VISIBLE LANGUAGE

THE JOURNAL OF VISUAL COMMUNICATION RESEARCH

47.1

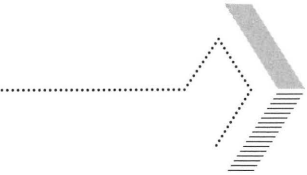
47.1

ABOUT THE EDITORS

Mike Zender is Professor of Design and Director of the Graduate Program in Design at the University of Cincinnati. Mike received his MFA (terminal degree) from Yale University where he was the Carl Purrington Rollins Fellow. In 2004 he was a Medical Informatics Fellow at the Marine Biology Laboratory, Woods Hole, MA, and in 2009 was named a National Fellow of the AIGA (American Institute of Graphic Arts) for his contributions to design and design education.

Professor Zender has presented internationally and published regularly with two books and numerous journal articles. In 2013 he was named editor of Visible Language.

Sharon Helmer Poggenpohl has taught in notable design programs: The Hong Kong Polytechnic University, the Institute of Design at the Illinois Institute of Technology in Chicago, and the Rhode Island School of Design. Her focus over a long career has been post-graduate design education, both master and Ph.D., as well as design research. Taking a human-centered position with regard to design, she teaches to help students humanize technology, to learn to work creatively and collaboratively with each other, and to prepare them to contribute to building a body of design knowledge. For twenty-six years, she edited and published the international scholarly journal Visible Language. She co-edited with Keiichi Sato Design Integrations, Research and Collaboration (Intellect Books, 2009). Currently, she is working on a book tentatively titled Design Theory-to-go, while teaching occasionally in Hong Kong.



01 Visible Language in Transition

SHARON POGGENPOHL AND PAUL MICHAEL ZENDER

ABSTRACT

Visible Language evolves into its third generation with a new editor (Mike Zender) and a new institutional support (University of Cincinnati). Transitions across the two completed generations and plans and expectations for the third are explored. Forty-six years of continuous publication are celebrated.

It is singularly appropriate for a design journal to experience transition. Donald Schön (1983) defined design as a profession that stimulates transition: from existing to preferred states. How could a journal supporting design transformation not itself change as it seeks to facilitate the growth of knowledge in a change-oriented profession?

Visible Language has been published continuously for forty-six years—this is a small miracle in scholarly publishing, particularly when the scholarship deals with design of communications. The first editor and founder, Merald Wrolstad, provided twenty years of guidance, bringing the journal through a name change, from *Journal of Typographic Research* to *Visible Language*, with a focus on reading and writing, the processing of visible language (reading) and its construction (written language, calligraphy, type design, typography, diagrams, etc.).

The second editor provided twenty-six years of guidance and brought the journal into the digital age; broadening its mission to include digital communications with their more fluid, relational presentations, structural concerns regarding interface and interaction, an interest in communication in terms of contemporary issues like bilingualism, cultural difference, globalization, teaching and learning design, and research in all its formal and informal modes.

During this time, the Rhode Island School of Design provided a physical home for the journal, while the Institute of Design at the Illinois Institute of Technology provided early and continuous web access for the journal and its participants on their servers. The support of both these institutions was deeply valued. The Advisory Board, who reviewed articles, offered advice and occasionally guest edited issues, were the substantial backbone of the journal. Many people as authors, designers, consultants, reviewers and critics supported the idea that design could and should support dissemination of information that went beyond what a trade magazine supplied. In terms of the second editor, this was about building a discipline through research and various forms of scholarship; it sought to bridge the gap between science and art. It was inclusive regarding international participants, recognizing that research in design is a vital part of many cultures. A cursory count over the past ten years of authors' national identities demonstrated that American and foreign authors were almost evenly divided.

Some of the special issues that show the range of journal interest and gave the second editor special pleasure were:

36.2 AN ANNOTATED DESIGN RESEARCH BIBLIOGRAPHY: BY AND FOR THE DESIGN COMMUNITY
This was a resource in which many designers and educators contributed books with a brief commentary on their importance. That the issue sold out is a testament to its contribution and the design community's interest. Five PhD students were the guest editors.

36.3 & 37.1 RESEARCH IN COMMUNICATION DESIGN
Doctoral investigations often languish without reaching either education or practitioner cultures. In these two issues, research accomplishments were featured.

37.3 INSTRUCTION AND PROVOCATION, OR RELEARNING FROM LAS VEGAS.
Guest edited by Michael Golec and Aron Vinegar, the famous Venturi book *Learning from Las Vegas* received another look demonstrating that it still resonates within the design community.

38.1 CULTURAL DIMENSIONS OF COMMUNICATION DESIGN
This issue paired the most dissimilar articles, the Mixtec screenfolds from the distant past and from the present a visual analysis of user interface using Gert Hofstede's cultural model on international web advertising for major international corporations.

41.3 VISUAL METAPHORS IN USER SUPPORT
Guest edited by Karel van der Waarde and Piet Westendorp, the role of metaphors in communication, particularly as they guide user performance through abstraction or similarity was the focus. Some of the topics were, for example, the passage of time, a healthful diet or textual movement.

43.2/3 & 44.1 COMMUNICATION DESIGN FAILURES
Guest edited by Sharon Poggenpohl and Dietmar R. Winkler, various kinds of failure were featured in the belief that a critical examination of design performance and aesthetics is necessary to the advancement of the profession and should be part of critical learning. The failures under examination were diverse: the control room at Three Mile Island, temporary signage and prescription medicine information.

One design scholar called *Visible Language* "quirky." The journal has broadly drawn its mission, and the individuals who participate lend their academic and cultural flavor. "Visible language" permeates our lives, yet is so pervasive and taken for granted that we miss its significance until it fails to serve us. Imagine a day without visible language—no street signs, no computer screen information, no printed packaging or instructions, no books (whether physical or digital), no temperature gauge, no maps…

Western thought is full of polarities that disengage and fragment the continuum of thinking; we classify and set categories against each other. John Dewey (1958), the preeminent pragmatist philosopher, in his theory of inquiry, recommends abandoning dualisms of mind and matter, objective and subjective or general and specific as they exist on a continuum and depend on the context of inquiry. In this regard, designers sometimes think of themselves as generalists or specialists. The generalist works from theories and principles, applying them to a broad array of communication need or opportunity. In contrast, the specialist immerses him or herself in the history, tradition and constructive possibilities of making, for example, a typeface. Both are valuable approaches, and probably few designers exist at the ends of this continuum.

At a time when crossover between disciplines is increasingly desired and significant projects addressing human needs can be tackled only through collaboration, we need to reach across boundaries and entertain new information from other sources.

Visible Language has sought to bridge such gaps by presenting scholarship of narrow and broad focus, addressing the special, historical focus of typography and addressing analytical examination of various kinds of practice. Articles have presented empirical research, scholarly investigation in a more humanistic tradition, ideas in early development and those that are accomplished. While some of the articles have dealt with a specialist interest, others or the context of the journal's entire corpus have been general. Knowledge flows in both directions and given the changing nature of expectations and practice; this is appropriate. *Visible Language* continues to be curious about how processes including people's habits and desires are changing regarding communication.

Visible Language is entering a new phase in its life, with a new editor, Paul Michael Zender, and a new institutional support, the University of Cincinnati. Mike, as he prefers to be called, along with many years

of teaching and practicing design, brings a strong interest in advancing design through research. He has written papers on his collaborative research that focuses on making medical information more accessible for medical researchers and practitioners. Two of these papers were presented in this journal (Zender, 2006, 2007). The first article came at the start of what has become a years-long research program in symbol design. Describing a research study funded by Procter and Gamble to communicate product attributes without words, it quickly became apparent that the study of icons, pictograms and symbols had importance well beyond any commercial function and was strategic for understanding visible language. Mike's subsequent articles have explored various aspects of symbol design and issues of design research. A new paper is included in this volume.

The University of Cincinnati, with its long history of cooperative education that joins academic learning to professional exposure and experience in the world, provides a platform in which research may transfer into practice and application; weaving together what have typically remained separate endeavors. Experiential learning in general, and co-op in particular, harnesses the idea that we form important kinds of disciplinary knowledge through the dynamic interaction of research, theory and practice. In medicine this has been called from bench to bed, referring to the flow of ideas from the laboratory bench to the hospital room and indeed into the patient's bedroom, then back into the lab. In design education a co-op system follows a similar path: from research and theoretical exploration in the academy, students go out to put theory into practice in design firms and organizations, then return to school with knowledge from the field. This cooperative educational model parallels the design process itself where concepts (theories for how to solve a problem) are prototyped (put into practice), tested (evaluative research) and deployed (put into practice). Coexistent with the co-op system, the University of Cincinnati is a large research one institution with over $400 million in annual research funding and is also a complete academic enterprise with an academic medical center. This thriving home of research and practice now houses *Visible Language*.

As the journal changes editor and location it transitions to sharper focus on research in visual communication. True to it's name, *Visible Language* will continue to explore all things typographic and literate, while also true to its name

it will seek to stimulate and report research in all forms of visual communication: perception, symbols, 3-D objects, user experiences, contexts and interactive systems.

The original Visible Language *was about writing and reading. The evolved* Visible Language *will be about seeing, experiencing and gaining meaning from it.*

Specifically, *Visible Language* will be about publishing research and stimulating discourse to create knowledge of how designers make what people see, which informs what people know and do.

We trust *Visible Language* will continue to be quirky and broadly inclusive. It will welcome research from all design disciplines and points of view. But it will also seek to advance the quality and quantity of design research, from defining how design research is and is not like research in other fields, to identifying best research methods and apt standards of rigor.

This journal has been around for nearly 50 years. A transition is a good time to ask 'why.' Why is *Visible Language* around? Because it is self-evident that we are all surrounded by, immersed in visible language. Because the majority of our cerebral cortex processes visual information. Because designers who use visible language every day have so little explicit knowledge to guide their work. Because it is tremendously fun to learn and grow in community with colleagues who stimulate and challenge us through respectful discourse. With the explosion of technology putting visual language in the palm of our hands, *Visible Language* is more important today than 47 years ago when Merald Wrolstad founded it. Welcome to the next 46 years of *Visible Language*!

REFERENCES

Dewey John. 1958. *Experience and Nature*. New York, NY: Dover Publications.

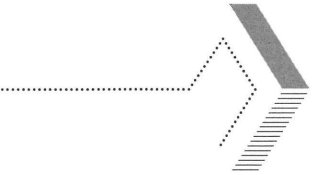
Schön, Donald A. 1983. *The Reflective Practitioner.* New York, NY: Basic Books.

Zender, Mike. 2006. *Advancing Icon Design for Global Nonverbal Communication: or What does the word 'bow' mean?* Visible Language 40.2, 177-206.

Zender, Mike and Keith A. Crutcher. 2007. Visual Language for the Expression of Scientific Concepts. *Visible Language* 41.1, 23-49.

ABOUT THE AUTHOR

Sharon Helmer Poggenpohl has taught in notable design programs: The Hong Kong Polytechnic University, the Institute of Design at the Illinois Institute of Technology in Chicago, and the Rhode Island School of Design. Her focus over a long career has been post-graduate design education, both master and Ph.D., as well as design research. Taking a human-centered position with regard to design, she teaches to help students humanize technology, to learn to work creatively and collaboratively with each other, and to prepare them to contribute to building a body of design knowledge. For twenty-six years, she edited and published the international scholarly journal Visible Language. She co-edited with Keiichi Sato Design Integrations, Research and Collaboration (Intellect Books, 2009). Currently, she is working on a book tentatively titled Design Theory-to-go, while teaching occasionally in Hong Kong.



02 Reflections on Teaching Research: A Conversation with Meredith Davis, Mary Dyson, Judith Gregory

SHARON POGGENPOHL

ABSTRACT

As research in design is gaining traction in university programs, understanding approaches to teaching research skills, the value of a research approach in design and even fundamentally reflecting on what research is becomes germane. Like varieties of design practice, there are many varieties of research process and methods to address different research questions, and certainly different programs have different goals for their students at various levels of education. Three faculty teaching in university design programs with years of experience guiding research projects, reflect on their experience, offering different perspectives on this emerging topic.

AS design is growing into a more knowledge oriented enterprise and designers are collaborating on larger, more socially far-reaching projects, the issue of using existing research and developing original research becomes a significant issue in design programs. Some universities are insisting that design take a place in knowledge development along side other disciplines that have a long research history. This puts pressure on faculty without an appreciation of research, much less the skills, to participate in a new initiative.

Unfortunately, research carries for some a stigma of inconsequence relative to design, or is seen as a puffery and intellectual inflation of academic origin. Varieties of research, their creative potential and usefulness in practice are often dismissed within both academic and professional contexts. Further, despite numerous sources offering practical knowledge about how to support creativity (Adams, 1986; Gordon, 1961; Holyoak and Thagard, 1995; Koestler, 1964; among others), some believe that the mystery of creativity must be maintained and think it is undermined by the logic of research. Given the typical humanities background of many design students and teachers, creative science is unheard of and unknown. Added to this is the design focus on making and doing as opposed to deeper questioning and critical thinking. Under pressure from university administrations with regard to research production, there has been a dilution of the meaning of research to include projects of little substance that yield little if any knowledge. The combination of these factors makes for considerable resistance to research. Yet, among the university design programs that integrate research into undergraduate through doctoral programs, research is developing and its knowledge product is increasingly apparent in international conferences and a few design journals.

The National Association of Schools of Art and Design (NASAD), the accrediting body in the United States for these programs, is in the process of adopting new guidelines for assessing these programs. Research is prominently mentioned in the new guidelines and separate standards for graduate professional and PhD programs are present, differentiating their teaching/learning goals. The American Institute of Graphic Arts (AIGA), the largest professional organization for design in the States has already adopted these standards.

As this initiative becomes more widespread, the need for reflection on teaching research across the curriculum becomes apparent. It is in the spirit of such reflection that the following conversation on teaching research in the context of design is offered. Participants in the conversation were selected based on their experience and commitment to teaching research and their dissimilar backgrounds. Meredith Davis has a background in design, Mary Dyson has

a background in psychology, and Judith Gregory, a background in informatics. All have years of experience doing and teaching research. Like many other design skills, the experience of doing deepens and amplifies the ability to teach this skill. There is no one unified way to approach research or teaching. Like design itself, with multiple forms of practice, the following reflections are based on differences in experience and goals.

Before the conversation begins, introductions to the participants are in order.

MARY DYSON
teaches research skills for essays, dissertations and theses in the Department of Typography & Graphic Communication at the University of Reading, UK. She has taught there for nearly thirty years and began supervising PhDs early on. She introduced classes to prepare undergraduates for researching and writing dissertations around twelve or thirteen years ago. This has spread to Masters students (MA Typeface Design, MA Information Design, MA Book Design, MA (Res) Typography & Graphic Communication). She also teaches the design of empirical studies through an undergraduate and masters project.

MEREDITH DAVIS
has primary teaching responsibility for graduate students in the Master of Graphic Design program and the interdisciplinary PhD in Design program at North Carolina State University. Although she has developed undergraduate curricula that develop student attitudes toward research, her focus has been teaching master's students since 1978 and doctoral students since 1999.

JUDITH GREGORY
has in one way or another been addressing different communities of practice and learning, primarily within graduate programs at the University of California/Irvine, the Institute of Design at the Illinois Institute of Technology, the Institute for Informatics at the University of Oslo, among others. She has been teaching research methods for fourteen years and her expression of qualitative research methods includes theoretical and philosophical contexts along with methodologies and methods.

SHARON: *Do you have a general model of research you refer to when teaching about research?*

MARY: I don't think so, which means I don't use an explicit model. A structure is provided to students for how to develop their dissertation proposal. I also get students to read and analyze past dissertations (under- and taught post-graduate) that have received good marks to identify their positive characteristics. Through these sessions, we discuss things like the way topics have been researched, how the dissertation is structured, nature of sources, etc. What this session reveals is that we do not have one model for a dissertation in our department. I guess I am addressing what we mean by research.

One approach that we encourage is the analysis or evaluation of original material, which may be collected by the student, found in an archive or collection, or created for the purpose of testing in an empirical investigation. This applies at undergraduate as well as postgraduate level and can apply to theoretical or historical topics.

MEREDITH: Master's and doctoral students have different reasons for learning about research. Our master's students are enrolled in a professional degree program with a studio focus and most won't continue as doctoral students. Their interests are largely those of professional practice in which the intent of research is to inform design decisions in a specific context. They aren't terribly concerned about certain kinds of details, such as sample size, or the generalization of results to the level of theory. Instead, they want to make informed judgments about the direction of their practice and to deliver well-reasoned solutions to practical problems.

Doctoral students, on the other hand, are interested in the development of theory that is relevant to a variety of contexts and an array of readers, some of whom have no background in design. There are broad categories of content that I talk about with these students. Don Norman has mentioned some of these categories, but I've added to his taxonomy with points I think he overlooks:

> *How designers think addresses research relevant to current concerns for innovation in ways that are deeper than managerial strategies. In particular, we've been interested in what design thinking can bring to teaching and learning any content.*
>
> *What people want and need is important to any user-centered design practice.*

What the context demands addresses those issues that benefit more than the individual and that define modulations in the culture at large. Sustainability, for example, is more than something an individual wants or needs.

How design is planned, produced, and distributed includes the processes through which designers take action. Historically, there has been a lot of attention on production but less on distribution, which rises in importance in a digital world.

What effects design action has on people and settings examines the consequences of change for people and the surrounding social, cultural, technological, physical and economic environment. This includes the study of design history as well.

The research methods we use to study these issues are also a focus. The methods used by many design researchers have been borrowed whole cloth from other disciplines with little regard for how the people and settings for design may require new strategies.

We teach a course in research paradigms that exposes doctoral students to various philosophical and epistemological approaches to research. This work leads to the development of a conceptual framework, which we ask students to diagram and to support with appropriate literature. As an interdisciplinary design program, there are a number of paradigms represented by student research projects and faculty who supervise doctoral work. There is work that takes a positivist approach (daylighting and priming studies, for example), but also projects that are more phenomenological.

We don't try to narrow the range of positions, but students must be able to locate their positions within the larger landscape of ideas and be accountable to the standards of evidence within that position. We don't promote a single model of research.

JUDITH: My approach to teaching research methods in design education shares the principles that Meredith has outlined so well. I teach and have taught from more than one model of research in the sense that I've taught research in different disciplines: design, informatics, public health. I have theoretical and philosophical backgrounds in cultural-historical activity theory, actor-network theory and science and technology studies. The continuity between these

lies in common commitments and respect for phenomenology, ethnomethodology and appreciation of practices, experiences and discourses in situ and how they change and transform over time.

