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

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

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

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Jorge Frascara,
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Contents

Letter to the Editor

It is election day for the officers of the Students Union. Candidates for the various posts have been distributing leaflets and posters. A particular format this year has been to use small 155 x 110mm leaflets and leave them lying about in public places.

My observations are:

1. 100% used unjustified settings.
2. 90% of these small posters were set in portrait style, 10% in landscape.
3. 80% provided a portrait of themselves (usually head and shoulders).
4. 80% used at least two sharply contrasting colours.
5. 70% used text set in a single-column, 30% in a double-one.
6. 20% used tiny type-sizes, making them unreadable in places (even when held in your hand).
7. Only 10% used the reverse side of the leaflet to provide more information about themselves and their policies.

It is easy to find out whether some of these decisions, or combinations of them were more effective than others. All you have to do is to ask others to put the leaflets in rank order or, more simply, to choose the leaflet(s) they like best. Much to my mortification the students I asked to do this did not choose the ones I had chosen as best because they utilised clear principles of text design. The leaflet they chose as best featured a glamorous female on the front, with her policies on the back.

Jim Hartley
James Hartley
Emeritus professor, School of Psychology,
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James:
I hope we get more letters to the editor like this one: it's research-oriented, fun, and makes a great point! Thanks!!
Mike Zender
Editor

Visible Language

49.1-2

Design as culture builder

Design is coming of age. After an adolescence in which it only looked at itself, and gorged in its powers to capture people's attention and intrigue their imagination, it is now noticing that the world needs it well beyond the display of craftsmanship and aesthetic appeal. From a preoccupation with stylistic innovation and the expressivity of forms and colours, designers are now working on the front line of life, to preserve life, to improve life, right where they are needed, where design makes sense. But it is not easy. Clients call us normally at the end of a process, where there is only a need to implement a communication or upload it in a website. Only large business organizations know all the spectrum of what design can offer, normally not government agencies and least of all small businesses and municipalities.

There was a time when art was part of the cultural fabric. Back in the XIX Century it became an isolated activity, thanks to the personal efforts of many artists that wanted more independence from their patrons, that wanted to issue "their own message." The consequence is that today they issue their message alright, but nobody cares. Unfortunately, some granting agencies have chosen not to fund design projects that are related to health or education, desiring that research funding should go only to a specialists already working in those domains. Design is left looking at its navel in search for research funding. This is the worst thing that could happen to design today. We need to counteract the move to muffle design's potential to deal with to society's needs, instead of design's needs. Design grows only when stepping beyond itself. Ken Friedman and the Group DesignX recently wrote: "Modern design has grown from a focus on products and services to a robust set of methods that is applicable to a wide range of societal issues. When combined with the knowledge and expertise of specialized disciplines, these design methods provide powerful ways to develop practical approaches to large, complex issues."

This is the place where we ought to be. We need to foster a design that is user-centred, evidence -based, and results-oriented.

To be there we have to engage in the development and promotion of our best abilities that are connected to research in design, design evaluation, design thinking, information management, and public communications aimed at instructing and educating. To be able to promote the extent of our abilities we need to nurture them, and one way to do it is through networks and information exchange. This is the intention of this issue. Many professionals are working on the forefront of communication design in the health sector. But we do not know each other. We have to create ways to get in touch, to pool our resources, and to demonstrate the contribution we can make to the state of the art in health-related communications. This is what recently prompted the creation of the Health Design Network (www.healthdesign-network.net)

Different from more traditional fields like Law or Medicine whose educational programs are based on disciplinary boundaries, our educational programs are conceived as problem-based learning, and have therefore resulted in the formation of professionals able to relate to diverse disciplines. Some disciplines are part and parcel of our most fundamental skills, such as psychology (cognition, reading, perception, learning), anthropology (ethnographic observation, cultural studies, interaction with populations), and sociology (large social issues, social statistics). Other disciplines enter the picture because of the topic of a given project, in the case of this issue, the health sciences.

This issue is a homage to those linking design with health and medicine, as well as a statement of position taking. Design is no longer the way to ego aggrandizing through some kind of fame, but the search for means to improve the welfare of people. This issue is not a manifesto, it is not an expression of desire of where design should be: it is a proof of where design is. It is where it makes sense. Design makes sense only when it is associated with the needs of people. A major designer told me once, after I had unloaded on him all my praise: "What have I really done in my life? I helped corporation 'A' make more money than corporation 'B'." He should have lived 30 years later, when design woke up from its silly dream and began to look at the real needs of people. One of the main needs of people is health. Without health nothing else matters. Funny enough, the attainment and defence of health does not rely solely on medicine and related areas, but to a great extent it relies on communication. Technical information, training materials, and, fundamentally, public education.

The problem that is found in many places is that designers have very good intentions some times, but they do not have the tools to deal with the problems they confront. The articles in this special issue show a variety of projects and approaches that document jobs done and results obtained. Design and research methods are discussed, outcomes are evaluated, and improvements are constantly implemented.

Why "Design as culture builder"? Yes, builder of a culture of caring, and not just in the health care environment but in any

other. Caring about the user of all the gamut of communications we contend with day in and day out. Creating an atmosphere of mutual respect based on clear communications, communications that respect the needs, wants, abilities, and limitations of all those involved, recognizing that in today's information society access to information is a human right. Not only access to see it, but also, and fundamentally, to understand it with ease.

This double issue begins with three articles that report on public health campaigns: Regina Hanke, in connection with the crisis created by antibiotics abuse; Audrey Bennett, dealing with HIV/Aids in Africa, and, also regarding Africa, but on hygiene, Mike Zender argues for the need of designers to improve their ability to conduct research. Each one offers a different perspective of complex problems where design is needed and can make a difference today.

Following these, other authors discuss tools and methods in connection with a variety of health issues. Guillermina Noël deals with how to overcome communication disabilities through a careful user-centered design approach; Amina Patton, Morgan Griffin, Ana Tellez, Mary Ann Petti, and Xanthi Scrimgeour explore the use of icons to facilitate communication; Andrea Taylor, Tara French, Jeni Lennox, and Jeremy Keen marry design with technology, exploring the use of virtual reality in health care services. Continuing with the use of technology, Sarah Lowe, Tami Wyatt, Xueping Li, and Susan Fancher discuss the value of transdisciplinary teams for the development of educational tools to support simulation in health care. Pamela Napier and Terri Wada discuss participatory design and co-designing as ways to develop new tools for health care. On a similar methodological approach, Belinda Paulovich disuses the advantage of using participatory design methods to improve the health education experience of clinicians and patients. The issue closes with Helen Sanematsu, Brenda Hudson, Amanda Nyhuis, Siu Hui, and Paul Dexter's article on how to improve the recruitment of health care volunteers through appropriate communication design strategies.

I hope the articles in this issue demonstrate the richness of the experiences being accumulated in the growing field of communication design and health. I also hope it will promote the development of networks of professionals that could empower each other to deal with larger and more complex health issues in the near future. My third hope is that, beyond preparing design students for the world of commercial goods and services, design education programs would take notice and ensure that students get prepared to deal with the wide variety of complex issues where good use of communication design expertise is needed today.

Jorge Frascara
Guest Editor

Targeted Communication to Reduce Antibiotic Prescription

Regina Hanke

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ABSTRACT

This paper reports a commissioned project to design targeted communication materials to attempt to reduce antibiotoc prescription rates.

KEYWORDS

targeted communication, antibiotic prescription

In April 2014, the World Health Organization published a report entitled "Antimicrobial resistance: Global Report on Surveillance measures" in which studies of the data from 114 countries suggest that bacteria strains worldwide are becoming increasingly insensitive to one or more common types of antibiotics. The use of so-called broad-spectrum antibiotics is particularly associated with the development of antimicrobial resistance. Additionally, antibiotic therapy is ineffective for more than 80 percent of straightforward respiratory infections, with such treatment having potentially negative side effects such as a shift in the balance of microorganisms in the intestine. (WHO, 2014)

Around the same time of the WHO report, the Institute of Hygiene and Environmental Medicine of the Charité - Universitätsmedizin Berlin approached Lindgrün GmbH in spring of 2014 to develop communication material aimed at creating a more meaningful use of antibiotics and, specifically, attempting to reduce the prescription of antibiotics for upper-respiratory infections in Berlin, Germany. This forms part of an overall antibiotic intervention project running from September 2014 to March 2015. Key participants include Professor Dr. Petra Gastmeier, the Director of the Institute, Dr. Janine Zweigner, and Dr. Miriam Wiese-Posselt. The wide scope of the assignment demanded a period in which we tackled each of our research and analysis goals in order to create a convincing, targeted message. What was crucial to this phase was getting a grip on the possible reasons contributing to the rise of antibiotic resistance. From there, we translated our findings into design proposals that formed the core of the task and summoned our expertise in strategic design. Working closely with the client, we moved into the phase of actively supporting the pilot project, which is still currently underway and yielding some very positive but, so far, limited feedback.

We began our research with a review of several extant European campaigns focusing on antibiotic intervention strategies. The different approaches range in tone and target audience, as well as the quality and quantity of presented information. Most studies have been conducted outside of Germany, yet no publication gives insight into the design process behind the choice of visual communication, or explains how the actual socio-geographic frameworks are structured. We could find no examples of storytelling, positive deviance, user journeys, narrative interviews, or evidence of target groups beyond patients and general practitioners mentioned in the available research papers. Nor did we find information on communication strategies or implementation plans, which we see as a significant problem in medical-related scientific information when it concerns communication and design.

We were able to isolate many factors contributing to the overall positive and negative effects of some of the campaigns. Among them, it appears that the most successful are those that are multimodal and that make clear, relevant statements addressing the differing

perspectives of both patient and GP target groups. Less effective are those that use media for its own sake, offer too complex a message, or create a gap in the perceived and actual relevance of the issues to these audiences.

This desktop research was presented to the client with findings, isolating several factors we felt aimed at a high likelihood of the project's success. From the examples we looked at, a complete, structured experience of the topic using few but high-quality media and separate, relevant statements to doctor and patient appeared to work best.

But there was more research to be done, and we were able to convince our client to allow the freedom to embark on our own modest but qualified local research. Our clients connected us with three physician's practices in the greater Berlin area, each located in a different district that represented, as much as possible, a social and cultural cross-section of the city. In addition to conducting brief interviews with three doctors and six nurses, we spent approximately three hours in each of the waiting rooms just observing.

The findings from the total sixteen-hour observation process were as follows— no one was seen to read or pick up any medical flyers; the doctors did not want to exceed the allotted appointment time with their patients; patients leaving with a prescription appeared more relieved than when entering; the age-group of patients was non-specific; and nurses seemed to have a positive effect on patients entering and leaving the practice. Another interesting finding outside of this exercise, but supported by local statistics, is that GPs in Germany are predominantly female. (Bremen University)

Observations hinted at possible reasons for the unnecessary prescription of antibiotics, many of which were supported by our research. With regard to the application of guidelines, physicians report either a lack of awareness of the recommendations or do not have the time to review them. In addition, the insistence on current practice could cause non-compliance of recommendations and be an explanation for inappropriate therapies. (Zweigner, 2012) Further surveys show that doctors often feel under pressure by patients or by the parents of children who are patients, to prescribe antibiotics against their better judgment, as in cases of viral infection. (Zweigner, 2012)

These findings brought into focus the issues relevant to a physician's point of view, which we felt our message had to address. These were time equals money, the need for practical and convenient solutions, a tendency to resist change, and, finally, a view that patient questions cost time. It was clear to us that time was a recurrent and crucial factor for physicians. In addressing them, our design package must either offer timesaving components, or at least avoid a high-time investment.

Because of a lack of resources, patients where treated as a single target group, focusing our communication on the ill patient who seeks healing by visiting the doctor. We think of this as a

pathway along which we identified a common focal point: the consultation. This direct meeting is the point of relevance for the message, overlapping the experience of both doctor and patient. Here we could focus on the core message of better health for the patient without a high time-investment for the physician and where appropriate tips would be one of our concrete communication objectives. We were also influenced by an idea behind a project done by Jorge Frascara and Guillermina Noel. (Formoso, 2013) Here, the physician provides detailed, helpful, and informative material to his/her patient in lieu of an unsuitable antibiotic prescription. It is a service design on a small scale, a concept that was well received by our client. We saw it as an opportunity to instill a positive and empowering message to the patient: there are many viable pathways to better health they can pursue themselves.

