the three participants with the new map who used the academic entrance, there was one individual who first navigated to the BB-Wing entrance. This participant traversed the area for ~4 minutes due to uncertainty regarding her location. She eventually backtracked to the original crosswalk area and traveled to the academic entrance.

Clearly, in future iterations of the map, we need to include the BB-Wing entrance. This entrance also seems likely to be popular with patients who arrive by bus, or use the valet parking service since the entrance is closest to the bus stop and valet station.

2 Environmental Assumptions

Most people assume that when entering a building, they are arriving on the first floor, or Level 1. However, as described earlier, because this complex is built on a sloped site, participants entering from the street level arrive on Level 3 (at front of the building) or Level 2 (at the back of building). Level 1 is the lowest (basement) level on the hospital side of the complex. On the academic side, there are two additional lower levels, and these floors are designated as Levels “-1” and “-2.”

Shortly after entering the building, four participants tried to take an elevator to Level 3. Two additional participants tried to use stairwells. Therefore, 25% of all participants (six out of 24) were not aware of the floor numbering system, despite floor number labeling on the maps. The six test participants who made these errors were evenly divided between those who had the original map, and those who had the revised map.

Three of the participants did not seem particularly stressed by their floor level error, perhaps because the time lost was relatively minimal (26 seconds spent climbing stairs and 7-35 seconds spent waiting for an elevator, entering the elevator, pushing a floor button, then exiting the elevator after realizing the mistake). The fourth participant seemed more irritated, possibly because she had spent longer (~2 minutes) repeatedly traversing stairs between Levels 1–3. Of course, such incidents may be more upsetting to actual patients, who are often pressed for time, anxious about upcoming procedures, and/or experiencing physical discomfort, as opposed to paid volunteer study participants.

For similar buildings constructed on a grade, Arthur and Passini have recommended the terms “Level 1” for the ground level, and “1 Below” and “2 Below” for basement levels (Arthur and Passini, 1992). A different solution was verified by a research study conducted at the University of Michigan General Hospital (Carpman, Reizenstein, Grant, and Simmons, 1983), where five floor-numbering options were tested with patients and visitors. In this study, the terms “Sub 1” and “Sub 2” were interpreted correctly most often.

To improve wayfinding, these or other naming options could be evaluated for this building. At minimum, perhaps the term “Minus” should be spelled out, because the negative sign is relatively small and easily missed.

It is possible that floor level information can be made more prominent on future design iterations of the map. However, this information may continue to be overlooked because people have strong pre-existing assumptions about floor levels based on their previous experiences in other buildings.



Figure 4A

To reach the dental clinics, patients must walk through an enclosed area that contains a set of elevators. From the main hallway, the enclosure appears to be a dead end.

3 Architectural Barriers

There are several areas in the building where the architecture is in conflict with the desired wayfinding behavior. For example, when entering from the main hospital entrance, visitors need to walk through a small enclosure in order to continue towards the dental clinics. This enclosure contains a set of elevators (the Pacific Elevators). However, from the main route, the enclosure appears to be a dead end—the opening to the subsequent hallway is not visible from the outside (*figures 4A and 4B*).

Six participants (25% of all participants passing through this area) stopped or paused at this decision point and consulted their map. Two participants had the original map, and four participants had the revised map. Of the six participants who hesitated, five participants eventually proceeded through the enclosure (after 3-27 seconds of deliberation).

The remaining participant also paused at the decision point but made a wrong turn that continued into the maternity area of the hospital. In the maternity ward, the participant searched her map (neither map shows the maternity department) and decided to backtrack to the original position outside of the elevator enclosure. Back at the decision point, she again deliberated before correctly passing through. The participant spent approximately three minutes on this error loop.