In teaching at master's and doctoral level, I emphasize the individual's (or team's) design research strategy in relation to the object of inquiry: thoughtful consideration of the problem and opportunity space (problematization); the coherence of the research methodology (creative multiple methods but not eclectic); clarity of one's research language (and fluency with some other research languages); and clarity of the line of argument. Figure 1 is a general look at the process.

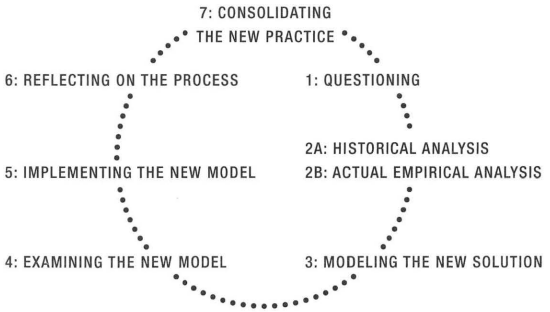


FIGURE 1 *Sequence of epistemic actions in an expansive learning cycle Adapted from Yrjo Engestrom*

SHARON: *If you were to scaffold the teaching of research across undergraduate through PhD experience, what learning goals would be present in each degree level?*

MEREDITH: At the undergraduate level, I think we need to do more in teaching students to frame design problems. Too much of what students do is predetermined by the faculty's definition of the project and its deliverables. In writing project briefs, faculty often strip problems of their internal conflict and overly focus all students on doing the same thing. And there is a lot of emphasis on designing formats (posters, websites, exhibitions), not on designing the interactions among people, activities, and settings. It is these latter concerns that require research. When students are given a "territory" and asked to systematically generate questions within that territory, they develop predispositions for research. And we can hold them accountable for learning about users and their contexts in our judgments about their work.

Master's programs, in general, are too much like undergraduate programs. They refine skills and fill in gaps rather than produce professionals with distinctly different competencies than those of undergraduates. It is evident in the discourse of professional magazines that most employers don't understand what designers with master's degrees bring to the workplace. I think master's students need to learn research methods that are matched to professional practice and to think about design in terms of its intersections with larger systems. If master's programs were about preparing practitioners who bring the influence of design to places where it previously had none, students would add value to professional offices. At the same time, the research perspectives that underpin such activity are preparatory for doctoral study.

Evidence-based doctoral programs are about building a research segment of practice in the field and constructing theory that drives practice. To accomplish that, we hold students accountable for the following:

> *Skills include the ability to:*
> *1) review and summarize seminal literature; 2) write proposals that clearly articulate researchable questions; 3) develop and employ methods for influencing and measuring the impact of design solutions in responding to human needs; and 4) organize and present research findings in ways that are useful to designers, policymakers, community groups, and others whose work is enhanced by an understanding of design issues.*
>
> *Critical perspectives ask that students form and articulate critical perspectives about specific research paradigms and methods.*
>
> *Knowledge building addresses the production of knowledge that supports the decision-making processes and practices of designers, policymakers, community groups, and audiences/users of design, as well as the theoretical knowledge that contributes to the broader understanding of the discipline.*
>
> *Dissemination asks students to subject their research to peer review and to develop skills in sharing research broadly.*

MARY: This is putting me on the spot, but I have referred to our module descriptions for taught programs as these formalize the assessable learning outcomes.

At UG level:

- *locate and assemble information on their subject*
- *review the literature of their subject*
- *draw on the appropriate methodology for their subject*
- *organize material and articulate effectively in written form*

At Masters:

- *exercise independent judgment*
- *locate, analyze and explain information about their topic*
- *critically review and evaluate the literature associated with their topic*
- *employ methods of enquiry appropriate for and relevant to their topic*
- *organize complex material*
- *write clearly, judiciously make and use illustrations, and present their dissertation to a satisfactory standard*

For PhDs, I can draw on the criteria for examining the thesis:

- *a critical understanding of their field*
- *an original contribution to knowledge*
- *recognition of the value/contribution of the work*
- *putting the work in context*

Because of the timescale and scope of a PhD, I also encourage students to develop a coherent argument through the thesis and make links between possibly discrete pieces of their own work. They also need to appreciate the depth of argument required.

JUDITH: I'm very much in agreement with Meredith's critique of current Master's programs and the challenges for where they need to go. There's much room for creative recasting of Master-in-Design programs to orient more towards research principles that are shared across the sciences and to provide students with critical thinking and reflective acumen for the responsibilities that come with being a designer and designing. To be leading not only following.

SHARON: *Do you think an understanding of science is important for undergraduate students?*

MARY: Not in any comprehensive manner. As I introduce students to empirical research findings, I do want them to be able to evaluate them to a certain extent. I therefore introduce constructs such as hypothesis testing, reliability and validity. When they carry out their own testing, they learn more about experimental design.

JUDITH: Science is more important than ever—my high school and undergraduate teachers were wrong about 'not everyone' needing sciences, math, etc. I believe these are critically important going forward. Contrary to advocates of 'informal learning' as the mode of learning, I believe we need to carefully construct the zones of proximal development that take us (we and those with whom we learn also known as those whom we teach) from 'half a concept'—which one can acquire informally, in situated cognition and from/in highly skilled practice—to 'full concepts'—acquiring and internalizing scientific concepts. That is to say achieving those qualitative leaps that can carry one/us/all forward. I'm for a research language that traverses design and science (does not deny, does not dichotomize). I feel the same away about the liberal arts—contrary to regression in some circles towards 'vocational' and 'technical training' being fine for the great many, I believe that we need the liberal arts, humanities and design more than ever.

SHARON: *You mention "zones of proximal development," Vygotsky's powerful concept (1978). Recognition of a student's understanding and level of performance is critical to helping them move along (figure 2). In graduate programs the variety of these zones among the students is a challenge and student backgrounds vary considerably along many dimensions, perhaps requiring a case-by-case approach to individual development.*

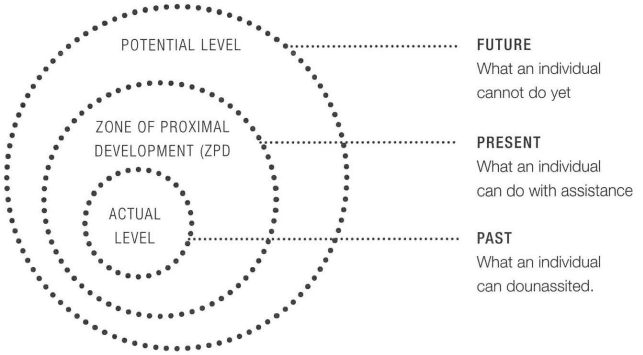


FIGURE 2 *Zones of proximal development*
Adapted from Wonjoon Chung

JUDITH: Design has been transformed by interactivity, interdiscipinarity and infrastructural responsibilities given the influence of 'the digital' across all fields and in social life. These layered transformations expand design responsibilities. Concurrently, the digital turn has opened onto youth, young designers and 'citizen designers' engaging in and creating new modes of learning—appjams, hackerspace, copyleft, open source, crowdsourcing, citizen designer, citizen science.

Design is especially well-positioned in Knowledge Mode II that refers to the generation of multiple forms of knowledge and contributions to social policy-making through collaborations between publics, industry, scientific enterprises and civil society (Kuutti, 2007, 2009 and others). Design students should gain the foundations of design thinking that can enable them to engage in such arenas. Having said all that, we should never neglect the importance of designing for 'everyday charm' and beauty in everyday life.

MEREDITH: I think it is important for students to understand disciplinary differences in modes of inquiry, which includes science, social science and the humanities, as well as design. Further, I think it is important for them to understand how these disciplines organize knowledge and what intellectual standards they apply to judging work in the field.

Traditionally, the general education of undergraduate design students has been "proximate" to their study in the major. Courses in various disciplines run concurrently with design study, but design faculty rarely know or make use of the content or concepts that students tackle in non-design courses. Occasionally design faculty will ask students to use content from other fields as the subject matter of design projects (for example, a poster on global warming), but the faculty don't assess the mastery of non-design content nor do they talk about the world views and methods of these other disciplines. Neither is there much instruction in reading research findings in other fields and students are often left on their own to make the leap from available data to design form.

These circumstances mean that students enter interdisciplinary collaborations with other experts at a deficit. The complexity of contemporary problems makes it likely that graduates of design programs will work in teams.

If they don't know how other fields define and solve problems, designers are at a distinct disadvantage and likely to be at the cosmetic end of a decision-making food chain.

I also think today's environment for practice has little tolerance for decisions that are not supported by compelling evidence about people, their activities, and settings. This heightened accountability for anticipating the outcomes of design action suggests that designers need to know what questions to ask and how to assess the implications of answers. Many of these issues can't be addressed through the traditional perspectives of design. So to prepare students for practice, schools have to think about what kinds of new information

are necessary to underpin the conventional form-making activity of design and how students make judgments about relevance.

SHARON: *Regarding literature searches, what do you suggest if the literature is too extensive?*

MEREDITH: I believe students need to master the compilation of meaningful bibliographies, regardless of the student level. I'm not comfortable with telling them what to read and what not to read or having them work with someone else's bibliography. There is no shortcut to developing this skill; they have to slog through the literature to understand what is relevant.

That said, the search involves finding what is seminal in the field and developing phased strategies for reading. They need to become familiar with citation and to read for the frequency with which particular studies are mentioned in the information they find. I send them to the library first for reviews of tables of contents and the light reading of several chapters. Their natural tendency is to dive into single books, reading and taking notes from cover to cover. That approach isn't very strategic when there is a lot of territory to cover, so we talk about that and how to build a log of what they've read.

Another practice I use is to give them a seminal text and ask them to work outward from that book or study. What kind of thinking led to the text and what ideas followed because it was published? I think it is important for students to see sources in a chronological listing; there is something to be learned by what authors address at particular times in history and who followed whom.

JUDITH: I mentor and coach students at master's and doctoral level on strategies for conducting literature reviews and forms of discourse analysis. Off the top, I recommend to 'talk' to people whose writings you especially cotton onto. To be ready to talk with them, read key works they value, writings that they place in proximity to their design research inquiry and design practice. In addition to usual literature searches—for which university librarians are terrific resources, I also ask students to choose two journals and peruse the journal over a ten-year period for the discourse on their topics of design interest. These days, students are often already adept at web searches; yet they will benefit greatly from expert help for cross-disciplinary searches related to their design focus and to get to a sound research level of familiarity with the literature.

Periodization of the discourse(s) is important, helpful—and artful. Mentors and key thinkers can help with this. One thing I learned as a young research analyst and new entrant into emerging discussions

is to talk with leading people and find out about someone's own 'self-critique' or reflections on where they'd gotten to and where they're heading next. In this, it helped that I'd been in journalism (as a metaphor and as a practice) in that I was comfortable asking experts how they saw the shape, the edges, the boundaries of knowledge, debates, inquiries, the unknown—and what questions they were turning to now, their new points of focus.

MARY: Too much literature commonly means that they have not narrowed down their topic sufficiently, so this is what I propose. At PhD level, I also discuss strategies for scanning material and criteria for selection. I try to discourage PhD students from trying to conduct an exhaustive literature review at the beginning of their research. I encourage them to do something like a pilot study or analysis of some material.

SHARON: *Mary, do you do this so students avoid becoming overwhelmed and lost in the literature, or to make research a practical, experienced skill?*

MARY: Both of these reasons: I believe there is a danger that students will lose their way and go off in various directions. I do this myself. This can be valuable to some degree, but without some clear parameters, the finding of new leads can become a disconcerting experience. For those students who intend to carry out some form of empirical research, I believe that a relatively simple study early on can provide a focus, introduce students to the procedures involved in testing, and hopefully the results raise more questions that can be pursued.

My experience is that much of the initial reading may not be relevant at a later point (at UG & PG level) as the research moves in a slightly or very different direction. Getting your hands dirty, through analyzing material, or running an experiment identifies what literature is relevant.

At undergraduate level this is scaled down but I do discourage students from writing their introduction/lit review first and encourage them to start in the middle—identify the meat of their dissertation, which is what will gain the most marks (in our context). Otherwise they can read around the subject at a rather superficial level and avoid addressing their research question.

SHARON: *What do you suggest if the literature is sparse?*

MARY: Although I don't recognize this as a problem, it can unnerve students. I suggest that they consider whether there is a parallel or related strand of research/literature, or a more general topic that they can draw upon. Initially students (mainly undergraduates) tend to search for their specific topic (e.g., design of TV listings) rather than

more general literature (e.g., list or table design). Our library staff gives sessions on searching databases with exercises.

As mentioned above, I also encourage students to make the majority of their dissertation their own research, rather than relying on the literature (even at undergraduate level).

JUDITH: Limited literature can mean that you are really onto something new. Ask for help by an interdisciplinary or trans-disciplinary committee who can: a) verify that it is indeed sparse because it's a new thread or strand, unraveling or winding up, gaining momentum, and/or b) point in new directions which might well be in other sciences than the 'locus' or fulcrum point seemed to be at first, i.e., they help open up the search.

MEREDITH: Not everything is in books. There is a lot to be learned from observing what people are talking about in blogs, in online journals, and on research-oriented websites. So if students are critical and learn standards for judging the credibility of information, they can find a lot that isn't in the library. In some cases, this opens opportunities for interviews or correspondence with someone who is currently conducting research in a related area. I am frustrated, however, by a general lack of student preparation for such interviews; students need to do some work before they talk to an expert and they jump too quickly to emailing people with questions that are so broad and unformed that it takes a dissertation-level explanation by the expert to answer them. I don't think faculty are working hard enough at developing these skills in the students they mentor; there is a lot of "passing them off to someone else" and it is not the job of experts to narrow the student's research question.

Students often have a limited bibliography because they don't know how to develop a semantic network of key words for their search. If something doesn't come up in the catalog or on the Internet that is a direct match to their chosen term, they may assume nothing has been written. So we talk about that. And a study may be good for method, for example, even though the content of the study is not directly related to the student's investigation. So they need to really think about how to develop a good key word list.

I also send students to theses and dissertations to see what other students have uncovered, as well as to the notes sections of important books. It is always helpful to contextualize literature; looking at how someone else used the same material makes that possible. And recently, I have found that foundations and think tanks are great sources. They often foreshadow emerging research topics and publish reports that support these investigations.

MARY: I'd like to echo this concern regarding interviewing. We are also wary of our students firing off questions to experts and I talk about my own experiences of receiving questions from students at other institutions. Interviews can be seen as an easy way of collecting material and I like to point out some of the difficulties, without putting them off. I suggest that interviews may need to be an additional source of material and should not be relied upon as students may find that they receive no response to their enquiry. I ask students to:

- *Reflect on their reasons for carrying out an interview (for their dissertation)*
- *Describe potential problems there might be in carrying out an interview (and how they might deal with these)*
- *What they might do (prepare) to try to ensure that their interview is a 'success' and helps with their research*
- *What do they need to know or do beforehand?*
- *What do they need to do afterwards?*

The last point leads to gaining ethical approval for research involving people: explaining what ethical research means and how to submit an application to our University Committee.

I also send students to past dissertations and theses to help with their bibliography and also to check what has already been covered as they must do a different dissertation.

SHARON: *How does a student know when they have covered the extant material?*

MARY: This is probably only a potential problem at PhD level. My initial response is that they don't know, but more recent tools (e.g., citation index) provide more checks than were previously available (for journal articles). However, these are probably more developed within Science (those I use). It is encouraging when a new journal article does not include a large number of references that are new to the reader.

SHARON: *In other words, the reader has covered sources well and is reassured.*

MARY: Absolutely!

JUDITH: Ask for help. This is a key point where mentors, faculty, colleagues wise with time are especially needed. Part of this (and the other lit search questions above), lies in distinguishing the near interval of time for the research at hand, whether 6 months, 1 year, 2 years, 5 years … from a 20 years landscape forward. There will be time.

MEREDITH: I require graduate students to visualize the literature in a concept map that matches what they think are the primary ideas related to their investigations. For doctoral students, this allows them to compare philosophical or epistemological perspectives. For master's students, it encourages them to explore work from a variety of disciplines. In some cases, I ask them to map the concepts from a single book or reading; their maps tell me what sense they are making of the literature. I can identify misperceptions quickly and the maps form the basis of our one-on-one discussions. We also use the maps to figure out what is missing or how we are going to limit the problem to something manageable. I find this especially helpful in working with students who are reading in areas that are entirely new to them.

The maps are also useful in writing. I use *Learning How to Learn* (Novak et al, 1984) that describes a narrative mapping strategy, concept nodes are connected by propositional statements that form complete sentences. Students can write from these kinds of maps, choosing different points of entry (different nodes) for discussion. It helps visual students to see the structural relationships among concepts and to explore a variety of ways to construct research arguments.

SHARON: *What aspects of research do you find most problematic for students?*

MEREDITH: Defining a problem that is both manageable and worth doing is difficult for doctoral students. Graduate students have a tendency to define problem scopes that are too large. They don't want to give up anything they think is important and don't see their study as the start of a longer research arc. So paring things back to something manageable is the toughest work. In asking them to write a research question with 3-5 sub-questions, I am usually certain that one of the sub-questions will eventually rise to the level of a final research question. But it takes a while for the student to see that possibility.

Another problem is more recent. Growing awareness of methods and concepts that have been borrowed from other fields causes some students to think they are qualified for research studies that are essentially about something other than design. So framing the question appropriately as a design research study is critical. The language in framing investigations and the ordering of concepts in research questions are important. Students want to settle on the question quickly; they don't like the uncertainty of not having a "prescription" for action. Slowing them down and asking them to write many questions is tough, but it pays off in later stages of the research process.

MARY: At undergraduate and masters level, deciding on a topic to investigate that will maintain their interest and realizing how narrow that topic needs to be is difficult. Then there is the difficulty of getting started so that they can see whether they can research this topic (or not) and whether they are still sufficiently interested.

The questions that students pose can also be unrealizable in that they want to determine the 'success' or 'influence' of, say, a brand and have no concept of how they will measure this.

The self-directed nature of this work can also be problematic in taught programs where practical projects with shorter deadlines take precedence.

JUDITH: Understanding and becoming conversant in research languages, modes of analysis and discernment of the line of argument in relation to particular research methodologies, traditions and languages—along the way of sorting out one's own research language, methodology and line of argument is important. I might approach this by thinking of clusters. Undergraduates and master's students are coming from such a diversity of preparedness and exposure or lack thereof. We need to respectfully lay the basis for discussion in common, so that students can make knowledgeable and reflective choices. I like *Reflexive Methodology* (Alvasson and Sköldberg, 2009) and other such works because they help us trust ourselves while working through the internal and external dialogues of research inquiry.