In order to reach as wide a group of physicians as possible, we consulted the Sinus-Milieus®, an established target group model based on demographic criteria such as age, gender, education, occupation, and income within the context of a population's cultural setting, behavior, and values. These models are used in major marketing studies in Germany, as well as internationally. (Flaig, 2014)

We extracted three different milieus in which our physicians are represented and gave an overview of the target group information to the client. We made the groups tangible to them by using moodboards that covered the values, lifestyles, work environments, and general likes of each. Differences—but also commonalities—emerged from comparing these moodboards, conjuring a picture of what our message to physicians must look like, as well as what it should communicate.

One conclusion we drew from this examination of physician target groups, as well as from our earlier research, was to build a positive statement strategy. Our visual package not only had to offer timesaving elements but empower the physician by facilitating his/her communication with the patient. It was crucial to avoid a patronizing tone or language in the material. The project had to offer high-quality content and visual appeal with tactile sensation while stressing core messages to both physicians and patients. To the patients, fewer antibiotics for better health is the message. To the doctors, antibiotic resistance is a problem that can be tackled without a big investment of time. After some deliberation, we boiled this pot of ingredients down to one clear slogan: "Less is More" ('Weniger ist Mehr'), which was incorporated as part of the project logo.

At this stage, we proposed a four-phase project plan to our client on how the project might proceed, with actions and events dictating the type of material necessary. The material would have to address both physicians and patients from different communicative and content perspectives. The project plan pulled together the conclusions drawn from months of research, planning, and materials, and needed actions by both our clients and us.

To implement the start of the overall intervention project, and in close partnership with our client, a series of Charité-hosted seminars for local GPs entitled "New Ways to Reduce Antibiotic Prescriptions for Respiratory Infections" was planned. Among the planned topics of this workshop were an examination of current studies on international and national antibiotic resistance, the frequency of antibiotic prescriptions given in Germany, the impact of antibiotics on the human gut, and the implications of this data for the future. In addition to the scientific part of the seminars, the doctors would be given an explanation of the material for their patients and how to use it. To encourage registration, but with an eye on time-saving, we suggested that workshops be scheduled on Wednesdays, when most GP practices in Berlin close to handle administrative tasks. We also suggested scheduling them as after work events, spread over four different regions of the city to cut down on travel time.

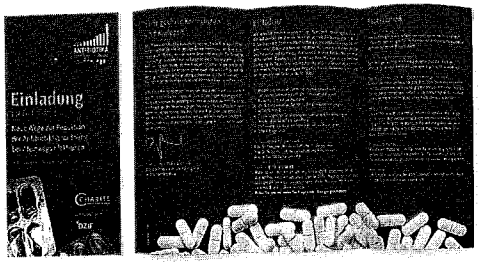


FIGURE 1
Invitation for General Practitioners to attend the seminars.

An invitation to the seminar had been mailed to nearly 2,400 GPs in the Berlin area, initiating a rollout of this part of the intervention project. We created this invitation as a foldout flyer that provided an overview of the subject covered in the workshop as well as a description of the materials, emphasizing that they were designed to support the doctor-patient consultation in an optimal, time-efficient way. Furthermore, the leaflet provides a contact telephone number for, during, and after the intervention phase, in the event doctors have questions or comments, something not normally found in an invitation flyer of this kind.

The actual concept material for the patients forms a dominant part of the targeted communication for this project, and its development involved several stages. We set out formulating various options for the visual content, which we analyzed and then discussed with the client. After this process, we arrived at decisions concerning both the information content and final design, at which point the execution began.

In addition to the seminar invitation, the communication material comprises a consultation flyer, brochure, infographics poster, doctor participation poster, and a few small, miscellaneous extras. As these items are the main channels by which the patient might learn about the project—in addition to some press coverage—we looked at several ways to enhance the persuasive nature of their content. The consultation flyer, which a doctor could potentially hand to the patient in cases of respiratory tract infection, uses graphics, images, and brief descriptions to make a concise but pointed explanation on whether or not antibiotic therapy is appropriate for this illness. In addition, it shows in simple graphics the step-by-step process by which antibiotic-resistant bacteria develops. It is a short flyer intended to facilitate the doctor's concise but pointed explanation of whether or not to use antibiotics.

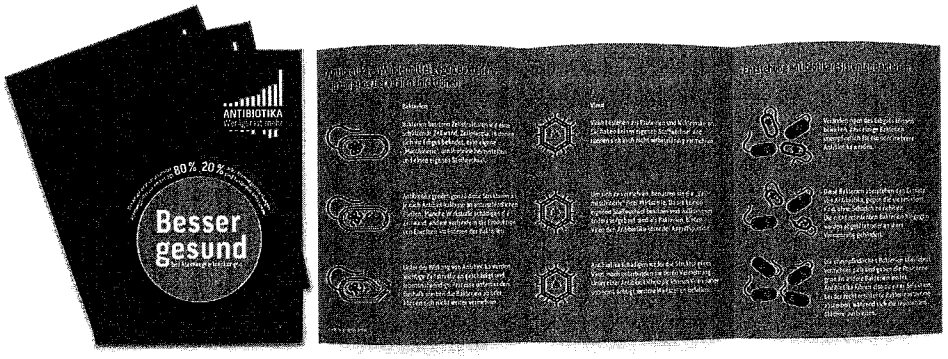


FIGURE 2
Consultation flyer:
Keep it small and simple. This is so far the most appreciated and used flyer by GPs.

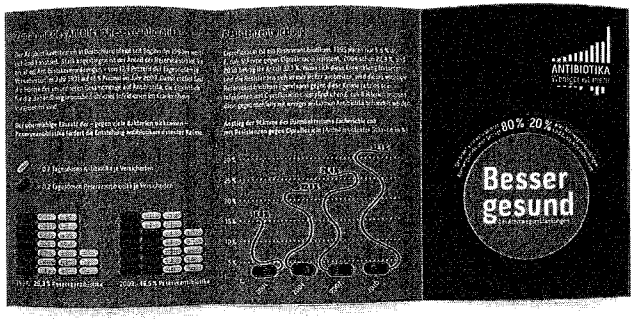
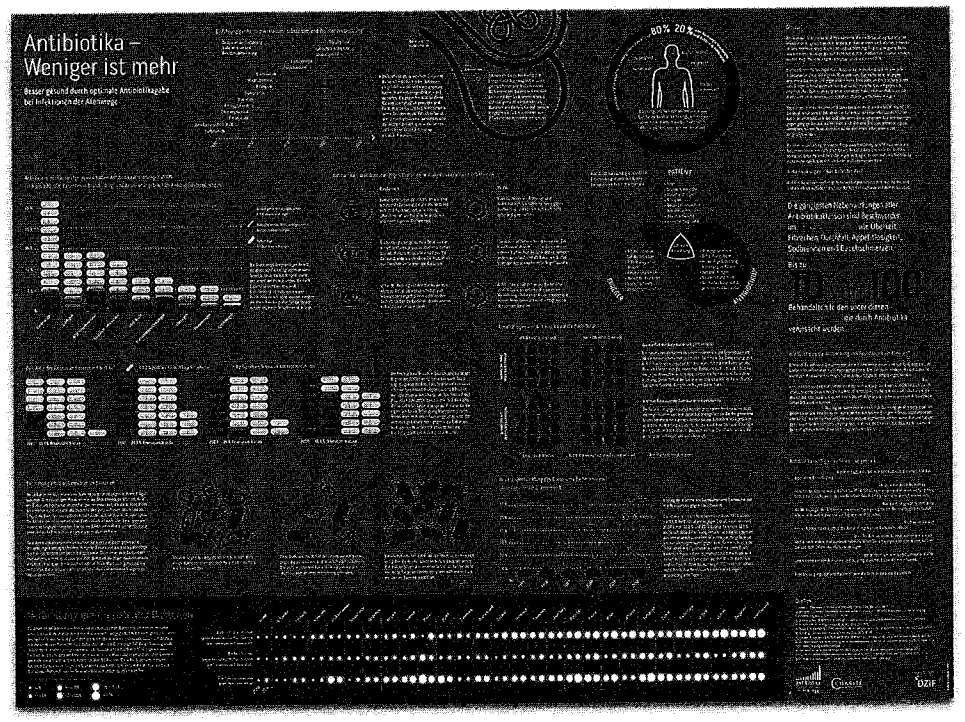


FIGURE 3
Infographic:
A huge amount of information on one A1 sheet. This is so far the least liked item by GPs.



The infographics poster contains more thorough facts on the subject, and if used optimally, such as on display in the waiting room, can reach a potentially wider range of patients. It features graphs composed of eye-catching graphics and images visualizing the key and locally relevant points for the layman. Among the charts depicted are those about resistance development of specific antibiotic classes, percentage of antibiotics prescribed vs. percentage deemed necessary by physician category in Berlin-Brandenburg, side effects of the drugs on intestinal flora, and the steady increase of last-resort antibiotics that have been prescribed in Germany in recent decades. The current feedback from GPs highlights the fact that the infographics poster was perceived as information overload for their patients; hence, the actual use of the infographics poster is very limited.

The doctor participation poster, also intended to be displayed in the GP's office, was designed to give support to the GP practice by displaying its platform to the community and its commitment to the intervention plan. This statement of participation not only benefits the doctor but can also be a conversation piece, encouraging and empowering patients to ask questions about the program.

FIGURE 4
Patient Information A5.
When people are sick, they want to know how to get healthy and stay healthy. This simple insight is reflected in the storytelling process.

The patient brochure offers additional, in-depth information balanced by a personalized approach that we feel optimizes its persuasive message. The intention is that the reception nurse would give this brochure to the patient in addition to the small flyer given by the physician, and/or in appropriate situations for them to take home with a prescription. In addition to the factual graphs and medical statistics used in the other material and outlined above, here we present real individuals from different backgrounds whose photographs and stories relating to respiratory illness are placed at intervals throughout the booklet, in between the more factually dominant pages. Based on the range of persons we observed most frequently in our research, we presented a young mother, an older man, and a younger man. Each describes a different attitude or experience regarding antibiotics and respiratory illness, side by side with fact-based commentary on their specific ailments. We also gave a human face to the page summarizing antibiotic resistance attitude or experience regarding

antibiotics and respiratory illness, side by side with fact-based commentary on their specific ailments. We also gave a human face to the page summarizing antibiotic resistance – personalizing it with a photograph and statement by a key physician in the program.

The idea to use real people in this way is based on the concept of Positive Deviance, a problem-solving approach that encourages the use of successfully tried and tested community-based solutions. (PD, 2014) Consistent with our aim of building an empowering message to the patient, we felt the sharing of human experience and opinion was beneficial for those with non-serious respiratory infections. Similarly, we devoted a page in the brochure to outlining common home remedies and over-the-counter solutions. Here we were careful to avoid clichés and overstatements but felt its inclusion would invest the booklet with enough helpful advice to satisfactorily substitute for a possibly needless prescription.

We intended a stronger, user-centered approach for the brochure than had actually been realized because it had to appeal to the 'average person' by outlining common strategies for good health, and it had to keep the scientific details to a minimum. Normally, medical brochures created for the public are dominated by facts and statistics and have little personalized content.

This user-centered approach relates to the language used for the content, which was very much a challenging issue for us. As subtitled in all our project information, we use no material or financial support provided by the pharmaceutical industry in the communication, nor does it have any involvement in the project, and so we wanted to avoid the type of (pseudo-) scientific jargon that the industry often uses. In addition, it was important to keep the language as plain and as understandable as possible to reach the widest target audience. We had to bridge the gap between the scientific approach and the plain language that lay people could understand.

Generally, in communication design, different levels of informational and/or emotional content are used in varying degrees depending on a number of project factors including the type of media, message content, target audience, and the funds driving the project. The use of real people and their stories in this brochure was a way to encourage an empathetic rather than intellectual response, presenting another way to, hopefully, attract people to the material.