In a similar fashion, outdoor walkways (*figure 5*) were also problematic for seven out of ten participants. The short hallway that leads to the walkway is small and easily overlooked, as evidenced by the six participants who missed the turning point and had to backtrack. In addition to those who missed the turn, there were two participants who reached the walkway door but did not go through. One participant turned away from the door immediately; the other participant looked through a small window set in the door before turning away. Several staff members later explained that



Figure 4B
Once inside the enclosed area, travelers can see the subsequent hallway that was not visible from the main hallway.

visitors often perceive these walkway doors to be locked or alarmed exits. This seems to be a common misapprehension, as several of these metal walkway doors have ad-hoc, occupant-created signs that state: “This door is NOT alarmed” and “This door does NOT lock behind you.” Of the seven participants with walkway door issues, three had the original map, and four had the new map.

The problems described above occur because the architecture discourages users from the correct wayfinding behavior. It is also possible for the built environment to encourage an incorrect navigational response. For example, the main academic entrance opens into a lobby and waiting area with a highly visible staircase (*figure 6*) that leads to a single location—an auditorium used for special events. One test participant attempted to use this staircase to reach other areas of the building, despite passing a posted sign that states “To auditorium only.”

In future iterations of the map, we need to include the location of the maternity ward, as it is a destination that is commonly reached by users. It also seems that neither map adequately shows the way through these architectural barriers (the elevator enclosure, the walkway doors and the auditorium stairs). We may be able to better explain the architectural elements by annotating the map with adjacent text. However, each annotation adds clutter and visual noise to what is already a complex layout.

4 Preference for Straight Routes

Participants who used the intermediate entrance—the entrance that leads to the BB-Wing—made a fairly consistent error. Instead of turning right towards the A-Wing and the first wayfinding target, the Dental Registration Office, three of the four participants (75%) continued traveling straight down into the RR-Wing (*figure 7*, next page).

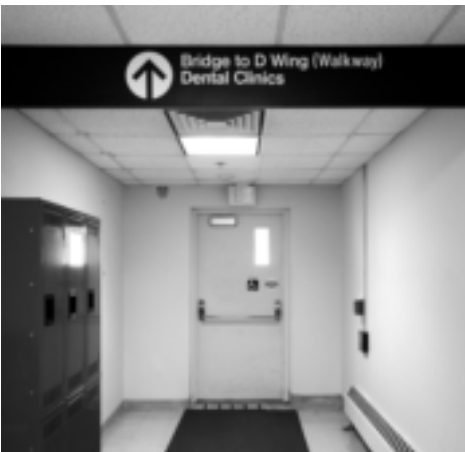
In the RR-Wing, these three participants searched their map (All three participants had the original map, which did not show the RR-Wing). There they deliberated for some time before backtracking to the original BB-Wing entrance and deciding to move down the correct path. This error loop consumed 33 seconds to ~2 minutes.

Interestingly, none of the other participants who reached this same decision point made the same error. When using the hospital entrance, participants must pass by the BB-Wing entrance on their way to the Dental Registration Office. Of the 16 participants who used the hospital entrance, none made a wrong left turn down to the RR-Wing.

A similar preference for straight routes was observed during the second wayfinding task, when participants were asked to navigate from the Dental Registration Office to the D-2 Clinic. Participants were directed by the research associate to make an immediate left into the B-Wing. (Signage also instructs visitors to travel down the B-Wing to reach the D-2 Clinic). However, half of the 20 participants who had been traveling straight (from the Hospital and BB-Wing entrances) ignored these directions and proceeded straight ahead into the C-Wing. Of the ten participants who moved straight into the C-Wing, six had the original map, and four had the revised map.

Figure 5 *bottom left*
Visitors often perceive the doors to the walkways to be locked or alarmed exits.

Figure 6 *bottom right*
The main academic entrance opens into a lobby and waiting area with a highly visible staircase. This staircase leads to a single location—an auditorium used for special events.



Based on this analysis, the map should be modified to include the RR-Wing since this is a common error destination. It is less clear how the map could be revised to prevent travelers from continuing straight and missing turns. It may be necessary to instead alter signage or the environment to make entrances to A-Wing and B-Wing more prominent.