SHARON: *Are there cultural aspects to consider in how research is approached and taught?*

MARY: I don't have much to offer here. I have been surprised by the expectations of some PhD students, which were based on their past experience, but I don't know how general this is. I have learned to be more explicit about the need for PhD students to develop their own research questions (with my support) rather than being given them.

MEREDITH: I'm not sure what you mean by "cultural aspects." As subject matter, the context for the study, or where students come from?

With respect to the contexts of studies, it is difficult for students to do field work in a culture with which the faculty isn't familiar or with which the student isn't familiar. I find it hard to address cross-cultural content if I don't have first-hand experience. Similarly, it is tough for international students to understand the American context. So much of the interpretive task depends on abstraction and cultural nuance.

So I am very careful about what I agree to mentor. I currently have a Columbian student who wanted to study the impact of after school design programs in developing children's "citizenship." The term "citizenship" was simply too general and too culturally loaded to take on. We settled on "empathy for people with experiences different from their own" as a concept that has fewer political and cultural overtones, but that contributes to good citizenship.

In terms of where students come from, I think the art and professional culture of bachelor's and master's programs in design create a particular challenge for PhD study. Little about these curricula in most American schools currently prepares students for PhD-level, evidence-based research. This is especially true with single-discipline art schools. Art school education typically involves limited exposure to non-design study and general education coursework is often slanted primarily toward the humanities. Some graduates of these programs struggle with social science concepts and systematic investigation and they often see doctoral study as an extension of studio-driven investigations, which is not our curricular intent.

JUDITH: On cultural considerations, I think about this on different levels and from different experiences and contexts in which I've taught research methods. One dimension is certainly the diverse practice, disciplinary and epistemic cultures from which master's and doctoral design research students come. The IIT Institute of Design aims for the Master-in-Design cohort (of 50-70 students) to be a mix of 40% students from non-design backgrounds and 35-40% international students. Several of the PhD-Design candidates were already highly accomplished design teachers, some well-known designers and some already established design researchers. That makes for a stimulating and challenging mix. One result is that everyone—international and US master's students—needs to learn how to work in international teams in the many projects in which they participate. It's not only that international students gain experience in the US design culture; US students are introduced to culturally-grounded differences in aesthetic preferences and different styles of professional interaction—and everyone needs to learn 'grace under pressure.'

While at the Institute for Informatics, University of Oslo, I was a core faculty member in the dual International MSc-Informatics and MPH programs of University of Oslo, University of Eduardo Mondlane (Mozambique) and universities in South Africa, Tanzania and additional partners. Across these contexts, master and PhD students included staff of Research Institutes, Ministries of Health and Medical Faculties as well as early career informatics and medical master students. I learned much in regard to inter-cultural, international and interdisciplinary collaboration. As principles that I carry with me, I learned that

mutual learning and reciprocity among design collaboration partners and between designers and users is key to success in intercultural, interdisciplinary, international and inter-institutional contexts. And that respectful dialogue in which difference is valued is essential to intercultural sensitivity and collaboration; shared ground is co-created, not given. I believe these principles adhere to our teaching and our relations with our students from diverse backgrounds as well.

SHARON: *In the case of PhD study, how extensive should their knowledge of research methods be?*

MARY: My views have changed on this. PhDs within the UK have increased generic skills training which can provide a much broader perspective on research methods. I think this is a positive move as our Graduate School provides this support, removing the requirement for disciplines like ours (with a small number of staff) having to find the expertise ourselves. PhD students are therefore now in a good position to gain an overview and to consider their choice of approach. Our departmental PhD student seminars also highlight research methods that open up discussion to a broader audience (which includes masters students) and familiarizes PhD students with methods beyond their own.

MEREDITH: I think instruction in methods is essential. This is an aspect of research education that isn't better if "discovered" by the student in the course of the study. Students need a variety of methods in their repertoire and discussion of how methods are alike and different; what they are good for; the kinds of data or findings they produce; and the "cost" of one approach over another in terms of resources.

We used to teach research methods in the first semester of the PhD curriculum. We pushed it to the second semester when we discovered that students were "a method searching for a problem." They chose research topics that matched the kind of work they wanted to do, but they often wound up addressing topics that were insignificant…

It is easy to count things, for example, but more difficult to determine what those things mean.

Now we begin by asking students to think about research paradigms and worthy topics. This has produced more interesting studies, and unless the research is an explicit study of methods, the means for conducting the research are selected for the fit with the research question.

We require students to submit proposals to the Institutional Review Board (IRB) for approval, even when the study doesn't require it (as in pilot studies with student populations). The IRB is great at asking questions about method that the student often overlooks. I think the IRB application process actually does more to focus the student on method than does the proposal writing.

JUDITH: I agree with Mary and Meredith so I will only add briefly here. One of the responsibilities of Doctors In Design Research is to have a quite comprehensive knowledge of methods and research approaches. Most important considerations are clarity and meaningfulness of the overall research strategy for the knowledge that may result in relation to the research questions.

SHARON: *What factors enter into making a method selection?*

MEREDITH: There certainly has to be a fit between the method and the kind of evidence that supports the research question. We ask students to justify such choices in their proposals. When they can triangulate findings through multiple methods, we encourage it.

Sometimes the study is in an area that doesn't have a deep history or well-established methods for studying it. Grounded theory, for example, is a useful approach in these circumstances; that is, working backwards from data collected through a variety of methods, then coding data to extract principles or a hypothesis from what is found.

There are also many practical concerns in their choices. If the method calls for access to people and a reasonable sample size, we encourage the student to think about that in developing the research question. For example, it is very difficult to do research with minors in K-12 schools. If the student can only gain access to a few students, then the method and resulting claims need to reflect that or the student needs to refocus the study on older users who can grant permission for participation. The same is true of longitudinal studies. The student has to decide if collecting data over time is really possible and under how many different conditions something will be studied. In other cases, the personality of the student matters. Some students just aren't good interviewers, for example.

MARY: I agree on the difficulty of conducting interviews and also discuss this when addressing interviewing.

At issue is what methods can address the research question. Then the experience and interests of the student; accessibility of resources, including people; need for a rigorous approach.

Some methods are intrusive and raise questions about the findings. One student observed writers for almost a year. There were times when she simply left the room because she realized her presence was unsettling to the writers and their behavior was unnatural. In other cases, technology can help. One of my students studied primary school children during recess to discover if their play in "unscripted" natural spaces involved metaphorical language that was not used by children in "scripted" playgrounds (it did). She put tape recorders in fanny packs that children wore when playing outside. Within minutes of donning the fanny packs, the children forgot they were being recorded.

JUDITH: Pilot studies are essential for getting a sense of what can be learned by way of particular methods and how so. Trying out methods in an analogous setting and/or with analogous participants can help the researcher(s) think through the basis for good triangulation of research methods in relation to the research questions. Clarity about the object of inquiry is essential for considering methods and how the methods will be carried out as they are shaped and governed by the conceptual-methodological research framework. A key phase that also shapes the methods is the conceptualization of units of analysis in intermediate spaces and contexts for understanding interactions, practices, materialities and temporalities. Then the researcher and mentors need openness in regard to the object of inquiry along the knowledge, research and design journey. Intermediate concept construction is also iterative sense-making.

SHARON: Are you troubled by the fact that design uses research methodology from other established fields?

MARY: Most definitely not, but I am biased. This is less of an issue in terms of training and expertise now that we have a Graduate School.

JUDITH: No. Not prima facie. What's important is that the research methods employed are sensibly used and/or adapted towards the research inquiry. Sensibly coherent combinations of methods in mixed methodology research approaches are often carried out within master and doctoral studies. Research methods employed in design research by now include: qualitative social science methods (ethnography, semi-structured interviews, participant observation, audio/video documentation of interactions and activity); design experiments; kansei engineering methods for understanding emotions; distinctively design methods such as cultural probes and charette. Modes of analysis include: grounded theory coding and analytic memo-writing; various modes of analytic metrics and quantitative analysis; aesthetic analysis of form and space, artifacts, architecture and public spaces; historical, documentary and archival analysis;

analysis of human-computer interfaces, information systems and other kinds of knowledge infrastructures. Modes of analysis include 'fuzzy set' analysis for emergent or rare phenomena for which the number of instances are few (Ragin, 1987). Amidst all this, other fields are starting to use 'design methods.'

MEREDITH: I'm not bothered by borrowing—but I do think we have to be critical about how we use approaches from other fields. Methods reflect perspectives about what can and should be measured. In one of my own projects, for example, my behavioral research collaborators favored methods that yielded the highest number of score-able elements in students' problem solving. The process was parsed into so many individual elements that it no longer reflected a holistic process. On the surface, human factors testing in labs seems a good match for studying user interaction with software, but it doesn't tell us why people use the software in the first place, how surrounding contexts influence their performance, and what they expect to accomplish if successful in mastering the program. So I think we have to be careful about what is not being studied when we adopt methods from other disciplines.

MARY: Meredith has raised the very important issue of ecological validity and this is something that pervades my own research area and is raised in my teaching of empirical research. I don't think there is any easy resolution to the conflicting aims of scientific method versus reflecting design practice or normal context of use. So I just present the dilemma.

SHARON: *Pierre Bourdieu (1980, 1998) has explored this reflecting on the idea that science and practice exist in completely different modes of time. Science is timeless while practice is situated in time and rife with contingency. His Logic of Practice is an argument against a science of design.*

SHARON: *Do you think design should develop its own research methodology?*

MARY: I'm not sure what this might look like. Drawing on my own area of expertise, I do think there are issues of applied versus more theoretical research; how materials are selected for study etc. I'm not sure if this would constitute a different methodology or particular applications of existing methodologies.

JUDITH: Provisionally and ecumenically, I'd say yes, I think so. I believe this is already happening in some design schools and doctoral design research programs. By provisionally, I'm thinking about the proposition that design becoming a discipline can also come from the discipline of design itself (Cross, 2001; Blevis, Lim and Stolterman, 2006; Kuutti, 2007, 2010). By ecumenically,

I'm thinking about how this expands the design research repertoire rather than veering away from the design-mixology with transdisciplinary research approaches we've been discussing. How research methods get put together depends on the research inquiry and how its questions, concepts and design directionality are shaped, explored and interpreted.

SHARON: *What philosophical underpinnings support design research?*

MARY: Although I may have particular leanings, I don't think I can label them as I don't think in these terms.

MEREDITH: Not really sure what you're after in this question. Seems like an endless list if you're talking about the content of design research. Do you mean what underpins the idea of doing research in design? Or are you going for what philosophical frameworks are relevant (ex. pragmatism)?

SHARON: *I am after philosophical frameworks as fundamental anchors for thinking. Early in my thinking I began as a logical positive, then I began to understand its shortcomings. Then I discovered I was already a practicing pragmatist and found John Dewey particularly enlightening. I imagine others have a different trajectory leading to other filters. I am just curious as this does change our perspective and influence how we think and work with students.*

MARY: Well I suppose I am an empiricist, but that is fairly obvious. It does influence how I advise students, most certainly. I have softened over the years and am now more open to qualitative research methods. I also acknowledge the importance of craft knowledge but still like to challenge it from time-to-time. As I am now mellowing, I have turned to looking for ways to bridge the gap between scientific approaches and design writings (based on experience).

JUDITH: Returning to your question about philosophical underpinnings, I would say the boring 'it depends.' Where my own interests are broad and include phenomenology, ethno-methodology in certain of its ways, critical science and technology studies (too compound a philosophical 'house' but very rich in concepts, range, thoughtful reflection across the board—I wish for more coming together with design research). For me the socio-historical school that goes by 'cultural historical activity theory' (Cole and Engström, 1993; Raeithel, 1992) and 'socio-cultural historical research' are important in good part for their explicitly philosophical depth. I'm also quite familiar with contrasting positions by now, e.g., actor-network theory and the like. The archeology of knowledge (Foucault and others' brilliance); the dialogicality, polyglossia, refractions of Bakhtin and those who follow; the techno-feminist philosophers of science . . .

MEREDITH: Personally, I am a pragmatist and a fan of Dewey. I think pragmatism provides a sound philosophical basis for research in a field of practice that, in many ways, grew out of trades. Thinking about design as a discipline with articulated theories of action is a fairly recent activity in comparison to fields with longer research histories. I also believe that the situated nature of design problems, in which interpretation and use depend so much on context, make it hard to see real value in making everything a matter of "proof." But I don't expect my students to share my position and what our introductory course in research paradigms does is expose them to a range of philosophical and epistemological positions through readings and discussions with researchers who have different worldviews. These positions have their own intellectual standards and my concern as a teacher is whether the student's philosophical stance is fully informed and defensible in terms of these standards. I do believe the emergent nature of the design research culture, variability in our definitions of design as a discipline and a practice, and rapidly changing contexts and purposes for design research make professional consensus about an appropriate philosophical framework unlikely at this time, if ever. What schools can do through the work of their graduate students and faculty is demonstrate the implications of adopting one position over another. Over and above the findings of any study, this is a contribution to the field.

SHARON: *What question/answer of importance to you have I failed to ask?*

MARY: These questions have made me reflect on how I teach and I feel as though my approach is bottom-up. Although I do plan and deliver classes, my feeling is that I am most effective in delivering research skills through individual tutorials and feedback on writing, i.e., responses to specific projects. This is clearly not an efficient way of teaching. I raise this because I don't know how I would teach someone to do this teaching. This is why you are asking us these questions I believe.

SHARON: *It appears you teach on a case-by-case basis in relation to relevant knowledge and experience. Perhaps it is too soon in the development of design research to have a more systematic and carefully clarified set of goals and methods. I have often envied Science and the ability of a research project to be carefully positioned on the backs of others and the ability to see the trajectory of work; to see the past and anticipate the future.*

Your participation in this conversation advances our thinking about teaching design research. I am certain you have even more to share. Thank-you.

REFERENCES

Adams, James L. 1986. *The Care & Feeding of Ideas, A Guide to Encouraging Creativity.* Reading, MA: Addison-Wesley.

Alvesson, Mats and Kaj Skoldberg. 2000. *Reflexive Methodology: New Vistas for Qualitative Research.* Thousand Oaks, CA: Sage.

Blevis, E., Y.K. Lim and E. Stolterman. 2006. Regarding Software as Material in Design. In *Proceedings of Wonderground 2006*, Lisbon, Portugal, Design Research Society.

Bourdieu, Pierre. 1980. *The Logic of Practice.* Stanford, CA: Stanford University Press.
—. 1998. *Practical Reason*. Stanford, CA: Stanford University Press.

Cole, M. and Y. Engeström. 1993. A cultural-historical approach to distributed cognition. In Solomom. G., editor. *Distributed cognitions: Psychological and educational considerations.* Cambridge, UK: Cambridge University Press, 1-47.

Cross, Nigel. 2001. Designerly Ways of Knowing: Design Discipline Versus Design Science. *Design Issues* 17.3, 49-55.

Gordon, Wm. JJ. 1961. *Synectics.* New York, NY: Harper & Row.

Holyoak, Keith J. and Paul Thagard. 1995. *Mental Leaps, Analogy in Creative Thought.* Cambridge, MA: MIT Press.

Koestler, Arthur. 1964. *The Act of Creation.* New York, NY: Macmillan.

Kuutti, Kari. 2007. Design Research, Disciplines, and New Production of Knowledge. *In Proceedings of IASDR 2007: Emerging Trends*, Hong Kong Polytechnic University, November 12-15.
—. 2009. Artifacts, Activities and Design Knowledge. In Poggenpohl, S. and K. Sato, editors. *Design Integrations, Research and Collaboration.* Bristol, UK: Intellect Books.

Novak, Joseph D, Bob Gowin and Jane Butler Kahle. 1984. *Learning How to Learn.* Cambridge, UK: Cambridge University Press.

Raeithel, Arne. 1992. Activity Theory as a Foundation for Design. In Floyd, Züllighoven, Budde and Keil-Slawik, editors. *Software development and reality construction.* Berlin: Springer.

Ragin, Charles C. 1987. *The Comparative Method, Moving beyond qualitative and quantitative strategies.* Berkeley, CA: University of California Press.

Vygotsky, L.S. 1978. *Mind in Society, The Development of Higher Psychological Processes.* Cambridge, MA: Harvard University Press.

ABOUT THE AUTHOR

Randa Abdel Baki is a design educator, graphic designer and an artist residing in Beirut, Lebanon. Currently, She is the chairperson of the Graphic Design Department at the Lebanese American University, where she has been teaching since 2005. She completed her graduate studies at Pratt Institute NYC where she also worked extensively as a designer and art director. Her designs and artwork have been exhibited internationally. Abdel Baki's scholarly activities include successful bilingual typographic methods, specifically solving the challenges of Arabic and Latin bilingual layouts. Her professional experience encompasses many areas in design including publication design, packaging, and multimedia design.

03 Bilingual Design Layout Systems: Cases from Beirut

RANDA ABDEL BAKI

ABSTRACT

This paper identifies and analyzes the challenges of bilingual design layout systems in Beirut. With the rapid spread of globalization, English and Arabic often enter the public realm together. As the design industry also rapidly develops and the Western influences are manifested, the duality of languages and scripts are constantly negotiated. This paper investigates various bilingual design layouts and proposes six new variations of bilingual design layout systems for designers, educators and students to employ and develop further. By employing an illustrative methodology in which different layout systems are both examined and compared, the author proposes visual structures for bilingual readers, adding an extra layer to the understanding of visual communication while offering the viewer the choice of reading both scripts.

With the rapid spread of globalization and the overwhelming development of the design industry in the Middle East, Arabic script has become secondary in publication designs. Beirut, as the capital, is used in this paper as an intense laboratory where Western influences are clearly manifested and negotiated in language and graphic design. In Beirut, bilingual design for a range of media—from street signs and graffiti to various forms of printed materials including posters, pamphlets, and books have become an increasingly obvious "challenge" as designers treat the two scripts; Latin and Arabic equally, despite their differences in direction, texture, and weight. As the design industry develops and as more designers are taught at Western educational institutions, the issue of bilingual design is more and more frequently resolved by having the Arabic script as a secondary form, foregrounding the Latin script.

This paper investigates the challenges of bilingual design layout systems in the Middle East and more specifically in Beirut, the capital city of Lebanon. It proposes bilingual design layout structures to equip designers with a better understanding of bilingual compositions and integrated methods of application. Many attempts have been made to bring together Latin and Arabic scripts in a harmonious way, yet, they have not yielded thorough explorations that will assist designers in the development of bilingual layout systems.

Building on Kimberly Elam's typographic systems and based on my research and observation of Beirut's visual bilingual topography[1], I developed bilingual layout systems and will demonstrate their applications by showcasing selected projects of my students' work at the Lebanese American University (LAU) in Beirut, along with personal work and vernacular bilingual city signs. The choice of these examples is representative of a larger scope illustrating the diverse applications of bilingual layouts in our daily life in Beirut.