The way in which we depict people in the brochure moves us away from our discussion of content to one of the visuals within our targeted communication process, forming the last section of this article. One idea was to present the individual wearing a white T-shirt or holding a white poster board on which we would later superimpose their individual narratives. Several photographs were made along these lines by Wolfgang Hanke, who is credited for all photography on the project, and though this solution did not make the final cut, it was one interesting way to integrate the context of the individual's story with his or her image. Perhaps

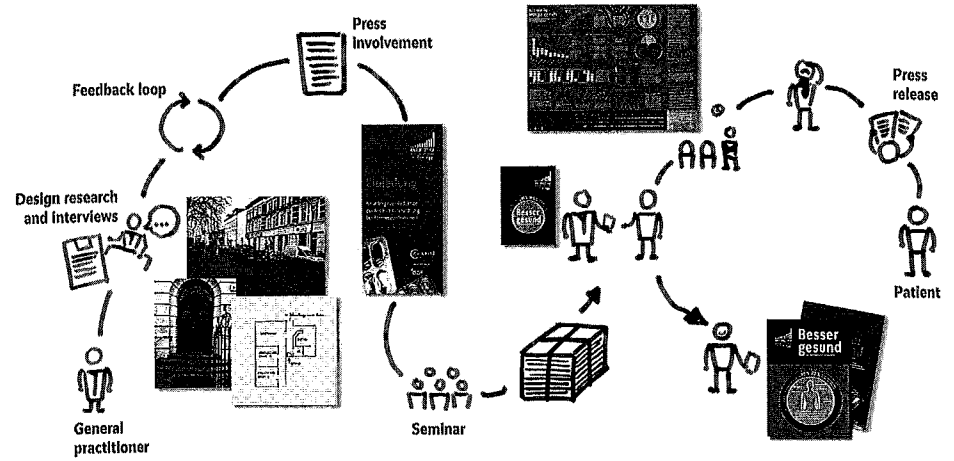


FIGURE 5.
Summary of the design process

even stronger was our final choice, to feature individuals at a distance in a context and then in close proximity. They appear in two postures, two moods, and with their close-up image gazing directly at the camera. The eyes are emphasized and pleasantly confront the reader, as we intended the image to capture its audience.

In deciding the color palette to use in this communication, we looked back at some of the observations, other than the qualitative ones, that we made in the waiting rooms of the Berlin physicians. Immediately apparent to us, but also somewhat anticipated, was the rather narrow use of color and imagery around the room and on the walls. Blue and green were the dominant color schemes, and soft photographs of families featuring healthy-looking elderly grandparents were a common hallmark. Imagery in a healthcare environment is fraught with sensitive issues beyond aesthetics and touches on ethical, emotional and informational matters. In thinking about these visual combinations of color and image we found in the waiting rooms, we knew we would go for something different.

As mentioned earlier, balancing the levels of emotion and information plays a significant role in determining the design of concept material. A campaign such as this with a weighty number of figures, graphs, and factual information to present, needed a pull in the other direction to provide an emotive brightness that would transport the scientific content. The two main colors purple and orange are red tone-based 'female' shades, and they form a bold color scheme within the context of medical and scientific driven health communication, which sometimes underestimates the importance of emotion. We felt this 'eye-candy' magazine-like quality of our colors also sends a more positive message, unlike the pale blue-green palette mainly dominating the communication of the pharmaceutical industry. We wanted to avoid the message of fear implicit as the common denominator in much of this medical communication, and by doing so, suggest a feeling of empowerment for the patient.

We included more subdued tones in our communication, as well, to offset the boldness and offer a more tranquil feeling when needed. To an extent, the brief duration of the intervention project dictated the degree of color vibrance. We might have chosen a more sober palette for a long-term project that ran, for example, for decades.

In developing the logo, we were inspired by our client's data showing the antibiotic prescription behavior of local medical specialists. Their chart compared first-line antibiotic prescription treatment with a growing last-line or last-resort antibiotic dispensation. In the logo we adopted these bar chart ideas, using the first-line antibiotic lines above the word 'Antibiotika,' and the last-resort lines beneath the slogan "Weniger ist Mehr" ("Less is More"). Both rise from low to high as our eye travels from left to right. The top increases steadily with the last bar making a big jump upwards, while the bottom bars representing last-resort antibiotics rise sporadically and unpredictably.

The imagery in the material is dominated by the issue at hand—pills and empty pill cards or blisters. We use pill imagery in different places, sometimes running along the bottom of the page against the purple background, and in the charts relevant to antibiotic dispensation. Our graphics are mostly simple black and white illustrations that form a contrast and balance to the photographs of real people in the brochure, as more detailed drawings might have detracted from them. The drawings of bacteria are based on a pill shape, alluding to the connection between bacteria and its cure, antibiotics, as opposed to the viral shape, which is completely different and makes no visual link to the drugs. We used orange lines to playfully divide information on the page, eliminating the need to put graphs into boxes, instead, creating a more open way of associating graphs with textual content. All of these elements combine to form a distinct visual language.

Although the seminars have been completed, the project with the dissemination of materials in GP offices is still going forward. A survey to gather feedback on the project is underway, and for that reason there are currently limited statistics and remarks. The invitation flyer, which had been mailed without an accompanying letter, received an overall 8.4% response rate with 6% percent of general practitioners from Berlin attending the workshops.

There was positive feedback for the quality of the material, specifically on its structure, design, and visual appeal. The patient brochure and consultancy flyers were particularly appreciated by the GPs who did respond, though a few suggested the booklet might be too long or have too much scientific information. This coincides with our original desire to make the user the center of the brochure, with less scientific background information.

We are extremely pleased to have had the opportunity to work on this challenging and formidable project, and we hope that the campaign of targeted information will have some impact in reducing antibiotic prescriptions for respiratory infections in the Berlin area.

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Regina Hanke began her career in London as a graphic designer. After years with The Partners in London where she learned that good ideas can create a market pull, she worked for MetaDesign in Berlin where she acquired profound knowledge of branding and corporate design processes working for international corporations. Her last engagement as an employee at Frog Design introduced her to research as an integral part of every product development process. Equipped with extensive experience, an additional degree in marketing, and a passion for brands and design, she founded Lindgrün GmbH together with Wolfgang Hanke in 2006.

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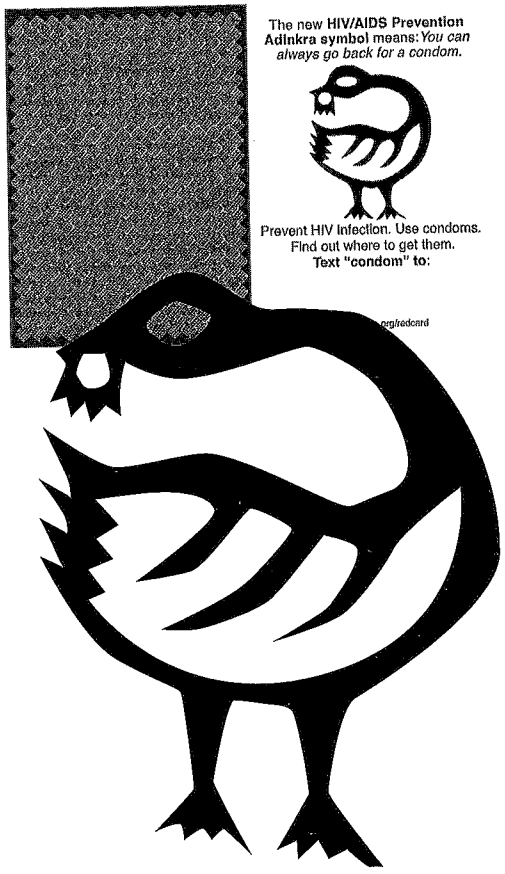
localized but dissonant



connotative localization

Connotative Localization of an HIV Prevention Image to Promote Safer Sex Practices in Ghana

Audrey Bennett

ABSTRACT

When designers localize an image's denotative elements according to the users' cultural preferences, research shows that it improves user experience and cross-cultural usability. However, this paper reports that, even when localized denotatively, culturally-based disparities—dissonance between how the designer communicates and how the user interprets from a cultural perspective—can still impede or entirely obstruct the image's connotative performance. Localization needs to facilitate adaptation of the image on a connotative level particularly when the goal is to bring about behavioral change hyper-locally, on a transnational and transcultural scale, with a community of users. This paper presents findings from a case study of a campaign for HIV prevention in Kumasi, Ghana that advocates for condom use. I conducted fieldwork over a period of two years during which I interviewed lay people in Kumasi about the denotative and connotative performance of an HIV prevention image called the Red Card. My data confirms the existence of cultural dissonance between my Westernized esthetic sensibilities and Ghanaian interpretive capacities. My data also corroborates that the use of connotative localization through an interactive communication design process (CLIC) can reveal semiotic noise hindering the image's connotative performance prior to its final production.

KEYWORDS

cross-cultural, transcultural, denotative, connotative, connotative localization, HIV prevention

Design education researchers who follow the creed of social consciousness advocated by the "First Things First Manifesto" (Barnbrook, 1999; Garland, 1964) and other related literature in the discipline, including Berman (2009), Heller and Vienne (2003), and Frascara (1997) may use their creative expertise and communication design resources to annihilate or at least prevent the further spread of HIV/AIDS. Those, with global humanitarian interests may opt to communicate HIV/AIDS awareness information and prevention images to lay people in different parts of the world. However, when they engage in transnational communication of this sort, disparities between their culture and that of the users of the images can cause varying levels of semiotic noise. The phrase "semiotic noise" refers to cultural interferences that hinder the ability of an image to communicate meaning in such a way that resonates culturally with the user(s). Preventing a health-based image for transnational communication from succumbing to semiotic noise can be the difference between the life or death of the users. Consider the following example told to the late graphic designer, Phillip Meggs, by the late graphic designer, Sylvia Harris:

> A group of American students tried to encourage inhabitants of a village in Nepal to take certain sanitation precautions. They presented the inhabitants with a three–foot–tall graphic of a fly contaminating food with an infectious bacteria. It was the intent of the American students to persuade the inhabitants to take the recommended precautions. Instead, the inhabitants of the village only laughed because they felt they [need not worry]. After all, the flies in their village were miniscule compared to the giant ones in the graphic.
> (Meggs, 1992, p. 4)

It is evident from this example that cultural difference can prevent visual language from communicating properly across cultures.

Applying Barthesian semiotics to the analysis of designed images, Frascara (2004) and Tyler (1992) argue that meaning occurs on two semiotic levels: denotation and connotation. Denotation, according to Frascara, is the user's objective reading of what the image represents; whereas, connotation refers to the user's more subjective, emotional reading. In the Nepalese example, cultural differences between the Nepalese villagers and the American design students created semiotic noise that hindered the ability of the students to communicate in the way intended. The image failed on the denotative level in that the villagers saw the representation of three-foot-tall flies as larger than the flies in Nepal. Consequently, the villagers blissfully connoted, perhaps with great relief, the opposite message of what the student designers intended: *We need not take the recommended sanitation precautions because we do not have three-foot-tall flies here in Nepal infecting our food with bacteria.*

The Nepal example is also significant for the ambiguity it reveals about the students' design process. On the one hand, if the

students intended the presentation of the poster to be the final dissemination to the targeted users, then they used an approach that the linear model of communication (Lasswell, 1948; Shannon & Weaver, 1949; Berlo, 1960) explains. In a linear communication process, communication is one way. The designer communicates an image to the user, and the user interprets the intended message. The goal of the image, as Tyler (1992) explains, is to engage the user in an experience and persuade her to receive life-saving information and take action. Tyler presents a taxonomy of user roles that include spectator, passive reader, active reader, and dynamic participant. In a linear communication process, the user performs the role of a passive reader who decodes a visual statement but does not participate in the formation of the designer's intended meaning. The designer confers meaning to the user. The linear communication process applies well to commercial design, where the goal might be to persuade the user to consume. For instance, aesthetically-pleasing packages, which sell cereal brands with excessive levels of sugar, epitomize a linear communication process that aims to drive consumption. There is limited regard for the impact of the sugary cereal on the health of the user. In the Nepal example, if it is a linear communication process, then the meaning to be accepted by the user is to take sanitary precautions.

On the other hand, if the student designers intended the presentation of the poster to be an opportunity to get input from the user prior to the production of the final poster, then they used an approach that the interactive model of communication (Schramm, 1955; Wood, 2012) explains. In an interactive communication process, communication is two-way. That is the designer communicates to the user, and the user provides feedback. In an interactive communication process, the goal of the image is as Tyler (1992) says: to engage the user in an experience and persuade her to receive life-saving information and take action. However, where the interactive communication process differs (from the linear model) is in the role of the user. In an interactive communication process, the user performs the role of an active reader who engages semiotically with the image decoding it according to his/her cultural beliefs and values. In the Nepal example, the Nepalese people gave crucial input regarding the culturally inappropriate size of the flies in the American students' poster. The conversational nature of interactive communication implies an iterative process when applied to design. Thus, if using an interactive communication design process, the American students would have had an opportunity to improve the poster's connotative performance by using, for the final dissemination, a more culturally-appropriate representation of Nepalese flies at a smaller scale.