Figure 7
Three participants (75%) who used the intermediate BB-Wing entrance continued straight down into the RR Wing. These travelers missed the secondary set of signs to the dental clinics posted by the elevators.



5 Room Numbering

For the four participants who used the academic entrance, a preference for straight routes should have neatly aligned with the initial wayfinding task. The first target destination (the Dental Patient Registration Office) is located in the B-Wing, and the entrance to the B-Wing is straight-ahead and visible from the academic entrance.

However, there is an addressing problem with the Dental Patient Registration Office, which is situated at the corner of A-Wing and B-Wing. The office has two doors; the address that patients are directed to (B-307, in the B-Wing) is permanently locked and no longer in use, and instead, the second door in the A-Wing serves as the main office entrance. The administrators have not provided the A-Wing door with a room number, although there are overhead text signs that point to this second door location.

Unsurprisingly, this addressing issue caused problems for two of the four participants who used the academic entrance. Upon entry, these two participants, both with the new map, proceeded straight down into the B-Wing. There, they spent 1-3 minutes traversing the wing (and trying the locked door to B-307) before deciding to backtrack to the entrance. After scanning the lobby area a second time, they discovered the signs that point to the office door in the A-Wing.

The location of B-307 was not an issue for participants who used the hospital and intermediate BB-Wing entrances, because these participants pass through the A-Wing on their way to the B-Wing. The office door in the A-Wing is visually prominent; if participants are passing through, they are unlikely to miss the office (*figure 8*).

Figure 8
The main office door to B-307 is visually prominent. However, the door is located in the A-Wing rather than the B-Wing.



It is not clear how the map could be altered to prevent the confusion caused by the existing naming scheme. Instead, we recommend that all room numbers be made consistent with their actual location.

6 Wing Names

Three participants (one with the original map, and two with new map) spent time backtracking in the BB-Wing, because they failed to distinguish between the B-Wing and the BB-Wing. This appears to be a common problem because the door to BB-306 is posted with occupant-created signs that direct dental patients to B-307. These unofficial signs are clear evidence of wayfinding failure.

We are unable to envision how the map could be altered to avoid confusion between wing names with the same letters (i.e., A-Wing/AA-Wing, B-Wing/BB-Wing, etc.). Instead, it may be desirable to give wings more distinctive and memorable names. Designer Paul Mijksenaar has discussed the similar problem of coding floors in car parks; he admires a system that exists at Disneyland, where floors are named after Disney characters, such as Pluto, Mickey Mouse, etc. The floor names are further reinforced in the environment by the use of character illustrations as wall graphics (Kinross, 1993).

7 ___Route/Wing Selection

During the second half of the test, while navigating from the Patient Registration Office to the D-2 Clinic, five participants (21%) selected the wrong wing at a decision point—a wing that led away from their desired destination. These errors all occurred on Level 2, after the participant had walked down one set of stairs from Level 3 (the entry floor).

Specifically, at the intersection of the C-Wing, D-Wing, and E-Wing, three participants continued straight ahead to the E-Wing (instead of turning left to the D-Wing). As described earlier, this error may be the result of a preference for straight routes. Two of these participants had the original map, and one had the revised map.

The other two errors are more difficult to explain. One participant made a wrong turn after going down the B2 stairwell, where it is possible to go left (correct) or right (a dead end). The other participant made an incorrect right turn at the intersection of the C-Wing, B-Wing, and A-Wing—and traveled back towards the hospital, rather than to the D-2 Dental Clinic.

Before making these errors, neither participant looked at their maps for a substantive length of time (both participants had the original map). The first participant looked at the map for seven seconds as he began the second route, then glanced at the map for two seconds while descending the stairs. The second participant is remarkable for not looking at the map at all during the entire experiment (he relied completely on signage).