This paper exposes the difficulties of combining dual distinct scripts of Latin and Arabic, and overviews several approaches for designing and pairing bilingual scripts in a harmonious manner.2 It culminates in the proposal of six new variations of bilingual design layout systems for designers, educators and students to apprehend, employ and develop a variety of bilingual compositions.

Many design publications in this region are produced solely in English since Middle Eastern designers are more comfortable using Westernized layouts given that their design background lacks adequate training in combining Arabic and Latin scripts. The lack of training stems from a well-founded desire to study in the West, but the application of this Westernized knowledge to further the dialogue between the two cultures is still amiss. The ultimate goal should be to enhance the local

language by looking at and learning from the Western design systems, whereas the trend in design seems to merely adapt Latin script compositions to the Arabic script that do not necessarily accept such aesthetics. Paul Cleveland, professor at Griffith University explains, "Aesthetic preference involves complex factors which optimize the degree of arousal potential. The use of ratios may be one of these, but balance, complexity and order are also important factors" (Cleveland, 2008:37). While assessing the relationship between the scripts of two languages, it is crucial to consider the specific elements that contribute to our innate visual preferences.

The lack of training in creating harmonious bilingual layout systems[3] calls for the need of innovative, compelling layout systems that can be employed for various daily needs of designers in the Middle East to combine Latin and Aribic type. Understanding the specific problems posed by the combination of Arabic and Latin script is vital to start thinking about the guiding principles in the creation of bilingual layout systems. The challenge of integrating bi-scripts of distinct nature into a coherent and skillful layout drove many designers in this region to choose form over function. Form over function here refers to the prioritization of goals; where form is treated as more important than solving the problem of handling Arabic and Latin script in a balanced manner. This is the easy way out so instead of thinking about the co-existence of the two scripts, designers dealing with bilingual layouts allow the Latin script to dominate, which underscores design limitations. This paper sheds light on this trend and I am hoping it will be a stepping-stone for further investigations in the field.

CHALLENGES OF COMBINING LATIN AND ARABIC SCRIPTS

Before tackling the issue of bilingual layouts, one has to start by understanding the challenges of combining two scripts of different nature and to learn how to select or create suitable and corresponding typefaces in order to proceed with an integrated bilingual layout design. Scripts play an essential role in layout designs, as they generate the texture, tone, contrast and form of the composition. They also indicate the reading direction of the text, each have an appearance and style that should be considered before structuring a bilingual layout.

There are two primary differences between the Latin and Arabic scripts that constitute the problem of bilingual layouts: form and direction. The curved, flexible form of Arabic type, rooted in its calligraphic foundations, is in contrast to Latin structured type. The ascenders, descenders and baseline, important in typography for word recognition, are different in Latin and Arabic scripts; in addition Arabic script has no capital letters.

The anatomy of the letters and the scripts reveals further differences. The two scripts create different textures, which further complicate their representation together. Texture of the script refers to the type created by the strokes as well as the curvature of the script. In an ideal bilingual layout, the textures of the two scripts would be to preserve a harmonious look and feel. As Robert Bringhurst notes,

> *"the more closely different alphabets are mixed, the more important it becomes that they should be close in color and in size, no matter how superficially different in form" (Bringhurst, 2002).*

For instance, Helvetica, a sans serif typeface that was developed in 1957 by Swiss typeface designer Max Miedinger, required a corresponding Arabic typeface that would be consistent and complement the Latin type in bilingual layout publications. The Arabic type library is still nascent in comparison to Latin typeface library and the flexibility of the Arabic scripts for typographic interpretation is an important matter of debate for designers such as Nadine Chahine[4], Yara Khoury[5], Pascal Zoghbi[6] who develop typefaces, in relation to and independent from Latin scripts. The Arabic text occupies different dimensions than the Latin with respect to the length and width of the paragraphs. As illustrated in Figure 8 and onward, the multifaceted Arabic script carries a wide range of ascenders and descenders and combines small glyphs and counters that create a smaller appearance in comparison to the length of Latin text.

Unlike Latin script, Arabic script is read from right to left, which makes the two texts collide if facing each other. They run in opposite directions. The Arabic script is rhythmical and its letters connect smoothly in a soft and natural flow. It is multi facetted; each letter has 3 to 4 assorted forms depending on its position in the word (Tracey, 1975). (*figures 1, 2*)

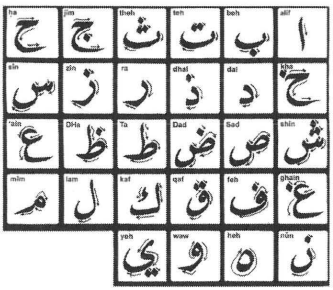


FIGURE 1 *Freestanding Arabic letters*

Name	Final	Medial	Initial	Isolated
alef	ـا	ـا	ا	ا
be	ـب	ـبـ	بـ	ب
jim	ـج	ـجـ	جـ	ج
dal	ـد	ـد	د	د
zein	ـز	ـز	ز	ز
sin	ـس	ـسـ	سـ	س
sad	ـص	ـصـ	صـ	ص
ta	ـط	ـطـ	طـ	ط
ayn	ـع	ـعـ	عـ	ع
fa'	ـف	ـفـ	فـ	ف
kaaf	ـق	ـقـ	قـ	ق
kaf	ـك	ـكـ	كـ	ك
lam	ـل	ـلـ	لـ	ل
mim	ـم	ـمـ	مـ	م
noon	ـن	ـنـ	نـ	ن
he	ـه	ـهـ	هـ	ه
waow	ـو	ـو	و	و
ye	ـي	ـيـ	يـ	ي

FIGURE 2 *A few Arabic letters with variation of forms depending on their placement in the word.*

In addition, the Arabic letters are mostly vertical in comparison to the horizontal form of Latin words that are based on a standard x-height, descender and ascender. Arabic letters have a varied x height, and an extended ascender and descender in comparison to Latin letters (Nemeth, 2006). They have many glyphs and hundreds of ligatures that make it difficult to typeset and read. The diacritics are hard to position correctly and often require manual adjustment, thus more time and effort. The difference in letter size makes the small Arabic size typeset illegible; moreover the vertical nature of the letters with big ascenders and descenders requires a larger baseline skip, hence less lines fit on the page (Haralambous, 1998).

HARMONIZING LATIN AND ARABIC TYPEFACES

Many reform attempts have been proposed to simplify the Arabic Writing systems but only few succeeded in providing adequate Arabic typesetting and a new direction for Arabic type design (Smitshuijzen AbiFares, 2001). Nowadays the Arabic typeface design library is still skeletal in comparison to the Latin versatile library of type. This is due to the complexity of the Arabic script and the lack of technological programs that enables Arabic font applications.

Consequently, recent efforts from a few design firms and local designers have been focused on developing a resourceful Arabic typographic library providing the designers with more choices of harmonizing Latin and Arabic typefaces.

There are different ways of associating typefaces, either by designing both Latin and Arabic type simultaneously such as pairing them to

secure a complete customized entity, or by matching a type to another and having a main script that influences the development of its matching script.

PAIRING TYPEFACES

A compelling case study to understand the design problems posed the specific bilingualism using Latin and Arabic script is the Dubai Metro. The newly constructed metro, a crucial part of Dubai's rapid modernization was opened in 2009. Dalton Maag, a design agency currently working on a number of Arabic font projects, created the branding system of Dubai Metro project in Collaboration with Transport Design Consultancy (TDC). They conceived a font design and typographic system covering both Arabic and Latin, which satisfied all of the functional requirements.

Dalton Maag identifies a most common problem with dual language systems—when Latin script is used to "set the tone," the Arabic script takes on a secondary role, disregarding the specific visual and cultural heritage. The need to treat Arabic script the same as Latin script becomes obvious in the context of growing tourism and cultural sharing opportunities (Dalton Maag, 2010). The subservient treatment of Arabic foregrounds the Western element in the Middle East and disregards the context and the specifics of local language.

According to the firm, too often in dual language systems, the Latin script is used to establish the tone of typography. This means that other scripts such as Arabic are considered secondary, giving little significance for its rich heritage and visual semblance to the rest of the identity. This project was a pioneer in developing two entirely different script systems in unison and harmony.

FIGURE 3 *Dalton Maag. Dubai Metro signage. http://www.daltonmaag.com/news/135.html http://www.transportdesign.com/?pid=2&sid=17*

Looking at bilingualism in the larger context by analyzing another combination of scripts, namely, Welsh and English, can help us anchor the study of Arabic and Latin scripts used in combination. Nikolas Coupland, in "Welsh linguistic "parallelism" as a crucial element in bilingual layout systems, through looking at bilingual designs employing Welsh and English (Coupland, 2010).

> It is possible to format bilingual text, stylistically, following principles of parallelism in several different ways [...] The main [principle] is equality: Welsh and English must be given equal weighting and prominence, so that the same access is afforded to each language. Equivalence is interpreted in the specific sense that the textual content of Welsh and English must be identical; then once again choice, in the assumption that bilingual speakers/ readers will be able to choose whether to access the content of a text either in Welsh or in English. A further principle is code integrity, requiring that Welsh and English text-elements must be presented as fully formed and separate from each other.

The relationship between Welsh and English is obviously different from the relationship between English and Arabic. However, the principle of equality holds valid for the conception of new bilingual layout systems. Parallelism, in the context of a globalized Arab world becomes particularly important as the governing principle should be that the local language is held in the same esteem as English, not as a subservient second, echoing colonial relationships between the West and the Middle East.

MATCHING TYPEFACES

Matching Arabic type to Latin has been a rising concern and has been explored by a few designers. Khatt Foundation lead by Huda Smitshuijzen Abifares has gathered Dutch and Arab typographers to conceive five new Arabic typefaces inspired by Latin type (Smitshuijzen Abifares, 2009). These new Arabic typefaces will assist designers in creating contemporary and compelling bilingual products. According to Abifares, this exchange plays an essential role in visually representing a culture's identity (*figure. 4*).

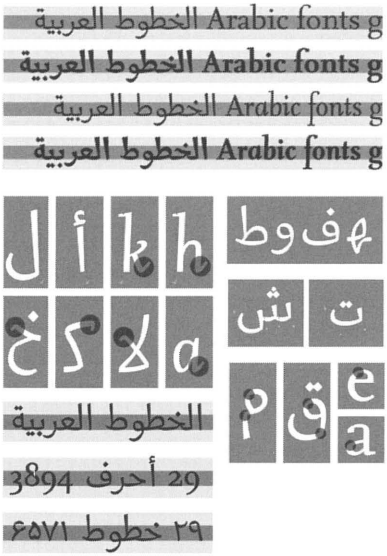


FIGURE 4 *Sada Font: A comparison between the proportions of the Sada Arabic fonts and the Seria fonts (Roman and Italic). Type design by Martin Majoor and Pascal Zoghbi, typographic matchmaking, 2007.*

Abifares approach brought together Latin and Arabic typefaces in a generic and practical manner disregarding the complexity of Arabic calligraphy, and following primarily Latin scripts guidelines, such as using a single baseline and an x height, therefore Latinizing the Arabic font (Nemeth, 2006). The contribution of Typographic Matchmaking typefaces to the improvement of bilingual layout designs has been substantive as many bilingual publications in the region are now utilizing these matching typefaces that are easy and ready to use with the purchase of the book "Typographic Matchmaking".

Even though new fonts are being developed to reach a better dual script combination, it is still crucial to understand how to select and arrange bi-scripts in order to create comprehensive bilingual layouts[7]. Matching and pairing fonts are important factors to achieve a harmonious bilingual design structure, yet they form a partial response to the needs of bilingual layout design.

BILINGUAL LAYOUT DESIGNS OBSERVATIONS IN BEIRUT

Lebanon has long been an intersection of many colonial powers including the Ottoman and French. In the 19th C, many missionaries

established schools and institutions in Great Lebanon (Salibi, 2003). Even though Arabic is the official language of Lebanon, the hybridity and mix of languages is quite dominant, especially in the capital city of Beirut.

Indeed, Beirut is a cosmopolitan city where both the native Arabic language and English are vital in the daily communication with the city's inhabitants. Most people who live in Beirut speak at least two languages. Therefore, bilingual publication layouts and visual identities are imper- ative to the integration of both cultures. They preserve the native language of the city inhabitants allowing a blending of identities and harmonious discourse. The balanced treatment of the two types becomes particularly important when the readers are bilingual. How do you retain visual harmony in text that enables the bilingual reader to read both languages easily? How do you design a complementary bilingual design or publication with an understanding of a well-balanced layout, ensuring a wholesome bilingual design?

Most of the vernacular poster designs in Beirut are solely treated in English script. Rarely are posters designed in Arabic, as local designers are more comfortable designing in Latin script, neglecting the native language and the specific visual and cultural heritage. As for bilingual posters most of them have not been elaborated sufficiently and lack an understanding of duality (figures.*5, 6*). They form a trivial section of the city's visual communication. Furthermore, many bilingual city signs are inappropriately designed and require a better script and layout treatment (figures *7, 8*). In such cases, it is vital to match or pair the typefaces since the text is minimal and the objective is to brand, inform and maintain a unified and harmonious presentation.

FIGURE 5 *Bilingual poster promoting a cabaret show. Hamra street Beirut*

FIGURE 6 *Bilingual poster promoting distribution of flyers, brochures and catalogues Beirut*

FIGURE 7 *Mixed Nuts bilingual store sign. Hamra, Beirut*

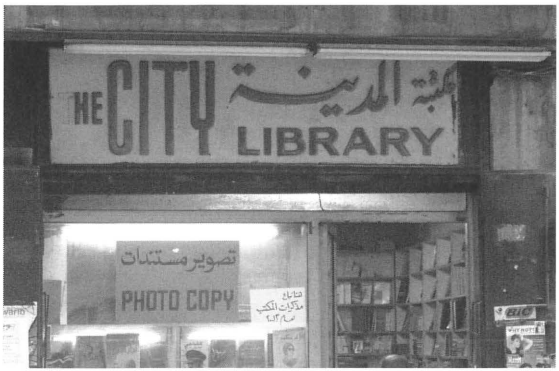


FIGURE 8 *City Library bilingual sign. Beirut*

BILINGUAL LAYOUT SYSTEMS EXPANDING ON KIMBERLY ELAM'S PARADIGMS

Based on Kimberly Elam's expansive research and approach to typographic compositions, along with my professional and teaching experience in bilingual designs and including my extensive observation of Beirut's bilingual designs representations, I propose six new bilingual layout systems. In order to propose new bilingual design layouts systems, I have used Elam's Typographic Systems as a reference, which led me to create a revised version that is suitable for bilingual layouts dealing with bi-scripts of distinct origin.

These will equip designers with innovative and flexible solutions when faced with the challenge of combining scripts that are different in nature, direction and form. These systems are set on dual and harmonious typographic systems based on target audience requirements. In the particular case of Beirut, the target audience is the majority of readers equally comfortable in two languages.

According to Elam, designers are unaware of the typographic systems possibilities that other systems hold for them (Elam, 2007). She proposed eight different systems: axial, bilateral, radial, dilatational, grid, random, transitional, and modular, that help designers create compelling layouts by exploring beyond the traditional grid. I have adapted three of Elam's systems: axial, bilateral and random to fit the bilingual layout requirements and integrated the rest of her typographic systems into three new developed bilingual structures: mirroring, interlacing and complementary (figures *9*).

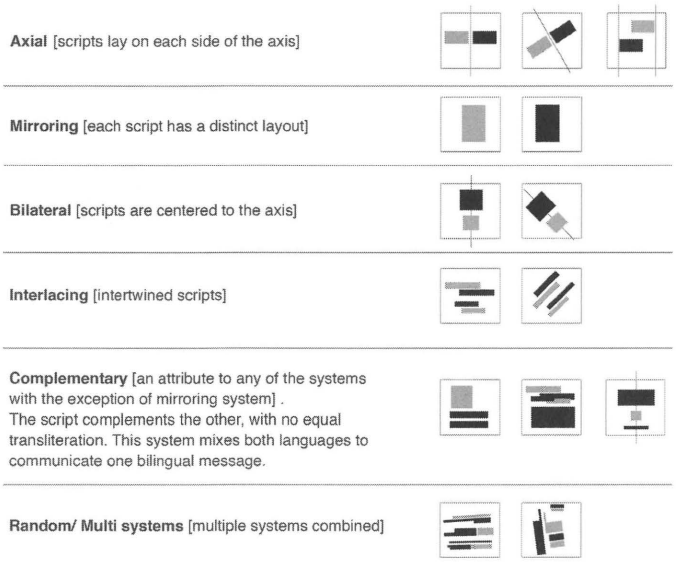


FIGURE 9 *Diagram of the six new proposed bilingual system. Latin script is represented by the black color and the Arabic script by the grey color.*

For a better understanding of these proposed bilingual structures, an explanation of each system will follow. I illustrate the proposed six bilingual systems using diverse visual examples[8] as well as graphical representations that I developed to better comprehend the relationship of both scripts. These graphical representations compute the volume allocated for each language; grey color represents the Arabic script and black color represents the Latin script. This chart communicates the visual ratios of the two scripts reinforcing the difference in volume between scripts and demonstrating that most frequently the Latin script is larger, as described earlier. It highlights the importance of script volume leading to a better understanding of bilingual structures. This difference in volumes supports the analytical fact of both scripts differing in structure and dimension. In addition, the arrows located in the black and grey areas represent the direction of each script showing how both scripts interact.

THE SIX PROPOSED BILINGUAL SYSTEMS

I: BILINGUAL AXIAL SYSTEM

The bilingual axial system is where each script (Arabic + English /French) lays on the side of a vertical or horizontal axis. This structure is widely used in bilingual catalogs and book designs, keeping the scripts independent from each other. It allows designers to place the scripts individually on one side or the other of a single axis, which creates an invisible divider (*figure 10*).

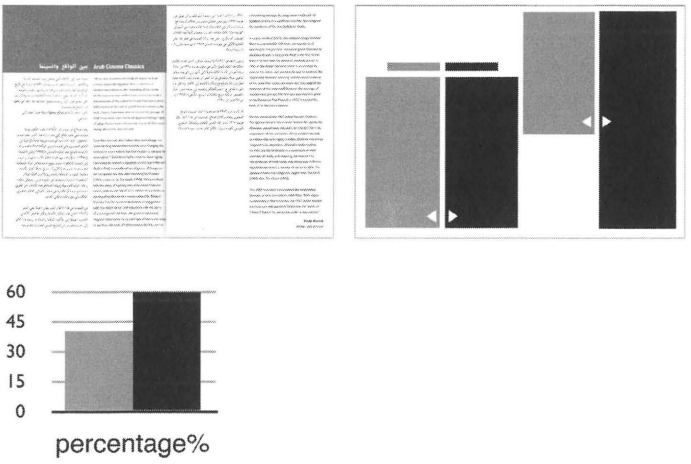


FIGURE 10 *Vertical axial system. "Ayam Beirut Al Cinema'iya" Arab Film Festival Catalog. Beirut 2008Arab Film Festival Catalog. Beirut 2*

This system is also practiced with two parallel axes each introducing a script that faces the other (*figure 11*). However, if both scripts are aligned, then the opposite direction of the scripts poses a problem for the axial system, as the texts ideally should not move towards each other, but away from each other, unless the designer chooses to create a particular negative space between the two scripts.