HYPOTHESIS

The question then is: Which model of communication design should be used to communicate images that aim to effect safer sex practices and prevent the further spread of the HIV virus in transnational contexts? I posit that

using an interactive communication process that solicits user input, prior to the final production of the image, can reveal semiotic noise hindering the image's connotative performance.

METHODOLOGY

Poggenpohl and Sato (2009), Bennett (2006), Noble and Bestley (2005), and Laurel (2003) document communication design's evolution into a research discipline. That is, no longer do communication designers use only intuitive-based, linear communication design processes geared towards attaining aesthetically-appealing outcomes. Today some designers are employing empirical, research-oriented design methods aimed at verifying or falsifying existing findings and contributing new knowledge to the discipline's literature. Moreover, Frascara (2003) documents a paradigm shift in design in terms of its integration of social science approaches. A paradigm shift that Frascara (1988) may have initiated himself when he asked the provocative question "Is graphic design fine art or social science?"

Thus I employed a qualitative, social science approach to test my hypothesis. I conducted ethnography in Kumasi Summer of 2010 and made observations that informed my designing and localizing the first iteration of an HIV prevention image for use in Ghana. Subsequently, during the summer of 2011, I conducted fieldwork at the Suntreso Government Hospital in Kumasi, Ghana. I carried out an interactive communication design session with lay people either getting HIV tested or treated for HIV at the hospital. I presented to each participant the Red Card shown in Figure 1, an HIV prevention poster the size of a playing card. Then I engaged them in a semi-structured interview about its semiotic performance. Finally, I conducted exploratory participatory design sessions with various stakeholders to develop an HIV prevention image using resources indigenous to Kumasi. The next sub-sections details these steps in the development of the Red Card.

FIGURE 1

Iteration 1 of the Red Card after denotative localization by designer

ETHNOGRAPHY

Prior to my designing the Red Card in Figure 1, I conducted an ethnographic study in Kumasi a year prior. During the summer of 2010, I observed the culture of Ghanaians and conversed with many of them in English, Ghana's official language. Over a two-week period, I documented photographically vibrant Kente cloth patterns in Bonwire and local markets in Kumasi, existing HIV/AIDS campaigns, Adinkra symbols emblazoned on architectural sites, and a variety of mobile phones on sale in local markets.

LOCALIZATION BASED ON ETHNOGRAPHIC OBSERVATIONS

With my experiential knowledge of the culture of Kumasi, I returned to the United States where I designed the red card to appeal to what I understood of Ghanaians cultural sensibilities. I illustrated an image that I believed would resonate culturally to Ghanaians and communicate to use a condom during sexual intercourse. In collaboration with stakeholders on my team from the disciplines of Computer Science and Science & Technology Studies, I integrated their text-messaging component to the Red Card campaign image.[1]

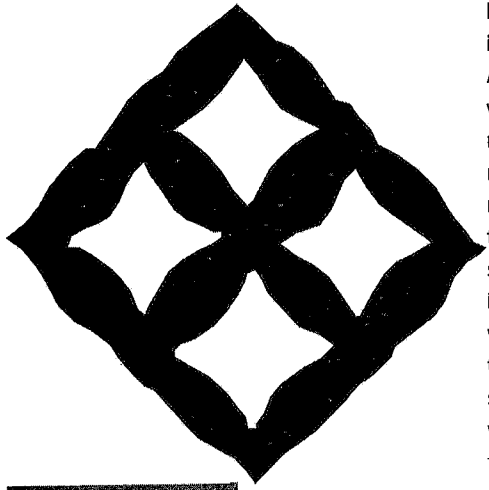


FIGURE 2

The Adinkra symbol called Eban represents fence and means "security, safety, and love" (see http://www.adinkra.org/htmls/adinkra/eban.htm)

In Figure 1, the backside of the card on the left is colored red with a background image of the Adinkra symbol in Figure 2 repeated in a pattern in white. I designed the front side of the card, on the right in Figure 1, to depict a brown-skinned, Ghanaian woman whispering into the ear of her Ghanaian, male sex partner: *No gloves. No love.* Below the image, I set a Quick Response Code (QR Code) side by side with text that reads: Use condoms. Find out where to get them. Text: [A blank space to write in a mobile phone number]. Below the main text of the card, is another text in a smaller point size revealing the URL www.baohouse.org/redcard where users can find additional information about the Red Card campaign. It is to that same URL that the QR code directs users. The purpose of the Red Card is to promote safe sex practices and help Ghanaians find out where to get condoms in Kumasi. First, the image aims to attract the attention of the user and pull her in to linger and read the card. Then, the user texts the number on the card to find out the closest location in the community to get a condom. Next, the user receives a reply with the nearest location to receive a free condom or purchase one.

INTERVIEWS WITH INTENDED USERS THROUGH FIELDWORK

The next part of my research project occurred in Kumasi over a two-week period during the Summer of 2011. There I gathered demographic information about each participant including:

A. Age

B. Gender: Male (M), Female (F)

I also collected "technographic" (Don and Petrick, 2003) information about each participant including:

C. Technical proficiency: I asked each participant whether they believed their technical ability to be high (H), medium (M) or low (L).

Finally, I presented the red card to each participant

1. To read more about how the mobile component of this culturally situated HIV prevention research is developing in terms of providing material access to condoms, see work by Rensselaer doctoral student David Banks on the open source condom vending machine at http://www.davidabanks.org/condom-vending-machine/.

and asked a set of questions that included the following:

D. Can you read the words?

E. What do this image and white text communicate to you? This question refers to the illustration of the brown-skinned woman whispering into the ear of her lover: "No gloves. No love."

F. What does this image of the QR code mean to you?

G. What does the pattern on the back mean to you? Do you recognize the Adinkra symbol?

The interactive communication session with the Ghanaians was transnational and transcultural. Thus, we experienced interpersonal communication challenges. For example, in some cases, the Ghanaian participants were illiterate, unable to read English or Twi (the indigenous Ghanaian language). In other instances, though Ghana's official language is English, the Ghanaian participants were unilingual, speaking only Twi. Thus, bilingual translators mediated my interviews with some of the Ghanaian participants.

PARTICIPATORY DESIGN THROUGH FIELDWORK

In the development of health communication, particularly about HIV/AIDS awareness and prevention, Minkler & Wallerstein (2010) and Rhodes, Malow, & Jolly (2010) advocate for community-based participatory research (CBPR) that engages the user and other stakeholders in the decision making process. Thus, my team and I conducted two participatory design sessions in Kumasi prior to my departure. The first participatory design session involved a nurse at the hospital's clinic whose job includes going into the community to raise awareness of HIV/AIDS and knowing one's HIV status. After this initial participatory session, we conceived of an Adinkra symbol to represent HIV awareness. In the second participatory design session, we collaborated with an Adinkra artisan to create the new HIV Adinkra symbol that extends the existing Ghanaian Adinkra symbol system.

DATA ANALYSIS

Previous research argues for the use of localization techniques and strategies to address semiotic noise, a term introduced previously in this paper to describe cultural disparities prevalent in transnational and transcultural communication. Cyr and Trevor Smith (2004, p. 1199) define localization as adaptation to "a particular language, culture, and desired local 'look and feel.'" They found that design preferences do, in fact, differ across cultures. Thus designers should localize web interfaces for transnational communication through the use of culturally-specific aesthetics. Prior research has also applied localization to the design of HIV/AIDS campaigns. For instance, after conducting semiotic analysis on Kenyan HIV/AIDS campaigns, Banda and Oketch (2011) assessed some of the images to be ineffective in bringing

	QA	QB	QC	QD	QE	QF	QG
1	26	M	H	Yes	No gloves no love means no condom no love.	I have seen it; but, I don't remember where.	I recognize the Adinkra symbol; but, I don't remember what it means.
2	36	F	L	No	The image is a condom.	The image means nothing.	I have never seen the image on the back.
3	22	F	M	Yes	I see an ear; but I am having difficulty understanding the image at the top.	I do not recognize the QR code.	Nothing.
4	23	M	L	Yes	I can't understand the image.	I do not recognize the QR code.	Nothing.
5	36	F	L	Yes	I can't make out the picture well.	I can't make out the QR code.	I don't recognize the Adinkra symbol.
6	25	F	M	Yes	I can see someone speaking into someone's ear. No condoms no sex.	I do not recognize the QR code.	I don't recognize the Adinkra symbol.
7	25	F	M	Yes	I can't make out the picture very well.	I do not recognize the QR code.	I don't recognize the Adinkra symbol.
8	22	F	H	Yes	I can't make out the picture very well.	I do not recognize the QR code.	I don't recognize the Adinkra symbol.
9	34	F	H	Yes	We want to eliminate HIV. I know about HIV; and, I know about condoms. So, immediately I know what it is saying that "No condom. No sex."	I haven't seen the QR code before.	I don't recognize the Adinkra symbol.
10	31	F	M	Yes	No glove. No love. The girl is telling the boy that unless he gets a condom, they are not going to have sex.	I haven't seen the QR code before.	I recognize the Adinkra symbol but it should be bigger.
11	66	F	L	No	I can't see anything meaningful.	I see black but that is it.	I don't recognize the Adinkra symbol.
12	39	M	L	Yes	I see a condom. It means protection.	I see a black and white design. I do not know what a QR	I don't recognize the Adinkra symbol.

13	30	M	H	Yes	A woman whispering "No Glove. No Love." Into the ears of another person...If it is not on, it is not in.	I don't know. A QR code is similar to a bar code isn't it? It is used to identify a particular item.	I don't know it.
14	33	F	L	No	—-	No	No
15	25	F	H	Yes	It is trying to tell me to protect myself.	I don't know.	I don't know.
16	30	M	H	Yes	No Glove. No Love... If you don't wear a protective rubber. You don't have to love someone. You have to protect yourself.	No.	—-
17	23	M	M	Yes	No. I can't read it. It is too small. It is not clear.	No	—-
18	22	F	M	Yes	It is an ear. I don't understand the rest.	No	No
19	23	M	H	Yes	I don't understand it.	No	—-
20	33	F	M	Yes	It is a male and a female. The female is telling the male if there's no condom there is not going to be sex.	No	Yes but I don't know the name.
21	24	M	H	Yes	Someone speaking into an ear. If it is not on, it is not in.	No	—-
22	26	M	M	Yes	No gloves. No love. Someone whispering something into another person's ear. No gloves. No love. It means if you don't use a condom no love.	No	I recognize the Adinkra symbol. I've forgotten what it means.
23	36	F	L	No	I can't make out the picture very well.	No	No
24	—-	F	H	Yes	I can see somebody speaking into someone's ear: No glove. No love. It means no condoms. No sex.	No. I don't know what it is.	No. I don't recognize the Adinkra symbol.
25	25	F	M	Yes	I can't tell what it is.	No.	No.
26	—-	F	H	Yes	No.	No	No
27	—-	F	M	Yes	I can see somebody speaking into somebody's ear: No glove. No love. It means No condoms. No sex.	I don't know what it is.	—-

TABLE 1:
Data generated from semi-structured interviews between the designer and Ghanaians

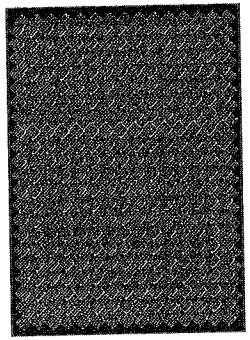
about behavior change due to cultural dissonance and antagonism between some of the communication modes of the campaigns and the users' culture. They argue that HIV/AIDS campaigns are more effective when localized by the designer through the use of communication modes and resources familiar to the intended users. However, as the data in Table 1 shows, though localized to Ghanaian culture, the Red Card still generated a high level of semiotic noise in the transnational, interactive communication process.