There are several possible explanations for these wrong turns. Participants may have become disorientated after traveling down one level—research studies have shown that level changes can negatively impact navigation (Hölscher, Meilinger, Vrachliotis, Brösamle, and Knauff, 2006). Alternatively, it is possible that their route choice could be the result of a preference for right-hand turns—a number of studies have found a rightward turning bias in pedestrian behavior (as described by Bitgood and Dukes, 2006). In either case, it is not clear how the map could be modified to prevent these errors.

8 ___Map Orientation & Alignment

Two of the participants with the revised map made a wrong turn upon entry to the hospital (both of these participants missed the secondary set of signs to the dental clinic). Instead of turning right towards the dental clinics, they turned left and traveled deeper into the hospital area. One participant corrected his route after reaching the hospital elevators. The other participant traversed several hospital areas (including the hospital elevators, the hospital information desk and the hospital pharmacy) before self-correcting. These error locations were noted for inclusion in future map iterations (none of these hospital facilities were shown on the new map being tested).

The initial wrong turn of these two participants could be the result of the map alignment errors. The original map had a “forward-up” orientation from the parking garage. Dental staff felt this orientation was incorrect, since this configuration places South at the top of the map, counter to the “North-Up” convention that is standard in most modern-day maps. Therefore, administrators requested that the revised map be “North-Up” even though several studies of fixed “You-Are-Here” (YAH) maps (Levine, 1982, and Levine, Marchon, and Hanley, 1984) have shown that people make significantly fewer errors when their map is aligned to be “forward-up”—when the map directly corresponds to the traveler (i.e., left and right on the map are also left and right for the traveler).

Of course, unlike a fixed wall-mounted YAH map, a hand-held map can be freely rotated in any direction. The only indication of the “correct” orientation is the positioning of text labels. It is not certain if aligning the main route and text labels in a forward-up orientation on a hand-held map will necessarily facilitate better wayfinding, especially considering the violation of the classic North-up convention in this particular circumstance. However, both participants were observed examining their maps prior to making the wrong turn, and neither had rotated the map to match their forward movement. Also, this wrong turn error did not occur for any of the original map participants, who had the forward-up orientation.

Perhaps one solution to a possible orientation problem is to install wall mounted YAH maps at key decision points, such as the hospital entrance. While there are a few wall-mounted YAH maps in the wings where the dental clinics are located, these YAH maps only indicate position, not alignment. Additionally, these YAH maps vary widely in style and content. It would be desirable for all building maps and hand-held maps to be part of a unified system, so that patients can more easily relate the map that they receive and study in advance of their appointment to maps that identify their position and orientation in the actual environment.

9 ___ Map Size

One of the twelve participants who received the new map failed to notice that the map was folded, and could be extended to a tabloid (11x17”) format. Therefore, the participant navigated during the test using only the basic building overview—she did not view or use the area that shows the B-Wing and D-Wing in greater detail with specific dental clinics and offices.

There are a few possible explanations for this occurrence. People may not normally receive tabloid size documents, so it may not be immediately obvious to unfold the map. It is also possible that the participant focused on the first side of the map immediately after receiving it because it allowed her to see her initial starting point. Researchers have hypothesized that

travelers mentally divide their route into sub-segments that are bounded by landmarks or areas of relative familiarity (Tverksy, 1992). The first segment of the test route begins at the parking garage, so travelers may have wished to keep this known anchor point in view as they navigated toward an unknown destination. The parking garage was not shown on the second side of the map, so that side may have seemed irrelevant.

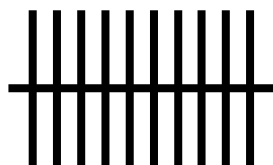
Given this analysis, it seems best to include the parking garage on the detailed side of the map. It may also be advantageous to reformat the map to fit on a single letter-size document.