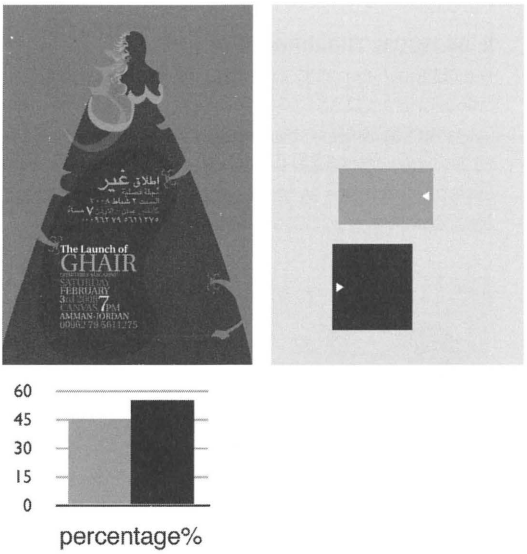


FIGURE 11 *Horizontal axial system. Poster design by Malika Katishat. LAU, Beirut 2008*

In advanced publications such as in posters designs, the designer can apply multiple axial systems combined to create an attractive and intricate composition (*figure 12*).

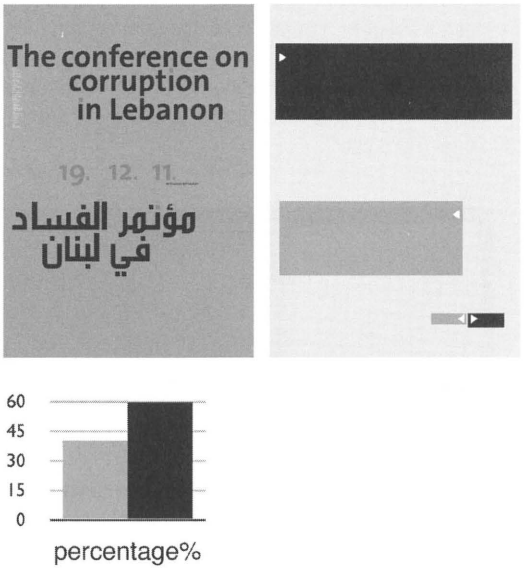


FIGURE 12 *Vertical and horizontal axial systems. Poster design by Dana Charabati. LAU, Beirut 2008*

II: BILINGUAL MIRRORING SYSTEM

The bilingual mirroring system is where scripts are "mirror" reflections and separated from each other. Most mirroring systems are used in bilingual package designs (*figure 13*), street signs, business cards and brochures. The mirroring system comprises of two parts with equal visual density, each containing exclusively one script.

FIGURE 13 *"Leaves" tea package design by Farah Kalash. LAU, Beirut 2008*

This system is widely used in brochures and books where the treatment of texts is equal yet separate. It deals with single script model that is convenient for lengthy texts to keep it intact without the distraction of the other script, thus making it easier to read. For instance in Figure 14, the scripts are facing each other, each placed on a flap of the cd booklet, displaying an equal text volume, and are divided by the center CD holder.

FIGURE 14 *"Darwish" CD design by Randa Abdel Baki. © Forward Music 2009*

Many designers choose this system as it deals with scripts distinctly, without handling the complexity of bilingual layouts. However, they have to understand even though the scripts are not combined together they still have to work

together, thus the importance of harmonizing bi-scripts as discussed earlier. The most common and weak application of the mirroring system is exhibited in the vernacular presentation of shop signage and adverts. These bilingual layouts are not integrated since the treatment of both types is neither compatible nor harmonious (*figure 15*).

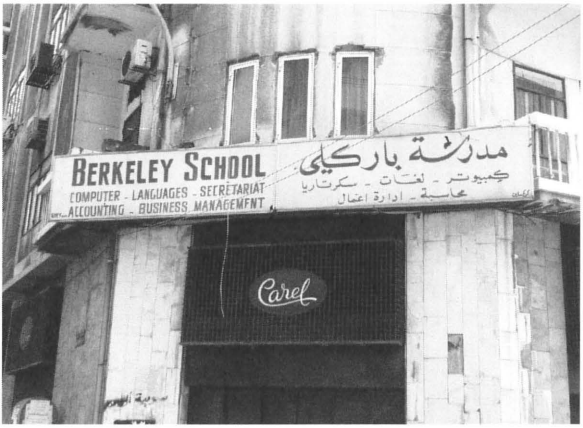


FIGURE 15 *Berkley School bilingual sign. Beirut 2012*

III: BILATERAL SYSTEM

The bilateral system is a symmetrical structure, where both scripts are centered on the same single axis. This organizational system separates the two scripts from each other, thus making the selection of language easier for the reader. In other words, the reader can immediately discern which language is easier to follow. The volume of scripts adopted in this system is mostly equal. It is mainly used in public bilingual city signs (*figure 16*).

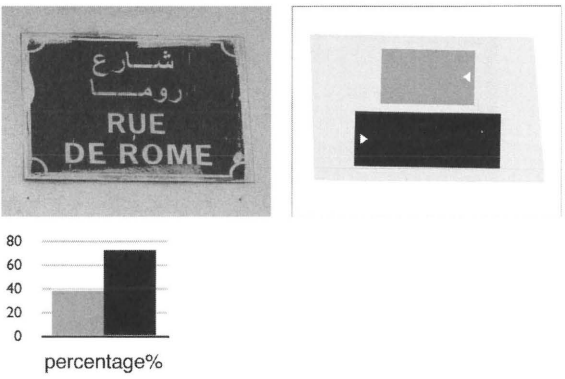


FIGURE 16 *Street sign. Beirut*

The practice of bilingual bilateral system is common and predictable, since it requires keeping both scripts separate and centered to the same axis. This simple bi-structure relies mostly on the choice of corresponding and harmonious scripts that are centered to one axis.

In many existing cases when the typeface treatment is not studied then the final outcome of the layout is weak. (*figure 17*) An effective treatment of bilateral system is when used for bilingual indorsed display sign. (*figure 18*)

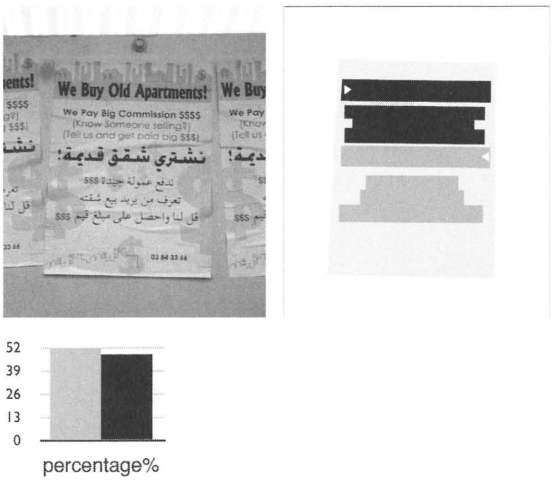


FIGURE 17 *Flyer posted on the walls of Beirut 2009*

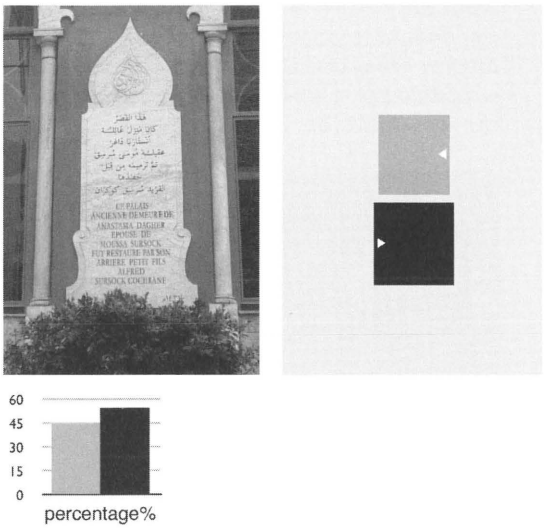


FIGURE 18 *Sursock Cochrane Palace sign. Gemayze. Beirut 2010*

IV: INTERLACING SYSTEM

The interlacing system is where intertwined or interlacing scripts display an interweaving of the two languages. The two languages are combined without a conspicuous axis. This system has the advantage of blending together the two scripts and making the separation of scripts seamless. This bilingual layout system gives the impression of having one unified body text where the volume of each script is no smore crucial as they seem to become one unit (*figure 19*).

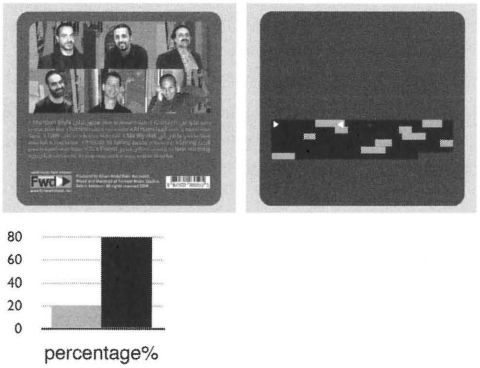


FIGURE 19 *"The Last Communiqué" back cover design by Randa Abdel Baki. Forward Music 2010*

In addition, this system can be combined with other systems such as bilateral or axial as illustrated in Figure 20, where the bilingual text is flushed to the right side axis, having an interlacing axial system. This advanced combination of two layout systems helps the designer to explore a wider range of sophisticated bilingual compositions aiming to unify both scripts into one.

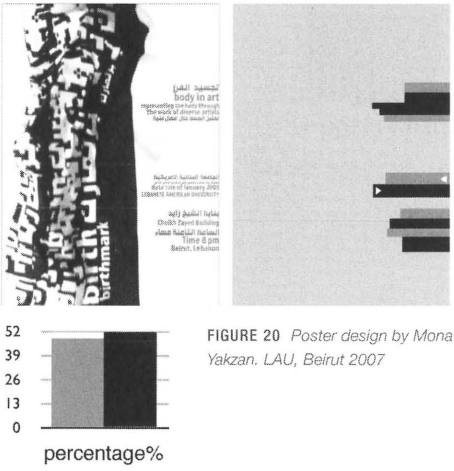


FIGURE 20 *Poster design by Mona Yakzan. LAU, Beirut 2007*

The interlaced system generates a blended visual message that creates a unified dynamic content. The designer has to understand that this bilingual system is inappropriate for lengthy text.

V: COMPLEMENTARY SYSTEM

The complementary system features a layout structure where one script complements the other. It is an attribute to any of the proposed bilingual systems with the exception of the mirroring system that has equal content and cannot be associated to a dual complementary combination. The complementary layout designs could be described or characterized as axial complementary (*figure 21*), bilateral complementary (*figure 22*), intertwined complementary (*figure 23*) or random complementary that will be discussed further in this paper. (*figure 24*)

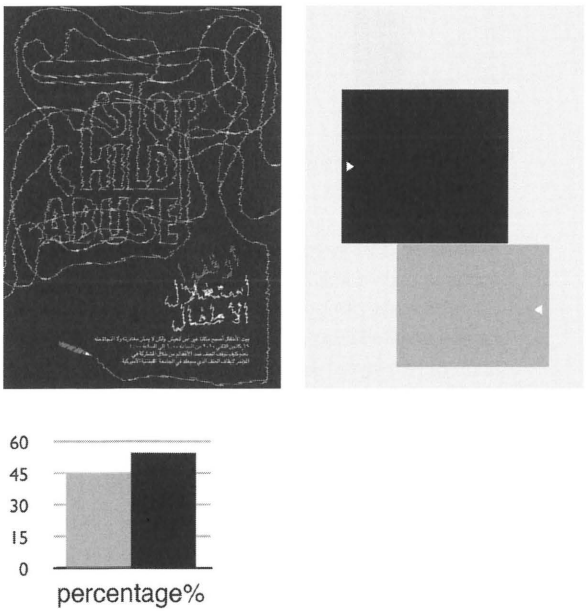


FIGURE 21 *Axial complementary systems. Poster design by Yasmine Salami. LAU, Beirut 2010*

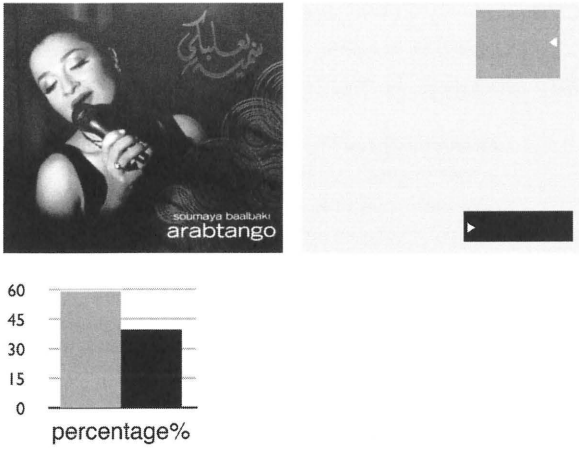


FIGURE 22 *The Arabic calligraphy complements the Latin script. "Arabtango" CD cover design by Randa Abdel Baki. © Forward Music 2009*

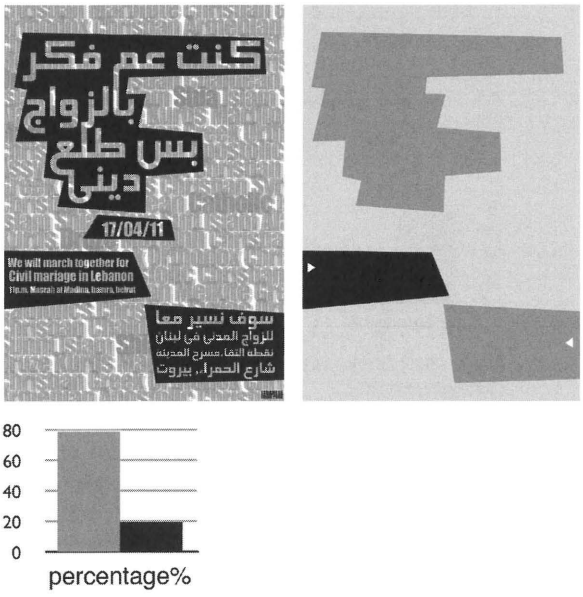


FIGURE 23 *Poster design by Dunia Nassar. LAU, Beirut 2011*

In this case, the designer should keep in mind his priority audience. If the viewer is primarily an Arabic reader, then the main information will be presented in Arabic script and vice versa.

Complementary systems are useful in contexts where the priority audience is clear and the information in the secondary language is merely present as a reference point.

As seen in Figure 25, the car brands are clearly recognizable in their original language and script. However, the potential customers need the information in Arabic. Therefore, the brands' logotypes are the only information in Latin script and the rest is in Arabic.

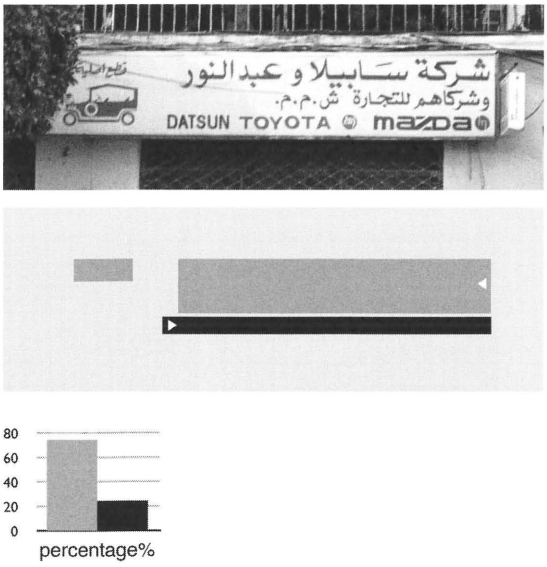


FIGURE 25 *Street shop banner. Car brands are represented by Latin Logotype. Gemayze Beirut. 2010*

VI: RANDOM SYSTEM

The random system consists of multiple systems combined where the scripts appear to follow no specific pattern. The combination of different systems enables a complex layering of information. Different factors, such as priority audiences, locality and hierarchy of information within the layout and direction of the texts can dictate the combination of systems. For example in Figure 26, the book cover design displays a random structure where the Latin script is primary and Arabic script presents the same information yet in smaller script for the local readers. This is further demonstrated in the percentage chart, which clearly conveys that the Latin script visually dominates the Arabic script in this particular example. Another

combination of multiple visual systems is presented in Figure 27. It is comprised of intertwined and axial structures, including the same content in both languages.

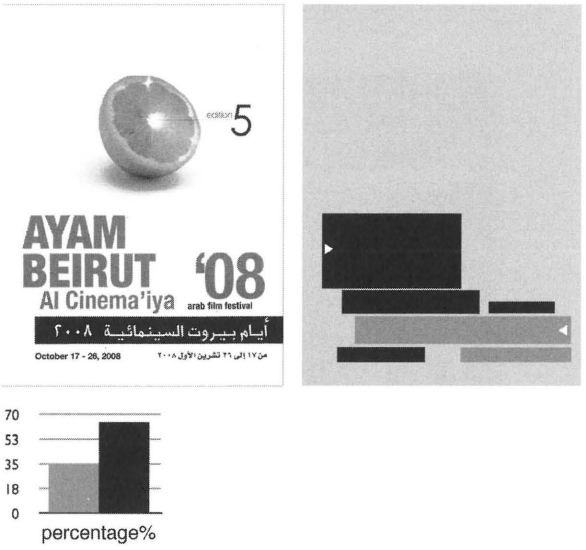


FIGURE 26 *"Ayam Beirut" book cover. 2008*

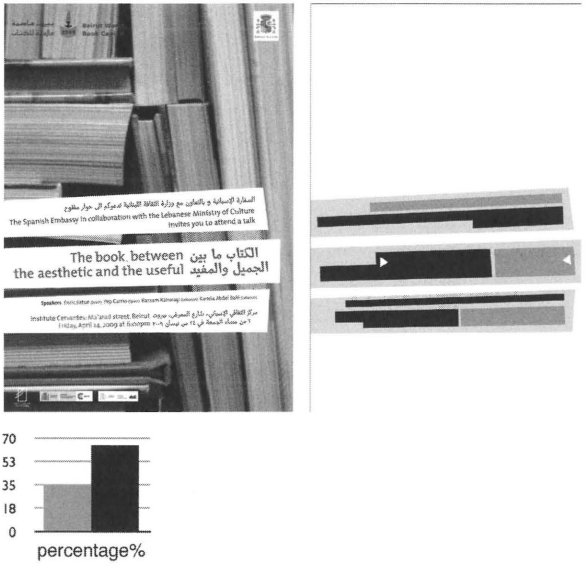


FIGURE 27 *"The book between the Aesthetic and the Useful" Conference. Poster design by Randa Abdel Baki & Bassam Kahwagi. 2009*

In other instances, the random system can also feature the complementary attribute, blending multiple compositional systems with variable contents. This means that the Latin and Arabic text complete each other instead of equally reflecting each script (*figure 28*).