FIGURE 3

The HIV Adinkra symbol in the form of an artisan stamp

Out of the twenty-six participants who responded to question E, less than half interpreted the image in the top portion of the card as I intended through the denotative localization I implemented. Most of the participants were unable to understand the meaning of my illustration of the brown-skinned woman whispering into the ear of her male lover: *No gloves. No love.* Twelve participants saw a woman whispering into the ear of her sex partner. Out of twenty participants, with a medium to high level of technical proficiency, only one recognized the QR code. However, none of the participants understood what it meant and how it functioned in the design. Finally, out of the twenty-two participants who responded to question G, only four recognized the Adinkra symbol; but, once again, none knew what it meant.

The participatory design sessions generated the HIV prevention Adinkra stamp in Figure 3. It is based on a well-known Adinkra symbol called Sankofa that means you can always go back to the past. The difference between the two is that



the HIV Adinkra symbol shows the Sankofa bird with a condom package in its mouth. Thus, in the next iteration of the Red Card, shown in Figure 4, I replaced the illustration of the brown-skinned woman whispering into the ear of her partner with a picture of the new HIV Adinkra symbol.

FIGURE 4

Iteration 2 of the Red Card after connotative localization through interactive communication

CONCLUSION

The question becomes What can we conclude from these research findings? One conclusion is that the concept localization needs to be re-operationalized to include two different levels of cultural adaptation: denotative and connotative. Cyr and Trevor-Smith's and Banda and Oketch's definitions of localization refer to the customization of an image's denotative features to a specific culture. However, this paper re-operationalizes localization as denotative *and* connotative customizations.

Denotative localization, in this paper, refers to the customization of an interface based on prior knowledge of the user's culture gleaned indirectly, for instance from print and digital texts, or experientially in an ethnographic manner through direct observation of users in their local context. The first iteration of the Red Card depicted in Figure 1 specifically represents denotative localization, for instance, through the use of brown-skinned people and an Adinkra symbol. I even chose the QR code in response to observing the use of cell phones in Kumasi. My data arguably shows that dissemination of the original iteration of the Red Card in Figure 1, would have likely been impaired in its function: to promote safer sex practices by Ghanaians and help them to find out where to get condoms in Kumasi. However, when I opened up the design process to allow for connotative localization, I found a new indigenous mode of communicating HIV prevention through the use of an Adinkra symbol.

Connotative localization refers to the adaptation of an interface to the culture of an intended user through an interactive communication process that provides a feedback loop between the designer and user prior to the production of the final image. During connotative localization, the designer opens up the design process to share control of design decisions with the intended users. Thus, in connotative localization, the user's role evolves to that of an active participant who co-constructs meaning (Bennett, 2012). The image signifiers that connote meaning leading to cognitive or behavioral change, come from a negotiation between

the designer and quintessential members of the intended community. The transnational and transcultural image in Figure 4 represents the outcome of connotative localization through interactive communication, an approach that entails the following designer actions:

Observing users and their environments through ethnography,

Developing and denotatively localizing an image based on recorded observations during Step 1,

Interviewing users about the semiotic performance of the outcome from Step 2,

Conducting participatory design sessions with users or quintessential users,

Rendering the next iteration of the image outcome based on the participatory design sessions and repeating steps 1 through 5 until finding a desirable outcome.

Noar (2006) and Maibach, et al. (2002) disclose principles for effective HIV/AIDS prevention campaigns that include formative user research and testing and summative evaluation requirements. The first five steps of connotative localization through interactive communication (CLIC) reflects formative user research. However, my previous work titled "Good Design is Good Social Change: Envisioning an Age of Accountability in Communication Design Education" (2012) argues for greater accountability in the discipline through evaluation of design outcomes in their intended social contexts. Thus we could extend CLIC to include summative evaluation with the inclusion of the following step:

Evaluating the image outcome from Step 5 and its ability to effect cognitive or behavioral change in the intended, transnational community.

For instance, the Red Card aims to prevent further HIV infections by advocating for condom use and helping Ghanaians to find condoms in their local community. Finally, additional funding for fieldwork can lead to testing of the Red Card to determine whether or not it achieves its goal. This lacuna in my data and findings brings us to a drawback of the CLIC approach: it requires extensive research funding.

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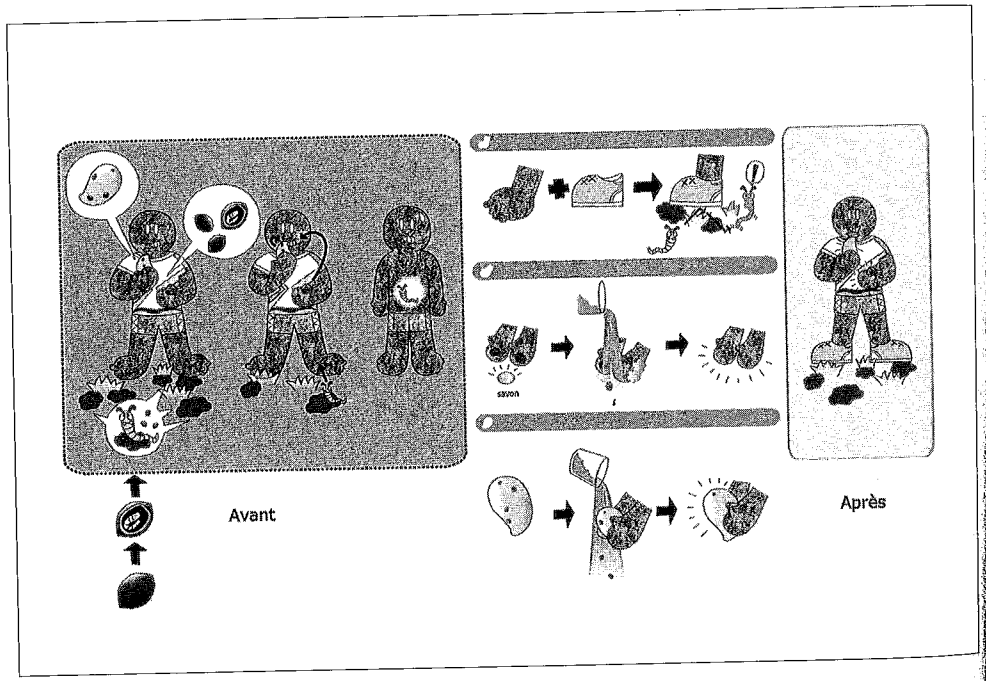

3 Designing and Evaluating a Health Program in Africa: *Hygiene Matters*

Mike Zender*, David K. Plate**

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ABSTRACT

Parasitic intestinal worms are a leading cause of poor school performance of children in Africa and a leading predictor of low quality of life for a lifetime. Deworming medication is effective and inexpensive yet experience shows that unless measures to improve hygiene are taken those who are rid of worms through medication are often re-infected within months. Responding to this, Hope Educational Foundation in partnership with a student/faculty design team from the University of Cincinnati designed, developed, and tested a hygiene educational program as part of a comprehensive deworming program in Africa. *Hygiene Matters* was designed with African-user participation, employed visual-story for communication, and was tested in the Central African Republic in 2012 with a larger pilot study in Togo in 2013-14. While hygiene knowledge increased significantly with the curriculum, practices did not increase significantly, and testing revealed flaws in the study protocol that need to be corrected in future evaluations. This project suggests that designers need to improve their ability to conduct research establishing program effectiveness in health outcome terms as designers move from creating individual artifacts aimed to meet client specifications to creating programs that aim to change health outcomes.

KEYWORDS

visual communication, health program, evaluation, worm infestation

BACKGROUND

In 2000 with a remarkable degree of agreement, the United Nations announced Millennium Development Goals. Chief among these was "Achieve universal primary education" because schooling was seen to be a driver of many other development goals: job success, gender equity, mental health, and physical health. One key to educational success is simply attendance, and a surprising driver of poor attendance is worm infestation. Soil transmitted helminthiases (STH) are a group of parasitic diseases caused by infection with nematode worms: primarily roundworm (Ascaris lumbricoides), whipworm (Trichuris trichiura), and hookworm (Necator americanus and Ancylostoma duodenale). These worms are transmitted by eggs in human feces. After maturing in the soil, worm eggs or larvae infect human hosts either through ingestion (roundworm and whipworm) or penetration of the skin (hookworm) (WHO, 2011). It is estimated that approximately two billion people worldwide are infected with these intestinal worms (de Silva, et. al. 2003. WHO, 2013). The burden of disease in Africa is relatively high in comparison to the rest of the world. (WHO, 2011) Infection rates with soil-transmitted helminthes are highest in rural, resource-limited settings, particularly where there is limited access to clean water, adequate sanitation, and improved personal hygiene practices. Where more people are infected, infection spreads to even more people; where fewer people are infected, the worms die out. Freedom from worm infection has been proven to be by far the least expensive way to increase school participation in settings with a high prevalence of worms (Karlan & Appel, 2011, pp. 205-209). Targeting treatment at school children has the added benefit of reducing prevalence in the community at large (Bundy, 1995).

Fortunately, deworming pills exist that are nearly 100% effective and cost just pennies apiece. Unfortunately, successful worm eradication is not as simple as one might wish. Many developing nations lack the funds and public health infrastructure to regularly distribute medication through primary schools. They also often lack health and pharmaceutical facilities, and even if people to whom rapid transit means a bicycle were able to get to a facility, the cost of regular deworming treatment would still be an issue. Worms thrive alongside poverty where clean food and shoes may be luxury items. Worms thrive also in areas with poor sanitation: unclean water and inadequate sewage management. Yet infrastructure improvements are costly, requiring not only funds for construction but also for proper maintenance. Worms are at home in certain social practices: indifference to using toilet facilities and washing hands for example. Finally, worms persist due to historic cultural traditions that can obscure scientific explanations in favor of mythical and mysterious ones; such can block the application of solutions right at hand because people simply don't believe in the solution offered.

Although an inexpensive pill can kill the worms, it is clear from the above that without a change in hygiene knowledge and practices children treated for worms can quickly be infected again. In fact, on a trip to Kenya, one of the authors directly observed that the majority of children dewormed several months previously were indeed reinfected. From this simple need we envisioned a deworming program that would address not only medical treatment but also the ignorance and cultural practices that create the need for continual re-treatment.

DESIGN DEVELOPMENT

Several leading design voices have called for a move away from an emphasis on designing artifacts. While it may be that knowledge gained from creating and critiquing individual artifacts is essential to the construction of design knowledge and a key feature of design thinking, it also has become apparent that the time for seeing single artifacts as answers to complex problems has passed. The problem of parasitic worms is multidimensional. Neither a pill alone nor a brochure alone are likely solutions. Our response was therefore to design not a single artifact but a multidimensional hygiene education and medication program that included both material artifacts and engagement processes.

The *Hygiene Matters* program aimed to improve the lives of primary school children by teaching healthy hygiene practices and by informing them about deworming medication. The program design incorporated a symbol-based education curriculum to transcend obstacles of literacy and linguistic translation.

The main design object was an instructional hygiene poster for the lower primary classroom (grades 1-3). The poster had just three words: Before - Soap - After. The poster was large (27 x 38.5") so that teachers could refer to it during instruction to a class of a hundred students (large class size is often a reality in Africa). A small 10 x 15" version of the poster was sent home with the students to share with their parents and siblings to further support social/family behavior change. A more detailed 32-page student booklet was designed for upper level primary students (grades 4-6).

A second symbol-based poster for lower primary presented Bible lessons connecting the hygiene lessons to moral values, spiritual purposes, and the value of each individual. Effecting behavioral and in some cases cultural change requires motivation and connection to significance and meaning. We believed connecting physical hygiene lessons to scriptural teachings could provide added motivation and meaning. Though sub-Saharan Africa is predominantly Christian, there are other significant faiths and occasional preferences for no faith, so this specifically Christian content was a separate part of each lesson and was optional for those teachers who wished to use it.

FIGURE 1

The Hygiene Matters hygiene poster
This employed primarily symbolic visual communication. It had just 3 words: Avant (Before); Savon (Soap); Aprés (After). The poster tested in the pilot study was in French, the language used in school in Togo. The poster symbolized 6 curricular lessons (from left to right): Lesson 1 What are Worms? (Before); Lesson 2 (middle) Hand Hygiene; Lesson 3 (bottom) Keep Food Clean; Lesson 4 (top) Protect Your Feet; Lesson 5 Always Use a Latrine (not pictured here); lesson 6 Review (After). The poster design evolved over time, changing the sequence of the images on the poster to better match the lesson flow from 1 through 6 and adding a latrine sequence for use of the latrine. This is an earlier version printed for CAR and, because it was readily available, the one tested in Togo.