10 __ Misunderstood/Missing Information

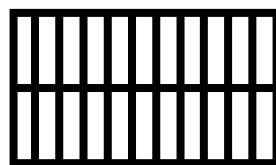
During the final stage of the test procedure, participants offered their suggestions for improving the map. These suggestions largely concerned areas that participants felt should be easier to anticipate and understand. Specifically, two participants asked if building entrances could be clarified and emphasized (see #1, Building Entrances). Three participants asked if the enclosure containing the elevators could be clarified (see #3, Architectural Barriers). One participant suggested that the sign to the Dental Patient Registration Office, B-307, be shown more prominently (see #5, Room Numbering). One participant asked if the difference between the B-Wing and BB-Wing could be shown more clearly (see #6, Wing Names).

In addition, participants suggested that certain elements be added to the map—these were either error locations (such as the RR-Wing, as described above in #4, Preference for Straight Routes), or landmarks (such as the escalators/stairs from the parking garage to the hospital entrance, the hospital information desk, and interim rooms.) This last suggestion came from participants who used room numbers to orientate themselves on the map. However, because of confusion with wing names (i.e., B-Wing vs. BB-Wing), door numbers were not always effective landmarks for participants.

On the original map, four participants commented that they did not understand the symbol used for stairs. This issue appears to be resolved on the revised map, where we used an enclosed form rather than the original “fishbone” icon (there were no participant comments regarding the new stair symbol).



Original 'fishbone' icon for stairs



Revised enclosed stairs icon

The goal of this study was to determine if a printed, paper map could aid visitors in navigating through a large, complex medical center. Given that all study participants were able to arrive at both target destinations by using a map, this artifact does appear to be of benefit to users. However, because almost all participants (22 out of 24) experienced wayfinding errors, there is clearly room for improvement.

Certainly, in this particular building there are a number of issues in spatial organization that make wayfinding with a map difficult. These factors are significant negatives for visitors to overcome when navigating in an unfamiliar environment. Clearly, the plan of this building needs to be re-examined. Potential solutions could involve operational changes (such as directing people to the most efficient building entrance or renaming specific wings), alterations to the built structure, and/or the adoption of new technologies for visitor communication and guidance.

Most importantly, what is needed is a wayfinding program that systematically integrates multiple wayfinding elements (floor plans, signs, verbal/written directions, information/help desks, and maps) into a coherent and consistently applied design program. Such an endeavor will require substantial, long-term effort, and significant dedication of financial resources. In the interim, a printed, paper map can function as an inexpensive supplementary measure while support is gathered for a larger initiative.

A secondary goal of this study was to determine how to best design a paper map for a specific context. The research described above reveals the complexity of maps as information design problems. Even though maps are commonplace objects, and their purpose is well understood, determining the ideal form and content of an effective map is not trivial.

As part of an iterative design process, we began by identifying a variety of design factors that influence the cognitive aspects of understanding and using maps during wayfinding. For some cases, it was obvious how research findings could be applied to our design problem; in others, the research was descriptive rather than prescriptive, and empirical testing was required to determine what information should be included or excluded on the map and if changes in format enhanced or detracted from communication goals. Playback and analysis of participant videos did allow our team to identify specific information that was missing and should be included on future iterations of the map, including key landmarks and the locations of common route errors. Following this effort, we plan to revise the map accordingly, and conduct additional user testing. In this way, the combination of the design principles, client/stakeholder input, and behavioral results works to inform a continuous cycle of design development and refinement.

AUTHORS' BIOS

Karen Cheng is Professor of Visual Communication Design at the University of Washington, where she teaches information design and data visualization. Karen received her Master's degree from the University of Cincinnati College of Design, Art, Architecture and Planning; she also holds an Honors Bachelor's degree in Chemical Engineering from Penn State University. Prior to joining the faculty at the University of Washington in 1997, she worked in Brand Management at the Procter and Gamble Company. Her book, *Designing Type*, was published by Yale University Press in Spring 2006, and has been translated into French, German, Spanish, Korean and Chinese.
kcheng@uw.edu

Sarah Pérez-Kriz is Associate Director of Institutional Assessment at George Mason University, where she manages academic program review and oversees the assessment of the university's learning spaces. Before joining the Office of Institutional Assessment, Sarah served as the Founding Director of the Office of Undergraduate Research at the University of San Diego. She also spent several years as a faculty member in the Department of Human Centered Design + Engineering at the University of Washington, where she taught courses in human-computer interaction, visual communication, and research methods. Sarah earned her PhD in cognitive psychology from the University of California, Santa Barbara in 2006.