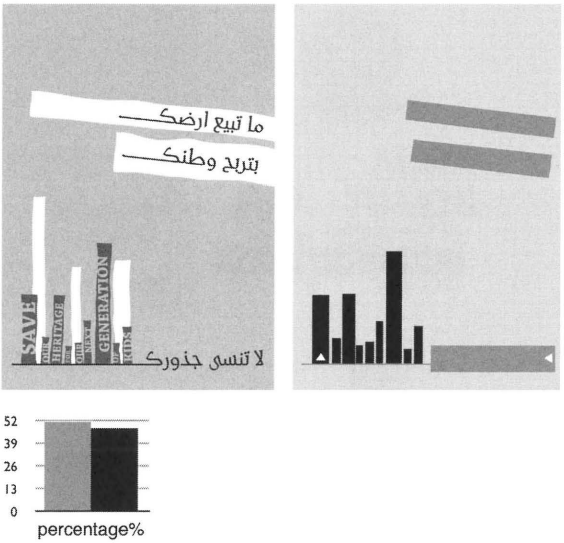


FIGURE 28 *Poster design by Aleen Chehayeb. LAU. Beirut 2011*

The purpose of this visual system is to produce a fusion of dynamic bilingual scripts while keeping the design cohesive.

DISCUSSION

In order to achieve a harmonious bilingual system the designer has to keep in mind various criteria such as appropriating complementary typefaces, hierarchy, direction of reading, legibility and contrast. The six proposed bilingual systems articulated above showcase a broad range of bilingual design solutions and offer designers, educators, and students the tools to expand and explore further bilingual systems. These bilingual systems provide the tools that can be applied to solve specific design problems. However, this dual layout approach is still in its infancy. It illustrates a complex visual structure for bilingual readers, which adds an extra layer to the understanding of visual communication while offering the viewer the choice of reading both scripts.

The specific challenge of bilingual systems remains for designers to create symbiotic designs that enrich the emerging global dialogue while preserving local culture specifics.

In bilingual design, the most important challenge remains to maintain harmony between the two languages. In a visual culture dominated by Western influence, it is important to bring Arabic script up to par in novelty, innovation, and legibility. Bilingual material possesses culturally sensitive duality, which poses a critical contemporary question for the local designers in the Middle East. The specific problems posed by the combination Arabic and Latin scripts are relatively novel and made acute by the cultural necessities of globalization. In this sense, the specific case study of Lebanon is an important beginning for this larger conversation on the use of bilingualism in design.

The duality of scripts, as illustrated in the case study of Beirut, can also be expanded to other scripts such as the Cyrillic, Hellenic, and Sanskrit alphabets. The specific issues posed by Arabic can be used as a foundation to expand on, as script-based differences will inevitably produce different affects. The juxtaposition of different languages will pose challenges that can only be overcome through the understanding of specific dualities.

The inherent hybridity in bilingual design layouts is an immediate rendition of a sense of belonging and the fusion of two languages is indicative of a cultural exchange.

The research in dualities and hybridity also furthers our understanding of design as a form of communication, a contemporary mode of research, and an intercultural tool. This opens up a new horizon of possibilities in places where there is a plurality.

The integral relationship between everyday life and design also accentuates the importance of carrying the permeability of this study in both the commercial design world and the more abstract understanding of these concepts in educational contexts. To put in harmony two scripts of different language in various formats such as adverts, posters, books, and packages can be enhanced with the application of the six proposed bilingual systems.

It is also of note that the general concept of duality can be applied to many different media and any artistic realm in which cultural production takes place. As cultural nuances become more prominent

in contemporary design, the need to integrate the differences as well as the similarities into the quotidian becomes more pressing. The abstract and the utilitarian come together in bilingual design layouts that can be used as a framework for other forms of hybridity.

REFERENCES

Bringhurst, R. 2002. *The elements of typographic style, 2nd ed.*, Hartley & Marks, Vancouver, 107.

Chahine, N. 2008. *Face to Face Interview.* http://ilovetypography.com/2008/05/01/face-to-face-an-interview-with-nadine-chahine (Accessed April 10, 2012).

Cleveland, P. 2008. *Aesthetics and Complexity in Digital Layout Systems.* http://www98.griffith.edu.au/dspace/bitstream/handle/10072/24181/49670_1.pdf?sequence=1 (Accessed May 12, 2012).

Coupland, N. 2010. *Welsh Linguistic Landscapes 'From Above'*
and 'From Below'. Jaworski, A., ed. Semiotic Landscapes: Language, Image, Space. London: Continuum, 77-101.

Dalton Maag. 2012. Case Study Dubai Metro in Detail. http://www.daltonmaag.com/news/135.html (Accessed May 20, 2012].

Elam, K. 2007. *Typographic Systems.* Princeton: Princeton Architectural Press.

Haralambous, Y. 1998. *Simplification of the Arabic Script: Three Different Approaches and their Implementations.* Lecture Notes
In Computer Science. Berlin: Springer-Verlag, Vol. 1375.

Linotype. 2012. Badiaya Family. http://www.linotype.com/341148/Badiya-family.html (Accessed April 11, 2012).

Nemeth, T. 2006. *Harmonization of Arabic and Latin Script. Possibilities and Obstacles.* University of Reading.

Salibi, K. 2003. *A House of Many Mansions - The History of Lebanon Reconsidered, New Ed edition.* London: B Tauris & Co Ltd.

Smitshuijzen AbiFares, H. 2001. *Arabic Typography a Comprehensive Sourcebook.* London: Saki Books.

Smitshuijzen AbiFares, H. 2009. *Typographic Matchmaking: Building Cultural Bridges with Typeface Design.* Pap/Cdr Bl Edition. Amsterdam: BIS Publishers.

Tracey, W. 1975. *Advances in Arabic printing, British Society for Middle Eastern Studies, Durham:* British Society for Middle Eastern Studies.

ENDNOTES

1 As a graphic designer and an academic working and teaching in Lebanon, I have thoroughly observed and analyzed many typographic bilingual layouts displayed in the city of Beirut for at least two decades and have directly worked with bilingual design issues in my teaching career.

2 Bi-scripts will be discussed later in this paper, as they represent a major component to design successful bilingual layouts. They display the overall texture, contrast and form of the layout.

3 I use the term "harmonious" and "integrated" to refer to a relatively comparable and equal treatment of both Arabic and Latin scripts.

4 Nadine Chahine, font designer and Arabic specialist at Linotype GmbH, handles Arabic-related projects. A few of her Arabic fonts are: Frutiger Arabic, Palatino Arabic, Badiya and Janna.

5 Yara Khoury type designer and design director at Al Mohtaraf (www.mohtaraf.com) design house. Her work focuses on designing corporate identities and publications for the Arab world and developing Arabic typefaces.

6 Pascal Zoghbi is a typography instructor and type designer specialized in Arabic fonts. He designed contemporary Arabic fonts for leading Middle Eastern Newspapers, magazines, and urban spaces.

7 In the advanced typography class that I taught at LAU, I requested from my students to develop bi-scripts in order to understand the differences of scripts and their challenges before moving forward and looking at the big picture of designing successful bilingual layouts. This was further developed in another paper: Coupling Bilingual Typefaces.

8 The selected visual examples are depictive of bilingual applications in the city of Beirut and demonstrate the integrated new bilingual layout systems. They are based on urban street signs, my students' work at LAU and a collection of personal design work.

ABOUT THE AUTHORS

Mike Zender is Professor of Design and Director of the Graduate Program in Design at the University of Cincinnati. Mike received his MFA (terminal degree) from Yale University where he was the Carl Purrington Rollins Fellow. In 2004 he was a Medical Informatics Fellow at the Marine Biology Laboratory, Woods Hole, MA, and in 2009 was named a National Fellow of the AIGA (American Institute of Graphic Arts) for his contributions to design and design education. Professor Zender's research is on non-verbal communication through simple symbols such as icons and pictograms in the medical domain, and the application and testing of these in global cross-cultural communication.

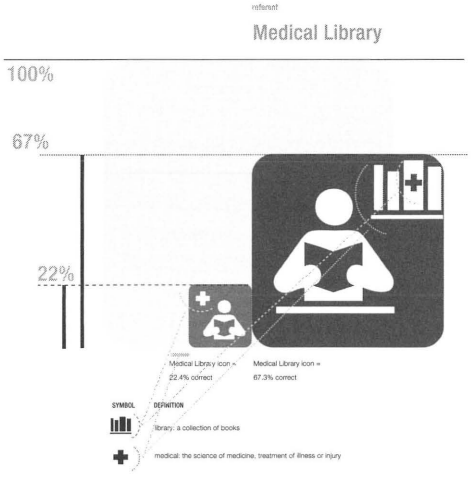
G. Mauricio Mejía is an assistant professor at the Department of Visual Design, Faculty of Arts and Humanities, at the University of Caldas, Colombia. He received a Master's degree in Design from the University of Cincinnati, USA. Currently, he is a PhD in Design candidate at the University of Minnesota, USA. His research work focuses on interaction design for social change. He is interested in the theory of rhetoric in design, human differences in design, and design research methods.

04 Improving Icon Design: Through Focus on the Role of Individual Symbols in the Construction of Meaning

MIKE ZENDER & G. MAURICIO MEJÍA

ABSTRACT

Despite the fact that icons are widely relied upon for communication, designers have few principles to guide icon design. This paper reports a study of the role individual symbols play on the construction of meaning from icons. An experiment compared two sets of four icons, each made of a different set of discrete symbols. It finds that the interaction of the right number of symbols for the referent, and a more apt combination of individual symbols for the referent, can significantly improve the construction of an icon that communicates what was intended. The rules of thumb proposed here are applicable to construction of any visual communication that uses symbols.



Icons today are ubiquitous and utilitarian. They shimmy on iPhones, bounce on computer screens, spin on cable TV's, and hang out on restroom doors. Icons are useful because they facilitate succinct communication. While their form is simple, their comprehension can be extensive. Indeed, nearly all communication happens through the interaction of symbols. Icons, ancestors of the earliest known forms of writing, have been a functional part of daily life since the pyramids were built so why study them now?

A sufficient reason would be that many icons are not understood as intended. The ISO (2007) and ANSI (2007) recommend 85% correct comprehension for all warning symbols. A 2010 USA Today article titled "One third of drivers can't recognize this idiot light" (Woodyard, 2010) reported that a tire inflation pressure warning icon mandated by law, was not understood by 60% of drivers: 46% couldn't even identify the symbol as a tire! Our own icon comprehension studies show depressingly similar results. Only eight of a set of 54 medical icons that were carefully designed to cross language and cultural barriers achieve 85% comprehension by subjects in the USA, and just 3 of those icons were comprehended at the 85% level by subjects in Tanzania. Indeed, fewer than 1 in 10 Tanzanians, many of whom had advanced medical training, could correctly identify 19 of the 54 medical icons. That's a failure rate of 90%.

Despite the common failure of icons, little is written about how they work from either a theoretical or a practical 'how-to' perspective. Beginning with Dreyfuss' *Symbol Sourcebook* (Dreyfuss, 1972) there has been steady parade of books that exhibit the latest symbols and icons, but few if any of these tomes explain how visual symbols work or how they might be made to work better. That is the gap our icon research seeks to fill. This paper describes a research study that measured the impact different combinations of symbols have on the comprehension of four icons. Based on this we identify some patterns, sketch some initial hypotheses for how people construct meaning from symbols, and propose some how-to rules of thumb to guide the design of more effective icons.

SYMBOLS AND ICONS

Besides being ubiquitous and utilitarian, icons are significant objects of study. Icons have simplicity of form compared with many other communication materials whose visual forms are much more complex. Icon's lean visual form reduces interpretive complexity. Icons also tend to have a very definite intended meaning: the referent…

Compared with other visual communications such as print advertising where the message can be nuanced, icon's intended message is clear, unambiguous and generally well-defined from the start of the design process.

This gives icons an established measure of comprehension success. Icons are typically created in a consistent graphic style. Since standardization efforts in the 1970's, notably the US Department of Transportation's commission of the AIGA to produce a standard symbol set, icons for a wide range of referents have followed the highly abstract round head and mitten hands familiar on restroom doors. Thus a wide variety of subject matter is available in a consistent visual style, facilitating study. While we are aware of one study that explores the effectiveness of this common style (Marom-Tock & Goldschmidt, 2011), similarity of style — however effective – has the benefit of reducing the number of variables in comprehension testing.

Despite the apparent simplicity, clarity, and consistency of icons, they are actually combinations of symbols. To clarify, a short digression into semantics may help. There are several descriptive words used for what we have been calling icons, variously called pictograms, symbols and signs. The *New Oxford American Dictionary* defines icons from a religious perspective: "a painting of Jesus Christ or another holy figure…". That dictionary's etymology of 'icon' traces it to the ancient Greek, eikon - 'likeness, image.' Biblical Greek translates eikon as image in Colossians 1:15 describing Jesus as "the image of the invisible God, the firstborn of all creation." Christian theology of the incarnation teaches that Jesus physically embodied the characteristics of God. Thus the early use of icon, or image, implies not mere physical resemblance but embodiment of the concept in visual form. Because historically 'icon' stands for this combination of physical representation that embodies concept, and because this integration of representation and concept can be widely seen today, we adopt icon as our preferred term for our study objects. We'll use the following taxonomy for this paper:

SYMBOL: *image referring to something else — a referent*

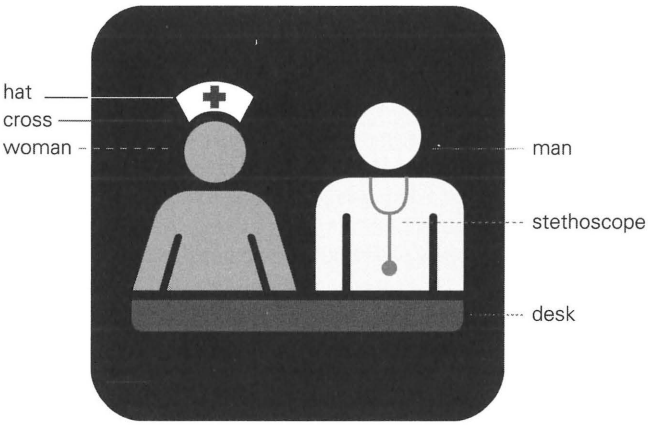
SIGN/GLYPH: *non-representational symbol, arbitrarily assigned with a wholly learned connection to a referent*

ICON: *representational image requiring no special learning for a categorical referent*

PICTOGRAM:*a combination of symbols and/or icons and/or glyphs to communicate a narrative or story or data set*

PICTURE: *representational image requiring no special learning for a particular referent*

Implied in our taxonomy is the concept that a single icon may integrate several different symbols to construct meaning. For example, the icon shown in Figure 1 combines six symbols: hat; cross; woman; man; stethoscope; desk; intended to communicate the referent "medical services." Sidestepping for the moment gender stereotypes, the man plus the stethoscope represent "doctor," the woman with the hat and cross on it represent "nurse," the desk represents "office or workstation." Taken together these individual symbols were designed to say in effect: "nurses and doctors (medical personnel) behind a desk to give information (not to treat patients)'" which is the definition of the referent, "health services." An icon that combines multiple symbols to construct meaning is not an exception but the norm. In an article previously presented in this journal (Zender, 2006), we noted that many of the 50 icons in the 1974 AIGA/DOT Symbol /Sign system were combinations of symbols. In fact, 35 of the 50 AIGA /DOT icons use more than one symbol: that's 70%. In the medical icon system noted previously, only 7% of the icons use a single symbol, all the rest 93% (50 of 54), combine two or more symbols to convey a referent.



man + stethoscope = doctor

woman + hat + cross = nurse

doctor + nurse + desk = **medical services**

FIGURE 1 *Six individual symbols interact to form a single icon to represent Medical Services.*

To better understand how multi-symbol icons work, we conducted a study to explore the impact of changes in individual symbols within an icon on the construction of meaning. We aimed to improve the design of icons so that they are comprehended more accurately. Our first hypothesis was that the addition of more symbols to an icon could improve icon comprehension. We reason that comprehension of a icon's referent would be aided if the icon incorporated a symbol for each aspect of the referent definition. We also reason that a symbol more carefully matched to the referent definition would improve icon comprehension. In the previously mentioned 2006 article, context was identified as the key concept for decoding the meaning of symbols. The study reported here focuses on the 'immediate context' of symbols interacting within a single icon. It does not study the Environmental Context: the environment in which the images function, or the Proximate Context: the field of interaction where symbols in a system interact with other symbols in the same system to construct meaning. These important contexts were respected in this study by the methods used but were not the subject of the study. This study focuses instead on the impact of a change within the immediate context of a single icon brought about by adding or changing one of the individual symbols within that icon...

From this study we hope to gain some knowledge of how visual symbols interact to form meaning in icons and by extension, how symbols interact to form meaning across the entire field of visual communication.

STUDY

BACKGROUND

In 2009 the University of Cincinnati joined a five-school consortium brought together by SEGD and Hablamos Juntos, an organization devoted to improving healthcare for Latinos, to develop universal icons for healthcare environments. These icons, designed to cross language and literacy barriers in hospitals and clinics, were to supplement a previously developed set of healthcare icons that fit generally within the style of the 1974/1979 AIGA/DOT Symbol system. Teams of undergraduate design students at each institution developed candidate healthcare icons that were tested at four of the five schools using the ISO comprehension estimation protocol. (ISO, 2007) Test subjects spoke five different languages to insure universal comprehension independent of language and across cultural contexts. The result was a tested group of candidate symbols that were given to noted symbol designer Mies Hora for final development.