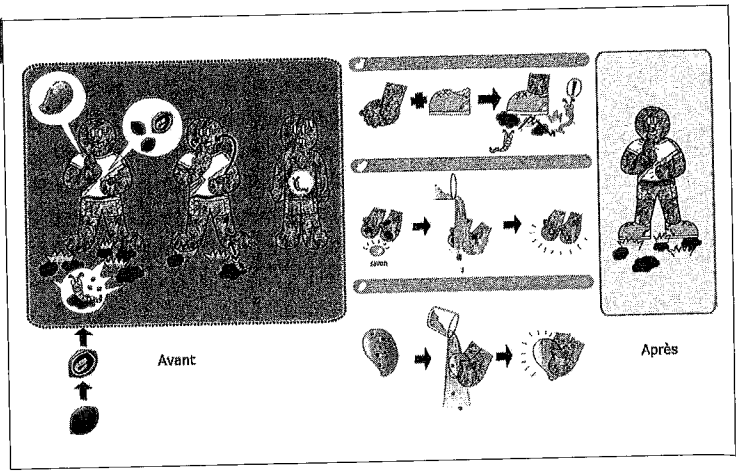
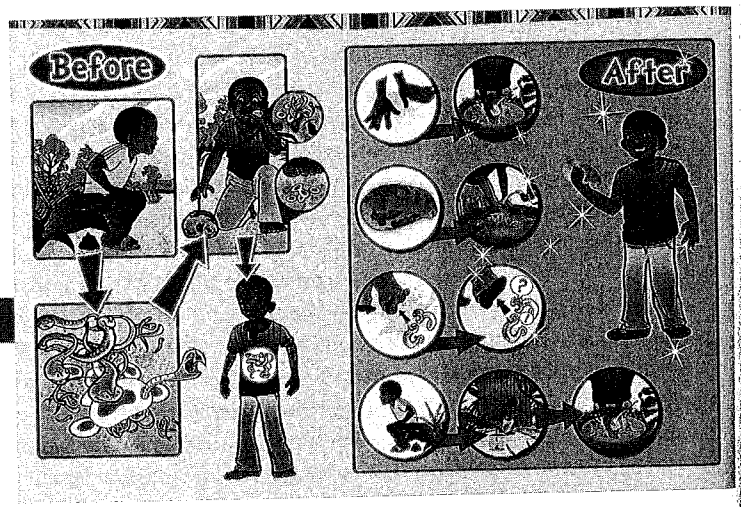


FIGURE 1A

Redesigned hygiene poster.
This is a redesigned version of the hygiene poster that included latrine content and responded to on-going struggles among younger children (grades 1-2) to understand worms. This was NOT the poster tested in Togo.



To accompany the students' materials above, a 32-page Teacher's Guide was designed for each curriculum version (lower and upper primary) and a teachers' training program was developed to teach teachers what to teach and how to teach it. Medication would accompany the school-based educational curriculum with appropriate government and community support. Evaluation testing methods and measures for communication design programs are not well established; thus for the pilot study reported here, a pre- and post-program student evaluation of Knowledge, Attitudes and Practices (KAP) was designed along with a teacher feedback survey.

TEAM

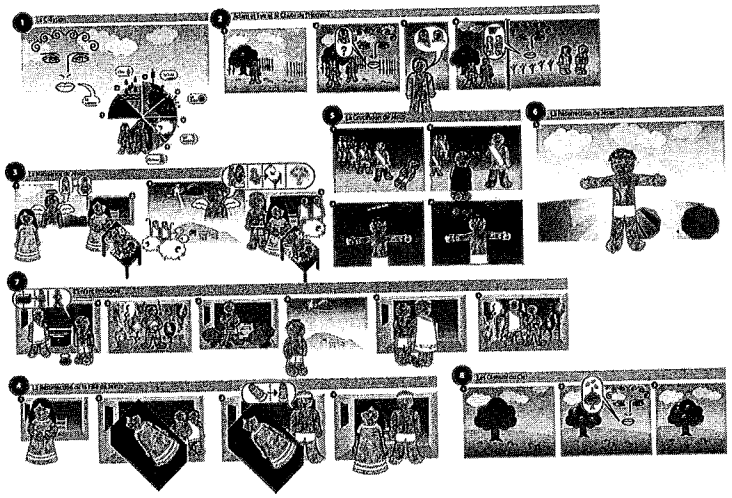
To design a multidimensional program requires a cross-disciplinary team. Our team included staff from the Hope Education Foundation (HEF), a global Non-Governmental Organization (NGO) devoted to addressing systemic threats to children: Emma Moore (Programs Director); Magali Hoffiz (Operations Director); Anna Chard, MPH, Kamila Przystula, MPH, and David Plate, MPH (Research Consultants) and Mike Zender, MFA (Design Consultant & Board Member of HEF, professor of Design University of Cincinnati - UC). This staff included specialists trained in social work, international health, international education, and communication design. Program development was supported by the Hope Educational Foundation. Curriculum and program design support was provided by staff from OneHope, a Christian missions organization: Kami Kindel (Design Team leader), Katie Spencer (Project Manager), Mandie Anderson (Artist & Graphic Designer), and Shannon Medisky (Writer). The program tested in Lome, Togo also had the support of local OneHope staff: Gédéon Attiogbe (Country Director), Jim Byh (Francophone Regional Director), Manuella Bouaben (Monitoring & Evaluation Coordinator), Gilbert Adom and Clement Akahoun (Field Staff), as well as the Togo Ministries of Primary & Secondary Education: Kossi M. Mensah (Health Education Coordinator), and Health: Edmond Sognikin, MD (Community Health Director; Neglected Tropical Diseases Coordinator).

CO-DESIGN PROCESS

We did not arrive at the program described above quickly or in a single step. We validated the initial program concept and developed content through a literature review of hygiene and STH-related learning objectives and existing curricula, as well as field testing and input from teachers. The resulting curriculum consisted of 6 lessons that may be presented to students over a period of weeks. Our communication strategy was based on our previous experience designing the iMatter HIV/AIDs prevention curriculum in Swaziland that relied heavily on stories for effective communication (Zender, Ecker, & York, 2010). We also learned through the experience that cause and effect, before and after, were not always the most natural explanations for sickness for those still living with a legacy of witchdoctors and ancestor worship. Based on this we sketched visual stories for each lesson emphasizing simple before and after in an apt style employing a generic African look designed to appeal to children. Sample stories were designed in conjunction with UC graduate design student Feifei Pang.

In June 2011 an initial design sketch for the poster was tested in Shariti, Tanzania. A Tanzanian college student administrator was trained to present the poster to a representative student sample of various ages. The administrator first asked students to explain what they saw and then solicited student feedback on what they understood, what they found difficult to understand, and why. In a rural school 18 students grades 1 – 6 agreed to participate. We observed there that older children

FIGURE 2



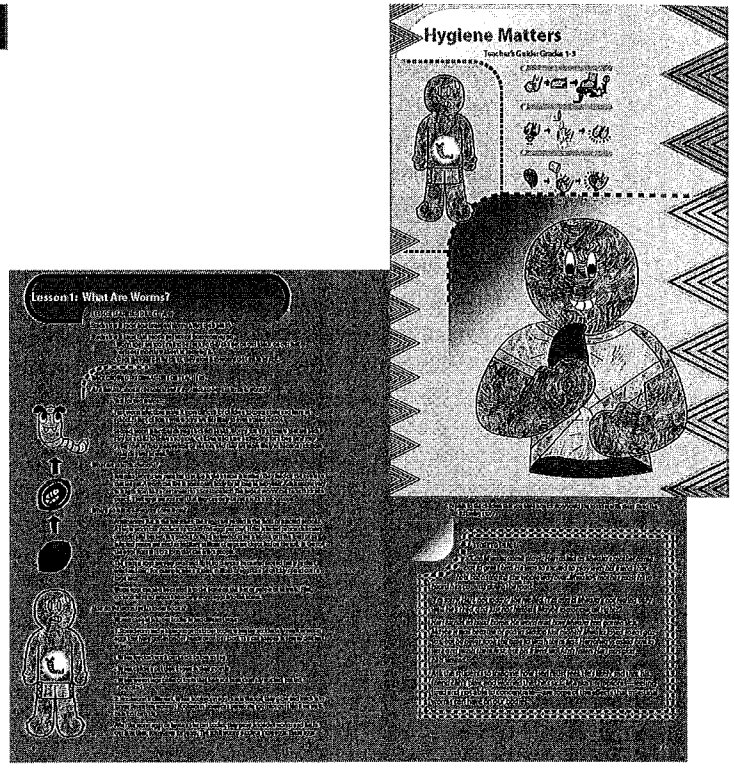
The Scripture Lessons Poster.
Optional lesson portions in the Teacher's Guide link scripture symbol-based stories on this poster to relevant hygiene lessons. Scripture stories 1 and 2 (top row) about God creating all things good and the subsequent fall of man that brought sin and bad worms into the world were linked to Lesson 1 teaching about the dangers of intestinal worms (What Are Worms?). Stories 3-6 on cleansing from sin (forgiveness) were linked to Lesson 2, Hand Washing; story 7 on obedience and making mistakes was linked to Lesson 3, Keep Your Food Clean; story 7 on avoiding bad, particularly negative peer pressure, and doing good linked to Lesson 4, Protect Your Feet; story 4 about growth through consistent faith linked to Lesson 5, Always Use the Latrine; story 8 about spiritual growth and future hope linked to Lesson 6, Review and the positive outcome (After). This poster is in French used in the classroom.

quickly grasped the poster content and then turned and helped the younger children with their questions about it. All students understood the poster content correctly within a few minutes. This suggested that the worm explanation and hygiene messages worked across elementary aged school children. Direct interaction with these children provided an invaluable co-design input.

In May 2012 the program was pilot-tested in two rural and two urban schools in the Central African Republic (CAR). After a half-day training, thirteen teachers taught the program in their classrooms. The six lessons were taught in one week, rather than over three weeks as designed. Evaluation methods included classroom observation of 16 individual lessons, teacher feedback surveys, post-program teacher focus groups, student KAP pre- and post-testing, and student art preference testing. Additional valuable feedback was provided by collaborators from a partner church in France who assisted with the validation, as well as by a government panel of health and education experts who reviewed the curriculum. Unfortunately, student KAP pre- and post-testing was interrupted by teacher strikes during the final week of the validation, so it was not possible to evaluate the program's impact on students.

Some of the key revisions resulting from the CAR pilot-testing included choosing more appropriate titles for the overall program and the lesson sub-sections, adapting lesson activities to make them more locally feasible, and improving illustrations to better convey hygiene messages. Later in 2012, the CAR Ministry of Primary and Secondary School Education & Literacy chose to not grant approval to implement the curriculum more widely in public schools throughout CAR, despite earlier indications that approval would be granted. In retrospect, it would have been impossible to continue conducting the program in CAR due to political instability lasting from late 2012 to the present.

FIGURE 3



Teachers Guide: cover and pages 6-7.
The cover summarizes the poster, with the Before in the upper left and the happy After in center right with three lessons in upper center. Pages 6-7 show how the poster symbols were repeated throughout the Teachers' Guide. Page 7 gives an example of a story used in teaching. Lessons also included hands-on activities. The Teachers' Guide included Teaching Tips and other teaching resources. Pages 34-35 of the guide reproduced the poster and showed how each lesson was illustrated on the poster and how to use it in instruction. The Teachers' Guide for the pilot was in French. This figure is in English.

Due to the difficulties in CAR, in 2013 we moved the pilot test to Togo. Togo was chosen for two reasons. First, STHs are endemic in Togo. Biological field surveys in Togo demonstrate a prevalence of STH infection above 50% in locations throughout all regions of the country (Global Atlas of Helminth Infections; Dorenoo, 2012). Second there is a strong existing relationship between Hope Education staff, the local Assemblies of God Church, and the government which necessarily facilitates implementation of any school-based education initiative. It was agreed with the Togo Ministry of Education that individual teachers would be allowed to not teach the Bible portion of the lessons if that was their preference.