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Authors' Acknowledgements

Special thanks to Tanya Test and Ronald Viernes, two students of the Visual Communication Design program at the University of Washington, for their work on the design of the new dental clinic map. Also, many thanks for the four students who worked with us to recruit study participants and conduct the user tests: Brennen Birch, Joy Palludan, Caryn Carlson Rothe, and Calder Thami. We are grateful for the useful suggestions of Linda Norlen, Affiliate Assistant Professor at the University of Washington, as well as the three anonymous reviewers. We would also like to thank the Wyckoff Milliman Endowed Chair in Art from the School of Art at the University of Washington, for their financial support of payments to test subjects.

Overview:

Visual theorist and design historian Johanna Drucker, in *SpecLab: Digital Aesthetics and Projects in Speculative Computing*, defines the digital humanities as “the study of ways of thinking differently about how we know what we know and how the interpretative task of the humanist is redefined in these changed conditions”¹. Design and the digital humanities connect through critical making practices, centering on human experience and advancing the prevailing expectations of their respective disciplines.

At the convergence of conceptual and material practices², the ongoing development of a framework for critical making offers a means to understand complex relationships between research, scholarship and production. In design, emphasis is placed on innovative notions of what criticism or authorship can be within the context of design-making; in the digital humanities, focus is on innovative notions of what “making” can be as a form of interpretation within the context of conventional scholarly dissemination. The intersection of these two areas presents opportunities to bring form and content together in ways that are practical and theoretical, rhetorical and physical.

Critical making in design is aligned with practices that facilitate innovation and exploration related to technology, materiality and communities. In graphic design — a discipline, a medium, a practice and a tool³ — “critical practice” has been used to describe a range of activities that position the designer as author, producer, scholar, curator or programmer⁴. These endeavors, whether individual or collaborative, may involve humanistic or scientific inquiry, and move beyond the traditional structure of client-based relationships. From a pedagogical perspective, key components of critical making include “hands-on practice, the processing of enhanced seeing and perception, and contextualized understanding”⁵.

In the digital humanities, critical making distinguishes its practices from traditional forms of humanities scholarship. With an emphasis on tool building, information visualization and digital archiving, the digital humanities merge two seemingly opposing modes of scholarship: reading and making. Critical

making dichotomies of thinking/making, knowing/doing and cognition/embodiment permeate current digital humanities discourse⁶ and projects demonstrate a desired interest in building through existing design and development processes. *The Critical Making Zine*⁷ uses physical production to publish and distribute a series of essays on technology, society and DIY culture. *Speaking in Code*, an NEH-funded symposium hosted at the Scholar’s Lab in 2013, addressed questions related to “DH code-craft”: tacit knowledge as it relates to the design and development of digital humanities projects⁸.

Perspectives:

This special issue of Visible Language investigates critical making at the intersection of design and the digital humanities, which is a site for expanding the role(s) of divergent scholarly and creative work. We invite submissions that address one or more of the following questions:

- What are the theoretical or pragmatic ways to frame critical making in design and/or the digital humanities? Where are the similarities, differences and challenges? How are these advantageous?
- In what ways might design authors and producers connect with the digital humanities? Where or how are digital humanists’ experiences of critical making intersecting with designers? How do these crossover ‘ways of seeing’ impact our scholarly and creative work — and future hybrid practices?
- How might forms of understanding such as speculative design, prototyping or hacking play a role in critical making, and in what ways are these influencing the scope of work in both areas?
- In what ways might design and the digital humanities collaboration be fostered in the studio or classroom? What are some examples of pedagogical approaches to teaching critical making?
- What are the forms these arguments might take as part of this special issue?