Mies recommended a number of refinements to icons including several that eliminated or replaced one or more symbols from an icon (*see figure 2*). For example, for the referent "Medical Library" the top scoring icon consisted of a dominant image of a person holding a book, at a desk represented by a single line waist high, with a shelf of books one with a medical cross in the upper right. The proposed revision simplified the icon by eliminating the desk and bookshelf. For another icon, Mies proposed keeping but changing contextual symbol: replacing the crescent moon symbol in the Inpatient Care icon with a clock symbol. Based on our previous work, we hypothesized that the elimination or alteration of the supporting symbols would affect comprehension. We specifically hypothesized that the removal of the smaller desk and bookshelf symbols would lower comprehension because it removed context; and that switching the moon and clock symbols would hurt comprehension because the clock contextual symbol less definitely suggested night, and therefore would not suggest overnight stay as well as the moon symbol.

FIGURE 2 *Left column: the revised icons with fewer or less apt symbols (Group 2) Right column: the original consortium icons with more or more apt symbols (Group 1) Our study compared comprehension these icons.*

STUDY DESIGN + AIM

The icon alternatives just noted provided us the opportunity to conduct a study of how individual symbol changes within an icon impact comprehension.

We labeled the two kinds of symbol change in a multi-symbol icon: quantity and quality. An icon could contain more or fewer symbols relative to the referent definition; quantity; or an icon could have a given number of symbols but those symbols could be more or less well matched to the referent definition: quality. We anticipated that if the multi-symbol icon lacked a symbol that was part of the referent definition that comprehension would suffer. Similarly, we anticipated that if a multi-symbol icon had a symbol that was less well-matched to the referent definition – less apt – that comprehension of that icon would likewise suffer. We suspected that absence of a symbol (quantity) would have a greater impact on comprehension that an imperfectly matched symbol (quality), reasoning from linguistics that an incomplete definition communicates less well than a definition with poor wording but that includes all the necessary concepts. We tested both kinds of change: quantity and quality. We selected icons for two referents: Medical Library and Health Services for the quantity test. Each had had a symbol removed. For the quality test we selected icons for two other referents: Inpatient Care and Nutrition each of which had a symbol replaced by different symbol. We designed our study to measure the effects of symbol change on comprehension. We expected that the icons with more symbols and more apt symbols would be better understood.

METHODS

This is a mixed methods qualitative and quantitative study. We wrote a modification of the existing Hablamos Juntos IRB protocol changing from a comprehension estimation method to the recommended ANSI Open-ended Comprehension Test method (ANSI, 2007) because this test is currently the most valid instrument for evaluation of icon comprehension. The test instrument asks a subject to imagine that he or she is in a given place (a health care facility for this study) and then answer two open-ended questions: the meaning of the icon and the actions that would be taken in response to the icon. The first question probes understanding at the level of abstract concept, the second at concrete action. Taken together, the two questions give an evaluator ample evidence to use to measure subject comprehension. An expert panel of three evaluators then independently scored subjects' qualitative answers. The quantitative scores were then analyzed.

We prepared two open-ended comprehension survey instruments to compare the two conditions between subjects: subjects in group 1 had icons with more and more apt symbols, while subjects in group 2 had icons with fewer and less apt symbols. Each test contained 4 icons, one each to represent the same 4 referents: Health Services; Medical Library; Nutrition; Inpatient. Figure 2 shows the eight icons used in the study. Two icons in group 1 contained more contextual information by way of additional symbols: the Health Services icon had an additional horizontal line symbol representing a desk; the Medical Library icon had a additional horizontal line symbol representing a desk and additional bookshelf symbol with a book having a medical cross symbol. The icons for group 2 lacked these symbols in the Health Services and Medical Library icons. The two other icons in group 1 had more apt symbols: the Nutrition icon for group 1 had a man instead of a triangle for group 2; the Inpatient icon for group 1 had a crescent moon symbol instead of a clock symbol for group 2. Our reasoning for these symbol substitutions was that the human symbol would better convey nutrition as a human health topic rather than a mere balance of foods, and that the crescent moon would better convey night than a clock which more generally represents time. Each test instrument had an identical instruction sheet that described the environmental context and gave an example of how to answer. After going over the instructions with the test administrator, each subject was allowed all the time necessary to write his or her answers on the test sheet, usually 15 – 20 minutes. The instrument administrator was present during the study only to answer necessary questions.

In spring 2010 a first cohort of subjects (n=30) was recruited, 15 randomly assigned to group 1, and 15 to group 2. Graduate students and Latino clients of a NGO composed this cohort. In autumn of that same year the study was repeated with a second cohort of 80 subjects (n=80), 40 randomly assigned to group 1, and 40 to group 2. Students visiting in a university student center composed this cohort. The total number of study subjects was 110 (n=110). Both cohorts were exposed to the same four referents to isolate the context variable for the study. The researchers discussed the classification of amount of contextual information and adequate context and used heuristics for decisions. Evaluators used a scoring sheet to independently score completed test instruments. A sample from the scoring sheet for Medical Library:

> **ICON 2:** *Medical Library*
>
> **RESPONSE MUST INCLUDE:** *medical or health or healthcare or hospital or clinic or doctor's office or care/care center, etc. plus library or books or book collection or reading room/area or information place/source, etc.*

Evaluators considered responses to both questions: what does it mean… what would you do… as a single answer to determine whether the subject correctly comprehended the icon. One of just three scores were assigned to each subject answer: correct, partially correct, incorrect. An example of a partially correct response would be a subject mention of library or books but not medical or healthcare or hospital for Medical Library. Scoring difficulties discussed elsewhere (Zender, Han, & Fernández, 2011) were largely overcome by use of three evaluators and by combining three forms of analysis. First, quantitative data analysis used t tests to compare comprehension means between groups. A value of 1.0 to correct responses, 0.5 to partially correct responses, and 0.0 to incorrect responses were assigned. Second, we used visualization to analyze the results and make comparisons. Third, we coded and analyzed the qualitative verbal answers. Using these methods we measured the changes in comprehension, if any.

FINDINGS

Comprehension was significantly better for the group 1 Medical Library and Inpatient icons that had the additional symbols. Comprehension was better, but not in a statistically significant way for the group 1 Health Services icon that had the more apt symbol, with no significant difference between the group 1 and group 2 Nutrition icons.

QUANTITATIVE ANALYSIS

In the quantitative data analysis, there was a significant difference in comprehension between the groups in the icons for Medical Library and Inpatient. In the Medical Library icon, the group exposed to more contextual information ($M = 0.736$, $SD = 0.407$) understood more than the group with less contextual information ($M = 0.400$, $SD = 0.400$). The mean difference was significant, $t(110) = 5.068$, $p = 0.001$. In the Inpatient icon, the group exposed to more apt contextual information ($M = 0.736$, $SD = 0.331$) understood more than the group with less apt contextual information ($M = 0.536$, $SD = 0.316$). The mean difference was significant, $t(110) = 3.774$, $p = 0.001$. There were no statistically significant comprehension differences between groups in Health Services and Nutrition icons.

Comparing the overall understanding including the four icon scores in each subject, the group exposed to more and more apt contextual information ($M = 2.618$, $SD = 0.938$) understood more than the group with less and less apt contextual information ($M = 2.009$, $SD = 0.781$). The mean difference was significant, $t(110) = 4.411$, $p = 0.001$. Therefore, contextual information is determinant of quality of icon comprehension as measured by understanding of meaning and actions that icons propose.

In comparing the means between the first cohort (n=30) and the second cohort of subjects (n=80), the trends were similar except for two slight differences. As shown in Figure 5, the Health Services icon in the first cohort had a lower mean (M = 0.450) than the second cohort (M = 0.650). In Nutrition icon, the first cohort had a higher mean (M = 0.600) than the second cohort (M = 0.482).

VISUAL ANALYSIS

Visualization of data is a proven method for gaining understanding. (Card, Mackinlay, & Schneiderman, 2003) The visualization in Figures 3.1 and 3.2 clarify the effect of two ways of quantitatively analyzing the data: the mean of the numeric rating of scores (1.0 = correct; 0.5 = partially correct; 0.0 incorrect), and the mean percent (%) of correct scores. The numeric rating scale incorporates partially correct scores with correct scores in a single number. As you can see in Figure 3.2, mean numeric scores inclusion of partially correct answers changes the picture: the advantage of the group 1 Medical Library icon is less pronounced when partial scores are included. Conversely, the superiority of the Medical Library icon is more pronounced when only considering % correct answers. The Nutrition icon shifts slightly from group 1 being better when only correct scores are considered to being slightly worse that group 2 icon when the numeric system accounts for the partially correct answers. One observation is that the simple question, "which icon is better" is more complex that it seems.Our results were significant, but clearly how you create those results has an important impact on the answer. These details matter. It is important for design research to operate at a level of nuance.

It is also extremely important to compare the full context when converting data to knowledge. The visualization in Figure 4 facilitates comparison by placing correct answers in context of all answers: partial and incorrect. Several interesting points stand out. The Medical Library group 1 icon clearly outperformed because of a very low number incorrect scores, while the group 2 icon for Medical Library had a very large proportion of incorrect scores. The group 1 Nutrition icon with the man instead of the triangle had either correct or incorrect scores, with very few partially correct, while the group 2 Nutrition icon had a significant number of partially correct scores. The group 1 Nutrition icon has a strong correct score but seeing that the number of incorrect scores is nearly equal to the correct suggests that subjects either get it, or they don't. The even dispersal of group 2 Nutrition icon scores suggests vagueness. A new design direction might build on group 1 seeking to clarify what some people get and others don't get. Both group 1 and 2 Health Services icons had a very large number of partially correct scores. This suggests the symbols integrated

in the Health Services icon are close to the right ones but not quite. In design language, this design needs 'tweaking' not a new direction. The same can be said of Inpatient group 2, except that the large number of correct answers for group 1 makes tweaking unnecessary – the right direction is clear: the moon tipped the icon from having a large number of partially correct to a large number of correct answers. None of these observations are obvious if you simply analyze the mean numeric scores or the % correct (*figure 3*).

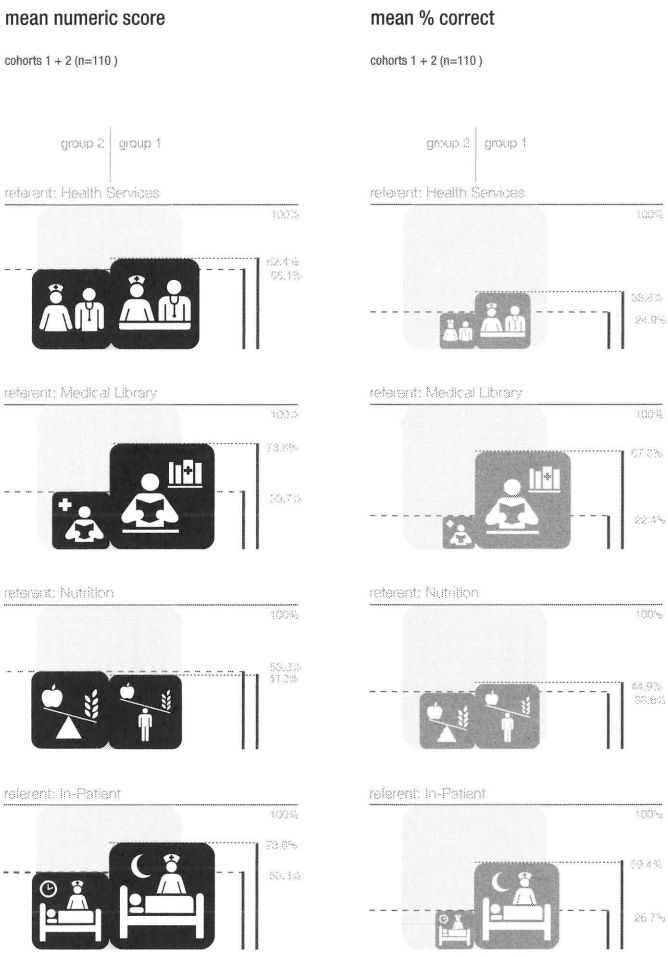


FIGURE 3.1 *The mean numeric score for each symbol is shown in the column on the left. This score is the result of assigning a numeric value of 1.0 for correct, 0.5 for partially correct, and 0.0 for incorrect, adding the scores together and calculating the mean. The percent of correct icons is represented in the right column. This is simply the correct answers as a percent of all answers.*

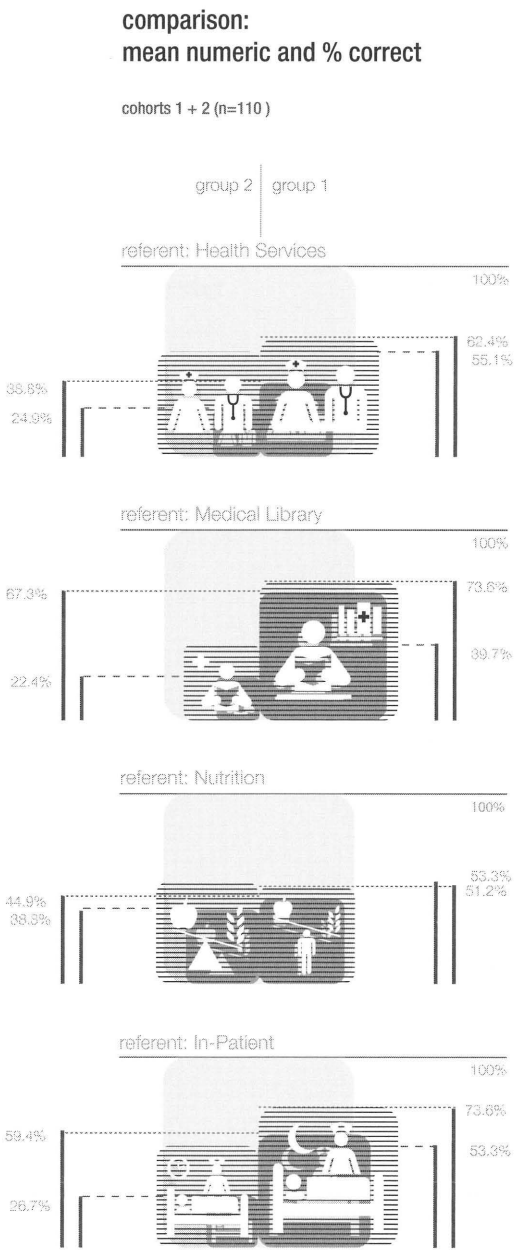


FIGURE 3.2 *A comparison of mean numeric scores (transparent line pattern) and the % correct (solid gray fill) is shown. As you can see, numeric scoring inflates the apparent success of poorly performing icons. Nevertheless, more generous numeric scores were used to calculate statistical significance.*

To verify the consistency of our data we also visually compared answers from the two different cohorts of subjects: cohort 1 with 30 subjects in spring 2010 and cohort 2 with 80 subjects in fall 2010 (*right column figure 4*). We found it interesting that cohorts 1 and 2 had similar results for the group 1 and 2 Nutrition icons, with the % correct being proportional for both icons, while the quantities correct were substantially different. Cohort 1 had eleven to eighteen percent more correct answers than cohort 2! This situation was reversed for the Health Services group 1 and 2 icons. While we were heartened that there was consistency of pattern between the two cohorts across the board, we have no clear explanation as to why the quantities were different between cohorts for Health Services and Nutrition icons. We can only speculate that cohort 1's lower number has more deviation and that the presence of numerous Spanish speaking subjects in that cohort skewed the results.

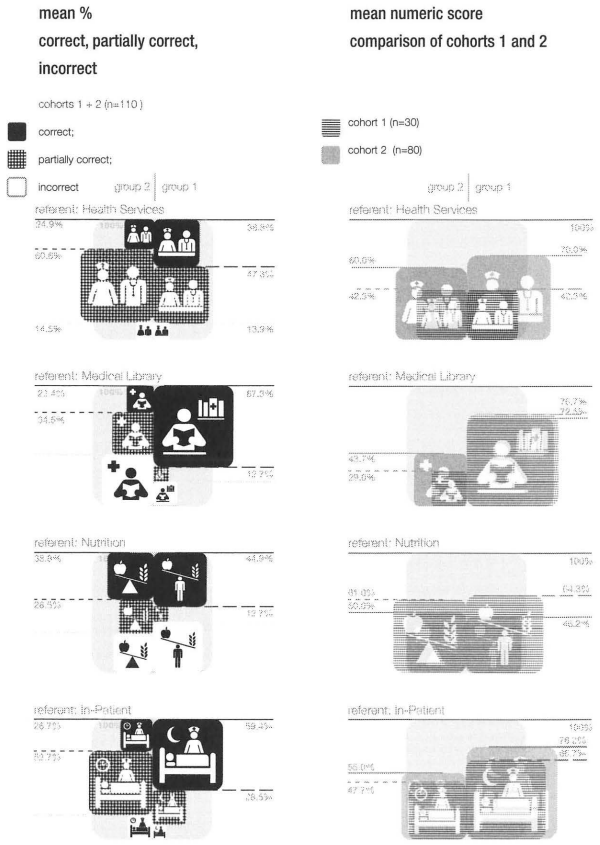


FIGURE 4 *Visual analysis showing the full context of scores: correct, partially correct and incorrect, is shown in the left column. Visual comparison of mean numeric scores of the two subject cohorts: cohort 1 spring 2010, cohort 2 fall 2010, is shown in the right column.*

QUALITATIVE TEXT ANALYSIS

Using a general inductive approach (Thomas, 2006), we analyzed the text of the raw subject answers to gain additional insight as to why some icons failed.

WHY WAS THE BOOKSHELF BETTER?

At the beginning of this paper we said our research program seeks to explain how visual symbols work and how they might be made to work better. As we have studied icons we have found that analysis of incorrect answers provides both insight for hypothesis formation and ideas for practical improvement. Our Analysis of subjects' written answers for the Medical Library icon shows that 8 of the 17 partially correct answers for the less successful "Medical Library" icon used the words 'read' or 'reading': 'reading room'; 'silent reading'; 'books available to read' are some examples. Clearly the general idea of reading was suggested by the man symbol holding reading material symbol. The problem is that a man can read a variety of things almost anywhere. The importance of this is illustrated by the incorrect answers to the same icon. Five of the 12 incorrect answers were 'waiting room.' Reading is often done both in waiting rooms and in libraries. The problem is that 'reading' is a more general concept that's related to, but not synonymous with, the more specific concept 'library.' Medical books however are generally only found in a medical library. As a result, we believed the key symbol in the icon was the medical bookshelf. We believed in this case the symbol of the man reading was functioning as a supporting symbol that aided interpretation of the rectangles and thin line as a bookshelf. Taken together, these symbols interacted to reliably communicate medical library. We believed that the rule under the man representing a table was supportive of the man-reading symbol, combining to communicate 'reading at a table' as opposed to 'reading in a lounge chair' which would suggest the different referent found in many incorrect answers: medical lounge /waiting room. We believed the reading at table better supported library.