METHODS

The *Hygiene Matters* program was validated in 2013-14 as part of a pilot program in 5 districts in the capital of Togo, Lome. The study had three objectives:

1. To evaluate whether the *Hygiene Matters* program was implemented as intended,
2. To evaluate the impact of the *Hygiene Matters* curriculum on the hygiene-related knowledge, attitudes, and practices (KAP) of school-aged children,

3. To obtain feedback from teachers regarding the curriculum content and ease of use,

We also explored the program's impact on self-reported sanitation conditions in students' homes.

Starting in October 2013, Hope Education Foundation sponsored a bio-survey estimating the prevalence of STH infection in 30 schools in the study area that were expected to have the highest prevalence based on sanitation conditions and other factors (Dorkenoo *et al.* 2014). From among the 18 schools with the highest rates of STH infection, 12 were randomly assigned to the education group (to conduct the *Hygiene Matters* program), and 6 were randomly assigned to the control group. These 18 schools comprise the validation study. Student KAP pre- and post-testing was conducted among 2590 students in these 18 schools.

TABLE 1

Pilot program & validation study comparison

	Pilot program	Validation study
Number of schools	298 schools	18 schools (including 12 of the schools participating in the pilot program, and 6 additional control schools)
Grades involved	Grades 1-6	Grades 3-6

TABLE 2

Study objectives and measurement tools

Objective	Measurement tool(s)	Timeframe for administering	Participating schools
1. To monitor implementation of the Hygiene Matters program.	Teacher training attendance & feedback form Distribution of materials form Class size & student attendance/registry forms, by lesson	Throughout the pilot program	All 298 pilot schools
2. To evaluate the impact of the Hygiene Matters curriculum on students' hygiene-related KAP, including self-reported sanitation conditions in students' homes.	Student KAP pre-survey Student KAP post-survey 1 Student KAP post-survey 2	Immediately before the intervention One month after the intervention Four months after the intervention	12 pilot schools (education group) 6 control schools (control group)
3. To obtain feedback from teachers regarding the curriculum content and ease of use.	Hygiene Matters lesson feedback form	At the end of the teacher training At the end of each of the 6 lessons	All 298 pilot schools

The overall pilot program involved an additional 286 schools, for a total of 298 schools conducting the *Hygiene Matters* program. Program monitoring forms and teacher feedback forms were collected from all 298 participating schools.

TEACHER TRAINING

Teachers in all participating schools were trained on the *Hygiene Matters* curriculum. Teacher training was conducted by a team of 12 Togolese facilitators. Facilitators were trained in August 2013 by Hope Education Foundation's Research Consultant and Operations Director, and then facilitators conducted a practice training in September.

Teachers were trained on the information that should be presented during each *Hygiene Matters* lesson. It was made clear that teachers were allowed to not teach the Bible portion of the lessons if that was their preference. Teachers in all 18 evaluation schools received additional training on how to conduct the KAP pre- and post-testing. Teachers in the schools in the education group received the *Hygiene Matters* materials necessary to implement the educational intervention, including teachers guides, student books, and posters while teachers in the control group schools attended the trainings but did not receive the materials or implement the curriculum during the study period. Educational materials were distributed to students in the control schools at the end of the school year, following the final KAP survey.

VALIDATION STUDY POPULATION AND SAMPLE SIZE

The study population consisted of school-aged children in grades 3-6 in selected primary schools in Lome. Based on pilot testing of the survey, children in grades 1-2 were unable to complete the written KAP survey, and one-on-one interviewers were not feasible.

The number of students included in the KAP pre- and post-surveys was sufficient for estimating KAP scores with 95% confidence and a 5% margin of error within each study group (education, control) as well as by grade. Students KAP scores would be expected to be more similar within the same classroom and school than across different classrooms and schools. Therefore, the required sample size for estimating KAP scores is mainly a function of the number of schools and classrooms, rather than the total number of students. However, it was only feasible to sample from approximately 6 schools per study group rather than the optimal 60+ schools. Therefore, school- and classroom-level clustering was ignored when determining the sample size.[1]

The KAP test was conducted in one classroom per grade in each school. The required sample size could have been reached by randomly selecting students to test in each classroom; however, it was easier

[1] Implications are explained in the Data Analysis section, below.

to give the KAP test to all students in a class. Therefore the total number of students in the sample was larger than necessary.

PROGRAM MONITORING

At each teacher training session, attendance was taken and teachers provided written feedback. During the program, all teachers in all participating schools were asked to provide the following information:

For each *Hygiene Matters* lesson: lesson date, number of students (total, male, female), and feedback on lesson content (positive/negative aspects, most difficult concepts, utility, suggestions for improvement, and success stories)

For each participating student: name, sex, age, attendance at each lesson

KAP & HOME SANITATION SURVEY

Each participant within the 18 selected schools completed a survey focused on knowledge, attitudes, and practices (KAP) related to hygiene and STHs. The KAP survey was pilot tested in 2012 in the previous validation in the Central African Republic. KAP surveys were administered pre-intervention, 1-3 weeks post-intervention, and 10-13 weeks post-intervention. (Intervention refers to the implementation of the *Hygiene Matters* curriculum.)

The KAP survey consisted of true and false, and multiple choice questions addressing basic information about STHs, transmission mechanisms of STHs, and ways to prevent STH infection. In addition, as an exploratory outcome, additional questions on the KAP survey evaluated standards in home sanitation as reported by students and measured any changes over the course of the evaluation period. Home sanitation topics included access to shoes, clean water, soap, and a latrine.

Scores for the KAP questionnaire were calculated out of a total of 19 points, excluding the home sanitation section which was a total of 4 points. Scores are presented as the percent of correct items in each section or overall. Scores are reported only for those students who completed all 3 KAP tests.

DATA ENTRY & QUALITY CONTROL

Data was originally collected on paper-based surveys which were transcribed into an Excel database.

Basic monitoring information was entered from all schools, and complete information was entered from a sample of schools (the 12 schools in the education group, and 10 randomly selected control schools) for in-depth analysis. It was not necessary or feasible to enter and analyze all the monitoring data collected from all program schools.

For quality control, a small subset of each survey or form (e.g. 10 participants for each of the KAP surveys) was entered twice and the two entries were compared. In all cases the error rate was below the predetermined 5% threshold, and in most cases the error rate was below 2%. No significant data entry problems were identified.

DATA CLEANING & ANALYSIS

For the KAP surveys, we excluded 7 students who were assigned to different schools for different KAP surveys. Statistical analyses were conducted using STATA v12 and SPSS v22. Independent samples t-tests were used to test for differences in post-means among study groups. Differences at a 90% confidence level (p-value below 0.10) were considered statistically significant, meaning we are 90% confident they did not occur by chance.

For the KAP analysis, when baseline scores differed between the education and control groups (and due to the non-normal distribution of the data), it was not possible to statistically test for the differences in these average values between the education and control groups.

Although students were grouped within schools, a multi-level analysis (to account for grouping within schools) was not done because it would have limited statistical power due to the small number of schools. (It was not feasible to sample from a larger number of schools.) Therefore, it may not be possible to generalize the results to all schools in the program area.

TREATMENT

In November 2013 a bio-survey was conducted. The prevalence of intestinal worms was below the 20% threshold established by WHO, so medication was not administered to all students as part of the program. All participants who tested positive for STH in the bio-survey received treatment. The medication was administered at each of the schools where participants who tested positive were enrolled and consented to obtain treatment.

IRB APPROVAL, INFORMED CONSENT, AND CONFIDENTIALITY

The Ministry of Health Ethics Committee in Lome, Togo approved the study prior to the start of data collection. Written consent was provided by the parents/guardians of potential participants in the bio-survey. The consent forms were sent home with each student prior to the bio-survey. Only students who provided a signed parental/guardian consent form were eligible to participate in the study.

Student and teacher names were collected during monitoring and evaluation activities for the sole purpose of linking information across different forms (e.g. linking KAP pre- and post-tests). Access to data was limited to HEF program staff conducting data entry or analysis.

RESULTS

The aim of the *Hygiene Matters* program was to reduce the community-wide infection of worms through a combination of medical treatment and health education. The pilot program and validation study were designed to demonstrate program effectiveness directly through change in KAPs and indirectly through a lower instance of worm reinfection in the intervention group that received the curriculum. Unfortunately for the study, the bio-survey showed the initial worm prevalence was lower than expected (below 20%) and thus administering medication to all students was not permitted as part of the pilot program. As a result, it was not possible to conduct a post-survey of worm prevalence thus thwarting our ability to measure worm reinfection rates and the effectiveness of our program on the ultimate outcome.

PILOT PROGRAM MONITORING

Teacher Training

A total of 1160 teachers from 298 schools in Lome were trained on the *Hygiene Matters* curriculum. On average, 3.9 teachers were trained per school. Seven training sessions were conducted from November 25 to December 15, 2013, with a range of 106 to 195 (average: 163) teachers per session. An eighth training session with 20 remaining teachers was conducted on January 28, immediately before the start of the program.

Due to budget constraints, it was not possible to train enough teachers for the original goal of reaching 100,000 students with the program.

Program implementation

Enough *Hygiene Matters* materials were distributed to 298 schools to reach 73,762 students, including 38,987 lower primary students (grades 1-3) and 34,775 upper primary students (grades 4-6).

Reported Number of Students Reached

One or more program monitoring forms were submitted by 931 teachers representing 1008 classrooms in 263 schools. This represents 80% of the 1160 teachers who were trained and 88% of the schools with trained teachers.

The *Hygiene Matters* curriculum was implemented across the participating schools from January 30 to March 17, 2014. Starting and ending dates varied considerably across schools. On average, the six lessons were taught over a period of 3 weeks (21.3 days) (range: 11-33 days), which is in line with the plan of teaching 2 lessons per week.

Reporting forms submitted by teachers account for 58,879 students being reached by the pilot program. This represents 80% of the 73,762 students who were potentially reached based on the quantity of materials distributed to schools. On average, there were 58.4 students per class.

Hygiene Matters Lesson Implementation

Program monitoring data were analyzed in more detail in a sample of 22 schools, including the 12 schools in the education group of the evaluation and 10 additional, randomly-selected program schools. In total, 99 (98%) of the 101 teachers in this sample taught all 6 of the lessons. Two teachers taught only 5 of the 6 lessons. On average, students attended 5.8 out of the 6 lessons, for a 97.5% attendance rate. Attendance varied very little by age or sex. Teachers reported only 1.4 absences per lesson, on average. The average number of absences was highest for grade 1 (2.1) and lowest for grade 6 (0.6). Each lesson lasted an average of 42 minutes. Lessons 1 to 6 were all very similar in length. However, lesson length gradually increased with grade level. Each Lower Primary lesson was 3 to 6 minutes shorter, on average, than the corresponding Upper Primary lesson.

KNOWLEDGE, ATTITUDES, AND PRACTICES (KAP)

A total of 2560 students participated in all three KAP surveys.

Demographics

There were no significant differences in the age or sex distribution of students across the three rounds of KAP surveys.

KAP Survey Results

At baseline (pre-survey), the education and control groups had the same average KAP score (see *chart 1*). Within one month after the intervention (post-survey 1), the average KAP score was significantly higher in the education group. At 2-3 months post-intervention (post-survey 2), the education and control groups had similar average KAP scores.

Chart 1, below, shows the improvements in the overall KAP scores in the education group relative to the control group. These were due primarily to improvements in knowledge scores, not to improvements in attitudes or practices scores.

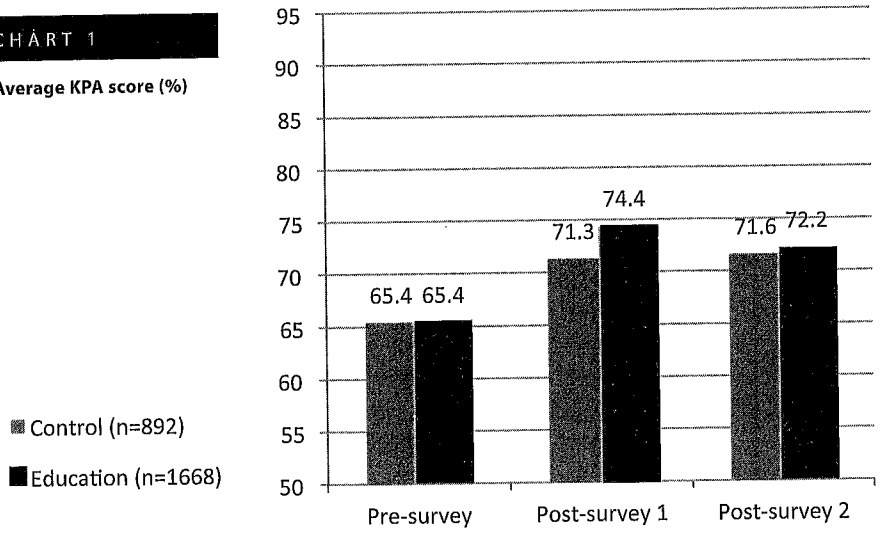
Overall KAP pre- and post-survey scores for the education and control groups

At baseline (pre-survey), the education and control groups had the same average KAP score. One month after the intervention, the average KAP score was significantly higher in the education group. At four months post-intervention (post-survey 2), the education and control groups had similar average KAP scores.