Visible Language is a journal that invites evidence-based research. For this issue, we encourage exploratory, creative works that incorporate evidence-based research through critical commentary, traditional analysis, audience responses or participant feedback.

REFERENCES

- ¹ Johanna Drucker. *SpecLab: Digital Aesthetics and Projects in Speculative Computing* (Chicago: University of Chicago Press, 2009), xii.
- ² Mark Ratto, “Critical Making” in *Open Design Now: Why Design Cannot Remain Exclusive*, Bas van Abel et al. (The Netherlands: BIS Publishers, 2011), 202.

Proposal due: January 15, 2015

Abstract acceptance/rejection: March 15, 2015

Full papers / works due: June 15, 2015

Review period: June 15 – August 1, 2015

Review feedback: August 1, 2015

Final paper submission: September 15, 2015

Anticipated publication: October 2015

Submissions:

In keeping with the theme of merging form and content, the traditional printed journal will be expanded to include a corresponding online space for interactive and digital work. We invite dialogue on what defines scholarly works in regard to non-traditional forms of writing and disciplinary crossovers. Submissions may include, but are not limited to, case studies, interactive reading experiences, aural and visual works.

Proposals should include a 300-word written abstract and a brief outline to show the structure of your argument. A corresponding visual abstract is strongly encouraged. For digital work, please include a URL or screenshots. Final articles can range from approximately 3–5,000 words.

Please send proposals through January 15, 2015 to Jessica Barness, jbarness@kent.edu

Open Peer-Review Process:

Submissions will be reviewed through an open peer-review process. An open peer-review process makes available the submission author's name to the peer-reviewer. Reviewer names and reviews will be published on the Visible Language journal website. Proposals will undergo review; a selection will be shortlisted for development into full-length papers / works and these will also be peer-reviewed prior to publication.

Interested in serving as a peer-reviewer?

Peer-reviewers will be responsible for providing feedback about abstracts and/or final submissions between January – August 2015. If you are interested in serving as a peer-reviewer, please get in touch.

Guest Editors:

Jessica Barness is an Assistant Professor in the School of Visual Communication Design at Kent State University, where she teaches graphic and interaction design. She holds an MFA in Design from the University of Minnesota with a minor in Writing Studies, and an MA and a BA in Art from the University of Northern Iowa. Barness' research through design investigates theories in social issues, language and interactive technologies. Her work has been exhibited at venues such as Hebei Normal Museum, China and FILE Electronic Language Festival, Brazil, and published in *Communication & Place* and *Currents in Electronic Literacy*. She has also presented research at the International Committee for Design History and Design Studies Conference (2014), SEGDA Academic Summit (2014), AIGA Design Educators Conference (2013) and HASTAC (2013), among others.

Amy Papaelias is an Assistant Professor in the Graphic Design program at SUNY New Paltz, teaching courses in web and interaction design, as well as 2D design and visual communication. She holds an MFA in Intermedia Design from SUNY New Paltz and a BA in Cultural Studies from McGill University. Her creative research lies at the intersection of design, culture and technology with specific interests in interactive typography and the digital humanities. She has presented her design work and pedagogy at *Theorizing the Web 2014*, *AIGA Design Educators Conference* (2007, 2013), *TypeCon* (2005, 2007, 2012), *UCDA Education Summit* (2011) among others. In 2013, she was selected to participate in *One Week One Tool*, an NEH-funded Institute for Advanced Topics in the Digital Humanities, hosted at the Center for History and New Media at George Mason University and co-authored a long paper on the experience that was presented at *Digital Humanities 2014*.

³ Andrew Blauvelt, "Graphic Design: Discipline, Medium, Practice, Tool, or Other" (paper presented at counter/point: The 2013 D-Crit Conference, School of Visual Arts, New York, NY, May 11, 2013).

⁴ Albinson, Ian and Rob Giampietro. *Graphic Design: Now in Production* (Minneapolis: Walker Art Center, 2011).