As part of our analysis we considered comprehension of the book-shelf symbol with and without the reading man, and the reading man at the table with a reading man in a lounge chair. We believe the bookshelf symbol was the primary carrier of meaning, supported by the man reading symbol and the desk symbol. You might call the bookshelf primary, the man-reading secondary, and the desk tertiary symbols. All % correct scores are correct to the referent. As in all studies reported here, subjects were given the context of a medical facility.

To test this, we designed and conducted a follow-up study to measure the role of the medical bookshelf symbol in comprehension. As Figure 5 illustrates, the symbol for the medical bookshelf symbol consists of 4 vertical rectangles (1) + a horizontal line (2) + a cross

symbol (3). We tested each of these objects independently to see if and at what point the individual objects (1) + (2) + (3) communicated medical library. If the medical bookshelf alone communicated medical library, we wanted to know if it communicated as well as the icon that included the man-at-the-desk. It did, almost. The (1) + (2) + (3) bookshelf symbol alone, without the man, was comprehended correctly by 51% of 78 subjects, increasing to 90% when correct and partially correct scores were combined. This compares favorably with 67.3% correct and 80% combined score for the group 1 icon that combines bookshelf with the man-at-the-desk. This affirmed our suspicion that the key to success of the group 1 Medical Library icon was the bookshelf symbol.

follow-up study
role of bookshelf symbol in
Medical Library icon

FIGURE 5 *As part of our analysis we considered comprehension of the bookshelf symbol with and without the reading man, and the reading man at the table with a reading man in a lounge chair. We believe the bookshelf symbol was the primary carrier of meaning, supported by the man reading symbol and the desk symbol. You might call the bookshelf primary, the man reading secondary, and the desk tertiary symbols. All % correct scores are correct to the referent. As in all studies reported here, subjects were given the context of a medical facility.*

To help gauge the role of desk symbol (the line) in the man-at-desk symbol in the group 1 Medical Library icon, we tested an alternative icon with a man sitting in a lounge chair instead. This icon scored 50% correct. This is slightly lower than both the bookshelf alone at 51% and much lower than the bookshelf-with-man-at-desk icon at 67%. Most of the incorrect responses to man-in-lounge chair icon gave waiting room or medical lounge. This suggests that when users think of a medical library they picture in their mind primarily shelves of books and secondarily of people reading at tables. People-reading-in-a-lounge-chair suggests a different referent to many. We believe the group 1 Medical Library icon was more successful because it combined individual symbols each of which aligned with the mental image of the referent definition: Medical Library – a collection of medical books. This further suggests that the foundation of a successful icon is a clear understanding of the users' mental image of the referent definition and the creation of symbols that match it.

We identified the key symbol in the Medical Library icon as the bookshelf: a shelf on which books are stored. The bookshelf symbol is itself made of three symbols: (1) books, (2) a shelf, (3) a cross-on-book-spine. Like the Medical Library icon, we believed the bookshelf symbol/icon would work when it fully reflected the bookshelf definition. To test this we studied the bookshelf symbols separately and in combination. Seen alone, the books symbol (1) (4 rectangles) was a failure, only 7% correctly reading it as medical library or as books. Seen alone, symbol (2) shelf-under-books also performed dismally, at 17% correct. The 'shelf' line under the rectangles improved reading only slightly, but the addition of the cross on the 'spine' clarified the reading significantly: 51% correctly identified this as medical library. Clearly the combination of symbols (1) + (2) + (3) was necessary to communicate bookshelf.

As noted, library is a narrower concept than reading, and medical library is a specific type or subset of library, suggesting that for narrowly defined referents more symbols with narrower meanings are needed for accurate comprehension.

WHY WAS THE MOON BETTER?

Adding symbols to fit mental concepts improved comprehension, and exchanging symbols improved comprehension as well. The moon was better than the clock for communicating inpatient. We believed this is because moons are most apparent at night, while clocks are seen at all times and represent time generally, not just 'night' time. Indeed, text analysis of subjects' answers indicate that 'night' was more than four times as frequent in the answers to the icon with the moon symbol than in answers

to the icon with the clock symbol. Conversely, references to 'time' and clock' were many times as frequent in answers to the icon with the clock symbol. This is understandable since the icon included a clock symbol! The problem is that most peoples' mental image of inpatient is equivalent to an overnight stay, not a period of time measured by hours on a clock. Overnight is a more specific idea than time, it is a subset of time: night-time. We believe the clock symbol was too general, producing various misleading impressions.

As before, analysis of incorrect answers was revealing in this regard: the most frequent incorrect answer to the icon with the clock was 'visiting hours' or something similar. Note the association with time: hours. An interesting incorrect answer for this icon was 'nurse timing nap.' This reinforces an observation we have had in other studies that when people are deciphering a set of symbols in an icon they can be quite literal, particularly when they are having trouble getting the meaning. The icon with the clock contains 4 symbols: a man, in a bed, a nurse, and a clock. To that symbol set the interpretation 'nurse timing a nap' is completely rational…

This reinforces that individual symbols in an icon interact to form meaning, and that changing one symbol in the group changes the meaning of the whole.

We have one final humorous note. The more successful Inpatient icon with the moon had three incorrect answers, two of which were: 'dead body – avoid it'; 'dead people.' Perhaps the current preoccupation with zombies and vampires, think Dracula and the dark of the moon, provided a context where a moon was associated with death! In the future perhaps designers will routinely check users' mental images against the most popular interactive games, movies, and TV shows before selecting symbols for their icons so as to avoid unwanted gruesome associations!

SUMMARY CONCLUSIONS: A THEORY AND FOUR RULES OF THUMB

In this study we aimed to explain how symbols impact comprehension of an icon…

We believe we have shown that icons embody multiple symbols, and that the interaction of those symbols evokes a specific concept in people's minds.

This may seem like common sense but we don't think this has been state this way before or demonstrated to this degree.

If icons can be seen as a collection of symbols contained in a common visual space to evoke a specific concept, then our findings might provide guidance for all symbol-based visual communication from concert posters to highway signs. We've shown that integrating symbols that more closely match the details of the referent definition can increase comprehension. This suggests both a possible theoretical foundation for symbol-based visual communication, and some practical rules of thumb for communication design practice.

POSSIBLE THEORETICAL FOUNDATION

There have been attempts to apply language theory to graphic design to lay a foundation for visual communication, semiology and semiotic theory being a notable example. One problem with applying semiology to visual communication is that Saussure (a founder of semiology) was a linguist. He appropriately emphasized the social construction of signs and the arbitrary assignment of meaning. This framework is a poor fit for symbol-based visual communication whose representational visual symbols have meanings directly linked to physical objects, not arbitrarily assigned to words. Without lapsing too deeply into digression we note that the relations between visual symbols also depend on the intended interpretive framework. Whole icons, as well as individual symbols that make them can be interpreted literally or metaphorically. W. T. J. Mitchel says, "The picture of an eagle in a Northwest Indian petroglyph may be a signature of a warrior, an emblem of a tribe, a symbol of courage, or – just a picture of an eagle." (Mitchell, 1987) It may be difficult to know the intended meaning of a particular visual symbol. Granted that there is considerable room for interpretation of visual symbols, nevertheless, a more appropriate foundation for visual communication might be founded on visual rather than linguistic processing.

Perceptual psychologist Stephen Kosslyn in *The Case for Mental Imagery* (Kosslyn, Thompson, & Ganis, 2006) explored how our brain uses, processes, stores, and manipulates mental visual representations to think and solve problems. He finds that humans store simple representations of familiar objects in a specific brain region and that these 'brain icons' can be recalled and pressed into visual working memory to think and solve problems. The existence of simple stored representations of common objects opens the possibility that people share a similar, or the same, 'brain icon' (our term, not Kosslyn's) for common objects. One of us explored this concept in 2011 in a series of workshops in India. In one workshop, each of the 75 participants was asked to draw a simple representation of a chair. The participants were then arbitrarily divided into groups

of 3 of 4 people. Each group was asked to draw a consensus version of the most representational chair, using their 4 individual chairs as the basis. Four groups were randomly selected to come and simultaneously draw their 'chair' icon, one on each side of 2 freestanding white boards at the front of the room: 1 'chair' on each side of 2 white boards: 4 chair icons. The class was surprised as they watched 2 identical chair drawings emerge as they were drawn on the whiteboards facing the class. They were amazed when the boards were turned around to reveal that the other 2 'chairs' were also identical to the 2 they had just watched unfold! The 4 drawings were identical: not only in having 4 legs, a seat and a back, but in the having the same 'canonical' point of view. This test has been done in various classrooms and in various locations with the same result: a typical chair with a canonical perspective.

Kosslyn's findings and our anecdotal experience exploring them in India and elsewhere suggests that a theory of how visual symbols are used by designers to construct meaning should account for the processes of visual perception, particularly the memory of simple iconic representations of familiar objects and concepts. This is a departure from the linguistic theoretical models offered previously, and appropriately so since it is now clear that language and visual perception use different neural processes. (Mayer, 2001) Our findings suggest that a successful icon is one whose symbols are most closely aligned with the mental images of users. This suggestion, built as it is on an established theory of visual processing and thinking, could lead to a theoretical basis for icon design.

FOUR RULES OF THUMB FOR ICON DESIGN

Our study is admittedly narrowly focused on the comparative success of 8 specific icons. Such a small study and such narrow findings are clearly insufficient to build a theory supporting specific principles or laws. However, we can tentatively offer three rules of thumb for icon design based on our study. Further research could raise these rules to the level of design principles.

1. MATCH SYMBOL TO DEFINITION

Individual symbols in the most successful icons were closer not only to people's mental images but also to their definitions of the referents…

Designers should learn how people define the referent then select the most accurate symbol for each concept in that definition.

Think for example of moon instead of clock for "overnight stay" or bookshelf rather than a man reading to represent "a collection of books". Designers should first recognize that an icon is a collection of symbols and then match symbols in an icon to individual concepts of the referent definition. This means that designers need to expend effort to understand how people define the referent and then to conceive of symbols to represent each concept in the definition. Not every likely symbol will do. Sloppy symbol selection produces uncertain comprehension.

2. ADD SYMBOLS TO NARROW FOCUS

The first and second rules of thumb are related but where the first emphasizes symbol quality, the second refers to quantity. Fewer symbols are not better. The old saw "less is more" does not apply to icon design where a symbol for each referent concept is critical to success. Think for example of the Medical Library icon where adding the bookshelf symbol, making the icon more complex, improved it. Clearly the bookshelf and desk symbols were closer to "library" for the Medical Library icon than a "man reading" symbol alone. The "man-reading" symbol added important context for the "bookshelf" symbol but was not the key symbol. Both were needed for high comprehension...

Designers should add specific symbols to help people shape the correct referent meaning. More specific symbols provide more substantial clues.

3. CREATE SYMBOL HIERARCHY

In the follow-on studying of the Medical Library icon we found that the "bookshelf" was the primary symbol and that the "man-at-desk" was the supporting symbol. This suggests that a visual hierarchy of symbols exists within an icon and that placing the primary symbol at the top of visual hierarchy and supporting symbols at secondary levels might produce more accurate comprehension. In some icons a sequence of concepts is an important feature of the referent definition. For example, a referent saying "2 pills with meals," is very different from "2 meals with pills." For this kind of referent the symbol hierarchy could be particularly important to icon success. In other studies we have constructed visual stories using symbols in which reading sequence was absolutely critical to success...

Designers should consider the desirable reading sequence of symbols in relation to the referent definition, and then design an icon whose symbols have a corresponding visual hierarchy.

4. STUDY FAILURE TO IMPROVE SUCCESS

The last rule of thumb does not deal with icon design per se, but with icon evaluation. First, we recommend that testing to evaluate communication be woven into the design process. Evaluation of comprehension is complex. (For difficulties in measurement of even simple icons, see Zender et al., 2011) However precise our current ability to evaluate symbols may be, it is clear that unsuccessful icons designs provide rich data to inspire improvement. We use the word inspire intentionally. Certainly, knowing a particular design approach fails helps to guide a designer toward one that succeeds. But we found that analyzing the answers to failing icons provides designers with more than guidance, it inspires designers to new creative possibilities they had not seen before. Our text analysis of raw user data of failed icons provided clear inspiration for improvement...

Designers wanting to improve comprehension would do well to study failing icons in order to gain insight for creative improvement.

Designers seeking the best icon might even intentionally design various inaccurate icons to confirm right directions, validate suspicions, and inspire new directions. Little can be learned about improvement from a situation in which an icon succeeds.

IMPLICATIONS FOR FURTHER STUDY

This study evaluated icons, each constructed from group of individual symbols. We are so early in understanding of the interaction of visual symbols to construct meaning that it is appropriate to devote space to speculate about implications and suggest rich avenues for further study.

SEMANTIC RANGE

One idea comes from the study observations for the Medical Library icon. The symbol combination of the man holding reading material generated a wide range of answers from 'waiting area' to 'reading room.' Adding the bookshelf and desk symbols improved comprehension of 'medical library.' This suggests that the symbol

'reading material' or 'book' was too broad conceptually to communicate 'library,' but that the more narrow concept 'book shelf' significantly improved comprehension of 'library.' Borrowing a concept from linguistics: some visual symbols apparently have a narrow Semantic Range, while others have a broad Semantic Range. In relation to the Medical Library icon, the *New Oxford American Dictionary* gives the word 'book' 3 noun meanings indicating a broad semantic range (3 different meanings), while the word 'bookshelf' has a single noun meaning indicating narrow semantic range (1 meaning). Further study to explore the relation between semantic range of individual symbols and their interaction might lead to a model for identification of the semantic range of a desired referent and of candidate symbols the designer is considering to communicate it. Based on the study just reported, you might hypothesize that for accurate comprehension a narrower referent would need more symbols rather than fewer. This knowledge could be used to guide designers to more successful icons.

CONCEPTUAL FIT

Another outcome of the study was that the Inpatient icon was less well comprehended with a clock symbol representing the concept of 'time,' while the moon symbol to represent 'night' was comprehended better. In terms of semantic range the word 'clock' has one noun definition, and so does 'moon.' With differences in comprehension but similar semantic ranges, the failure of 'clock' and success of 'moon' suggests something in addition to semantic range is in play. The concept of good Conceptual Fit of each symbol to the referent is an idea that grows out of this study that might provide significant insight into icon communication. Since most icons combine several symbols with each symbol influencing the interpretation of the others, the role of each symbol should be weighed in relation to its Conceptual Fit to the referent. We noted for the Medical Library icon that the desk supported the man reading and that the man reading aided interpretation of the bookshelf symbol, and that the bookshelf symbol was the key symbol. Further study to explore the conceptual complexity of individual symbols and interactions might lead to a model for identification of the conceptual nuance of a desired referent and of candidate symbols the designer is considering to communicate that referent. This knowledge could be used to guide designers to more successful icons as well.

Icons are ubiquitous and utilitarian. They are good subjects for study because they promise to inform visual communication. We hope this report sheds some useful light toward the future design of icons as well as the full spectrum of visual communication.

REFERENCES

American National Standard Criteria for Safety Symbols, Z535.3 C.F.R. (2007).

Card, Stuart K., Mackinlay, Jock D., & Schneiderman, Ben. (2003). *Readings in Information Visualization: Using Vision to Think*. San Francisco, CA: Morgan Kaufman.

Dreyfuss, Henry. (1972). *Symbol Sourcebook An authoritative Guide to International Graphic Symbols*. New York: McGraw-Hill.

Graphical symbols - Test methods Part 1: Methods for testing comprehensibility, 9186-1 C.F.R. (2007).

Kosslyn, Stephen M., Thompson, William L., & Ganis, Giorgio. (2006). T*he Case for Mental Imagery.* New York, NY: Oxford.

Marom-Tock, Yael, & Goldschmidt, Gabriela. (2011). Design for Safety: Symbol Genre in Safety Signs. Paper presented at the IASDR 2011 Diversity and Unity, Delft, Netherlands.

Mayer, Richard E. (2001). *Multimedia Learning*. Cambridge, UK: Cambridge University Press.

Mitchell, W. T. J. (1987). *Iconology Image, Text, Ideology* (paperback ed.). Chicago and London: University of Chicago Press.

Thomas, David R. (2006). A general Inductive Approach for Analyzing Qualitative Evaluation Data. A*merican Journal of Evaluation*, 27(2), 237.

Woodyard, Chris. (2010, Aug 03, 2010). One third of drivers can't recognize this idiot light, *USA Today.*

Zender, Mike. (2006). Icon Systems for Global Non Verbal Communication. *Visible Language*, 40(2), 177-206.

Zender, Mike, Han, Bing, & Fernández, Oscar. (2011). Did it Work? Evaluative Research Methods for Graphic Design. Paper presented at the IASDR 2011, Delft, Netherlands.

JOURNAL INFORMATION

Visible Language is an academic journal focused on research in visual communication. We invite articles from all disciplines that concern visual communication that would be of interest to visual communication designers.

READERSHIP

Visible Language, an academic journal focused on research in visual communiction, seeks to advance research and scholarship for two types of readers: academics and professionals. The academic is motivated to consume knowledge in order to advance knowledge thorough research and teaching. The professional is motivated to consume and apply knowledge to improve practice. *Visible Language* seeks to be highly academic without being inaccessible. To the extent possible given your topic, *Visible Language* seeks articles written to be accessible to both our reader types. Anyone interested may request a copy of our editorial guidelines for authors.

EDITORIAL CORRESPONDENCE

Article concepts, manuscripts, inquiries about research and other contributions to the journal should be addressed to the editor. We encourage article concepts written as an extended abstract of 1 to 2 pages single-spaced. We will offer prompt feedback on article concepts with our initial opinion on their suitability for the journal. Manuscripts accepted for peer review will receive a summary response of questions or comments within three weeks. Letters to the editor are welcome. Your response — and the author's reply — will not be published without your permission and your approval of any editing. If you are interested in submitting an article to the journal and would like a copy of our Notes on the Preparation of a Manuscript, please obtain it from the journal's website at visiblelanguagejournal.com

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
mike.zender@uc.edu

If you are interested in serving as guest editor for a special issue devoted to your specific research interest, write to the editor, outlining the general ideas you have in mind and listing a half dozen or so topics and possible authors. If you would rather discuss the idea first, call the editor at: 513.556.1072

BUSINESS CORRESPONDENCE

Subscriptions, advertising and related matters should be addressed to:

Visible Language
Sheri Conttingim
Office of Business Affairs
College of Design, Architecture, Art, and Planning
University of Cincinnati
PO Box 210016
Cincinnati, OH 45221-0016
513.556.4377
sheri.cottingim@uc.edu