⁵ Rosanne Somerson. "The Art of Critical Making: An Introduction" in *The Art of Critical Making: Rhode Island School of Design on Creative Practice*, ed. Somerson, R. and Hermano, M. (Wiley, 2013), 19.

⁶ "Critical Making in the Digital Humanities: an MLA 2014 Special Session Proposal" by Roger T. Whitson, accessed on March 3, 2014. <http://www.rogerwhitson.net/?p=2026>

⁷ *Critical Making Zine* by Garnet Hertz, accessed on March 3, 2014, <http://www.conceptlab.com/criticalmaking/>

⁸ *Speaking in Code*, accessed on June 9, 2014. <http://codespeak.scholarslab.org/>

*Design for Information:
An Introduction to the Histories,
Theories, & Best Practices Behind
Effective Information Visualizations*

Isabel Meirelles

Beverly, MA: Rockport Publishers, 2013.

For a complementary perspective of this book, please refer to the review written by Aaron Marcus in the *Information Design Journal* 20(3), 296–297

The book is a thorough representation of both the field of information visualization and the research interests of the author, whose focus is on “the theoretical and experimental examination of the fundamentals underlying how information is structured, represented and communicated in different media.”

Beginning by the “big picture,” the book includes an amazing collection of examples, the most thorough I have seen to date in a volume. The author organizes the content according to several categories represented by the titles of the chapters: 1) Hierarchical structures: trees; 2) Relational structures: networks; 3) Temporal structures: timelines and flows; 4) Spatial structures: maps; 5) Spatio-temporal structures; and 6) Textual structures. An appendix, notes, bibliography, contributors list, and index, complete the apparatus of the book.

Design for information is an extensive taxonomy of data visualization types, and is “a must” for anybody interested in the work done in the area. Each one of the hundreds of examples is explained and discussed, forming a kind of encyclopedia on the subject. It seems that nothing escaped from the thorough gathering of examples that Meirelles got involved in. The discussions and explanations normally focus on what information is represented and how it is represented.

It is interesting to see as well how many different professional fields use today diagrams to organize and represent information: basic science, applied science,

education, engineering, medicine, technologies, etc. The value of the book is centered on the inclusion of examples of how many different problems are today being confronted by data visualizations, how many historical efforts preceded whatsoever is done today, and how the advent of the computers have allowed the field to explode, handling large data sets as well as dynamic representations.

At the end of the examination of the 224-page volume one becomes curious as to how might these diagrams have performed with the users they were intended for in terms of ease of comprehension; what conclusions could one arrive at from an evaluation of the examples included regarding perceptual and cognitive human factors; or how could a complementary book contribute to the development of best practices. I would not expect that one volume could be so extensive as this one and also cover the field critically. One, however, has to wonder how the super-complex visualizations permitted by computer programs today would perform regarding comprehension, memorization, and use of the information presented. The discussion on perception and cognition is very brief, and it might leave some readers wondering about the assertions made: they are proposed as principles without them being discussed. This topic, as well as Gestalt theory, are not considered during the description of examples. The size of some reproductions is too small to assess their quality as data visualizations, they appear as samples of problems dealt with but not as information in themselves. To compensate for this, the book includes valuable URLs for people interested in seeing in better detail many of the diagrams shown.

While the above could be perceived as a weakness, the strength of the book is its truly amazing array of examples and the rare historical diagrams it offers. It also displays an uncommon erudition, and includes an extensive and useful bibliography. One does not know how long Meirelles took to complete the manuscript, but it feels like a life-time project. These assets, coupled by an excellent production, make it an indispensable publication for whoever can be interested in information visualization.



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Editorial correspondence should be addressed to:

Mike Zender
Editor, *Visible Language*
College of Design, Architecture, Art, and Planning
School of Design
University of Cincinnati
PO Box 210016
Cincinnati, OH 45221-0016
Email: mike.zender@uc.edu

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