From pre-survey to post-survey 1, average Knowledge scores increased to a much greater degree in the education group than the control group. A similar increase was seen from pre-survey to post-survey 2.

CHART 1

Average KPA score (%)



From pre-survey to post-survey 1, changes in average Attitude scores were similar in the control and education groups. From pre-survey to post-survey 2, the control group actually showed a greater increase than the education group.

Last, the control group showed more improvement over time in average Practices scores, compared with the education group.

TEACHER FEEDBACK

Program monitoring forms included the following open-ended questions for teachers:

What went well in this lesson?
What went poorly in this lesson?
Were any concepts not understood by the students? If so, which ones?
How could this lesson be improved?
Comments (general comments about the program)

We reviewed a sample of responses from 95 teachers, representing 27 schools. Most teachers provided feedback on all 6 lessons, so there were approximately 600 responses to each question.

"What went well in this lesson?"

In total, 68% of responses to this question were substantive. 30% of responses reported that everything went well, and only 2.5% "nothing". Responses weren't analyzed in detail, but some common responses follow:

Students were interested, were motivated, took the content to heart, actively participated, etc.
Handwashing and other activities were good

Students like the lessons, were proud of their books, etc.
The images, posters, and Bible stories were helpful

"What went poorly in this lesson?"

Teachers reported no problems in 85% of the lessons. The most frequent problems had to do with the Biblical content in the lesson.

"Were any concepts not understood by the students? If so, which ones?"

Remarkably, teachers reported that no concepts were misunderstood in 89% of the lessons. This is inevitably an underestimate on the part of teachers, but it is still encouraging.

Teachers in grades 1-4 reported that children had difficulty grasping the existence of intestinal worms. Older students (grades 3-6) struggled more with understanding how worms infect people.

Some students lacked basic hygiene knowledge, such as how to use a latrine and how to properly wash hands.

"How could this lesson be improved?"

52% of teacher responses gave no suggestions for improvements. 20% of teachers suggested specific curricular changes such as "show a film" and 20% requested additional materials such as soap for hand washing and other activities in the lessons.

General Comments

General comments from fifty teachers were reviewed. The few negative comments from teachers have all already been mentioned in previous comments above. A sample of some of the positive comments follow:

This project is welcome. It allows students to know the rules of hygiene that they must follow to be in good health.
This is a good program. Over the course of the lessons, the students were amazed at the harm worm [eggs] cause to people.
I salute your initiative since we live in a region with a high population density, confronted with parasitic diseases... Through these lessons, students can adopt good hygiene measures.
I wish we had more books to distribute to the students, as well as Bibles.
The lesson connected with God's Word interested the students.
We're proud of what you have given us. It's a plus.

DISCUSSION

Program Design

The poster and curriculum design increased knowledge. While younger children continued to have problems understanding the size of the worms

this may be simply an obstacle presented by use of the word "worm" in society/medicine both for something large we can all see in the ground and for something microscopic that grows larger inside your body. Design can facilitate understanding of difficult concepts but cannot change the nature of the concepts or change the language society has developed to describe them.

The image-based visual story approach was effective as was the simple before and after structure. It was not surprising that some problems were reported with the Biblical visual stories because there were not only more Bible stories, but each one was also more complex and longer than the simpler worm stories.

The teacher training was also effective, as discussed below perhaps too effective! The Togolese facilitators readily grasped the curriculum content and the visual stories used to convey it. In fact, anecdotal experiences suggest the symbol-based content likely made the program content easier to not only grasp for students but also easier to remember, explain, and deliver for facilitators and teachers alike. Results certainly identified no problems in knowledge transfer from program staff to facilitator to teacher to student.

The visual approach was also appealing to teachers and students alike, likely adding to its effectiveness.

In short, the program design and individual design objects in it were effective.

Evaluation Design

Even given the overall effectiveness of the program, it was still surprising that the KAP scores increased in the control group as well as the education group. There are several possible explanations for why.

First, KAP tests were administered by the teachers, mostly unsupervised by HEF or OneHope personnel. Therefore, it's possible that teachers may have coached the students when giving the KAP tests. This sometimes happens when teachers want their students to perform well on a post-test, even though they have been told that the purpose of the testing is to evaluate and improve the curriculum, not to evaluate the teacher or his/her students.

If coaching was taking place, it becomes impossible to accurately evaluate the effectiveness of the curriculum because coaching could inflate the KAP test results in the control schools, the education group schools, or both.

In future evaluations, all KAP tests should be given by program personnel, not by teachers, even if it means having a much smaller sample size. (In this validation, we opted for a larger sample size, although it meant we couldn't oversee testing in all classrooms.)

Second, teachers in control group schools participated in the teacher training along with teachers in the education group,

in order to prepare all teachers to administer the KAP tests. Since basic information on hygiene and intestinal worms was included in the teacher training, it's possible that teachers in the control schools may have passed along information about worms and hygiene to their students. If this was the case, it appears that the teachers conveyed the material quite effectively without the HM curriculum, although using the curriculum did have an additional impact (see Chart 1, above).

In future evaluations, teachers in the control group schools should not participate in the teacher training. If KAP testing is done by program staff, then there will be no need for teachers in the control group to be trained.

Third, students sometimes score better the second or third time they take a test simply due to familiarity with the test, even if they haven't learned any additional material. This effect might be more pronounced from the pre-survey to post-survey 1 where the interval was only 5-7 weeks, whereas the drop in scores from post-surveys 1 to 2 may be due to the longer interval (9-10 weeks) between those surveys. The purpose of the control group is to measure this effect. Thus, if the improvement in control group scores is due to this retesting effect, then any additional improvement in the education group (over and above the improvement seen in the control group) can be attributed to the curriculum.

Some additional preliminary analysis results (not presented here) indicate that the KAP scores varied significantly depending on who the teacher was. This might mean that the first and second factors above may have been occurring (since some teachers may be more likely to coach students than others or to voluntarily pass along hygiene information to their students), or it may simply indicate that teaching effectiveness varies a lot from one teacher to another. Future evaluations can be designed so as to minimize first and second factors above.

CONCLUSIONS

The *Hygiene Matters* program was found to be effective at increasing hygiene-related knowledge over the short term, but the program's impact was lower than expected in terms of (1) altering attitudes and practices (not just knowledge), and (2) effecting change over a longer period of time.

Several recommendations were made to increase the program's impact:

- Ensure the posters stay up on the classroom walls both during and after the program, rather than being taken down between lessons and/or after the lessons were completed. This will provide more opportunities for repeated exposure (both casual and intentional) to the lessons' content.

..... Add 3-4 short (e.g. 30-minute) follow-up activities at 1, 2, and 4 month intervals after the initial lessons to reinforce the poster/curriculum content and learning. This could involve story-based lessons, transfer activities, incentive-driven quizzes, etc.

..... Add more hygiene practice time. This could also be incorporated into follow-up/refresher activities after the initial course.

The program's effectiveness may have been underestimated due to problems with how the research was conducted. The following recommendations were made for improving the research protocol:

..... Don't train control group teachers (to minimize the transfer of hygiene knowledge to students in the control schools).

..... Use staff to administer tests thus improving control (to eliminate the possibility of coaching during testing).

..... Modify post-test design to educate less.

Evidence that the program may be more effective than testing would indicate came recently from Country Director Gédéon Attiogbe who related that when the Togolese government was doing public health education campaigns around the Ebola outbreak last year, the *Hygiene Matters* schools kept telling them "Hope Education already taught us this!"

From this project it appears that design in partnership with health professionals and education specialists can produce effective health programs, but that better outcome evaluation is needed to demonstrate effectiveness. It would be unfortunate if a good program were to languish because its measure of effectiveness was compromised through flaws in the evaluation testing. In our view, if the discipline of Design is to be a partner in developing health program interventions then Design must demonstrate skill not just in the creation of effective individual artifacts and not just in the design of effective programs that include effective individual artifacts but also in the design and execution of evaluation testing to accurately measure the effectiveness of program outcomes.

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AUTHORS

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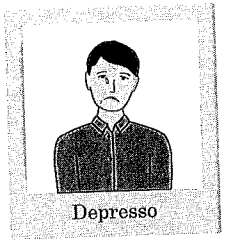
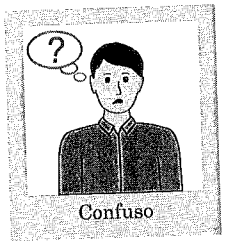
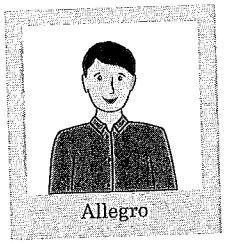
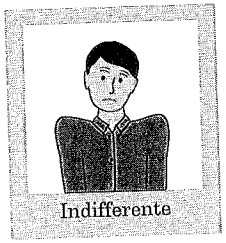
David Plate has been the Research & Evaluation Coordinator for Hope Education Foundation since 2011. In this role, he has focused on developing and evaluating the *Hygiene Matters* curriculum for francophone Africa. He is also part of the Research Team for OneHope. He previously worked as an epidemiologist with the Chicago Department of Public Health and the U.S. Centers for Disease Control & Prevention. He earned his Master of Public Health degree from the University of Michigan. David grew up as a missionary kid in West Africa.









4 Designing a Visual Tool to Interview People with Communication Disabilities: *a user-centered approach*

Guillermina Noël

ABSTRACT

To design in collaboration with users, speaking and listening are essential. This article shows the process of interviewing people with a communication disability called aphasia. Aphasia is caused by brain damage and affects speaking, understanding speech, reading, and writing to some degree. The focus of the article is on the creation of visual tools to facilitate the understanding of questions and producing answers by people with aphasia. Everything has to be adapted to match their needs: the wording, the types of questions, the way a question is introduced, and the length of the interview, among other things. For every question, specific material was designed to facilitate communication between the person interviewing and the person with aphasia. The strategy was to combine verbal information (oral and written), pictorial information, and movement. The main goal of the interviews was to understand the feelings and opinions of people with aphasia regarding the diagnosis process. The interview results helped identify people's preferences regarding the context in which the assessment takes place, as well as their needs regarding the visual materials used. The project demonstrated that it is possible and valuable to apply a user-centred design approach to the design of the visual material used to assess aphasia.

KEYWORDS

interviewing; communication disabilities; aphasia; user-centerer design; visual tools to facilitate understanding; collecting opinions; identifying feelings; outline only; line and tone; and color images; checking assumptions; object recognition

TRODUCTION

In face-to-face interviews, talking is the main tool for getting people's perspective and opinions about a subject. Hammersley and Atkinson (cited in Legard, Keegan, & Ward, 2003, p. 138) stated:

> The expressive power of language provides the most important resource for accounts. A crucial feature of language is its capacity to present descriptions, explanations, and evaluations of almost infinite variety about any aspect of the world, including itself.

Difficulty in producing or understanding language is a hallmark of aphasia, so it can be difficult to obtain these descriptions, explanations, and evaluations. It can also be difficult during the interview with people with aphasia to avoid making them feel frustrated and get tired. However, to gain insight into the patients' feelings and opinions regarding specific aspects of the assessment situation and to identify design possibilities, it was fundamental to interview patients.

In the aphasia literature, a clear need appears to use every possible avenue to obtain the necessary information. "The aim of an …interview is to obtain as full and unbiased an account as possible of the participant's perspective on the research topic, and the researcher's task is to use every means at their disposal to aid this" (Legard, Keegan, & Ward, 2003, p. 158). Similarly, Luck and Rose (2007) stated "both the interviewer and participant may need to use particular strategies for a successful communication exchange" (p. 209). The interview had to be adapted and planned with the needs of people with aphasia at the centre. Several questions needed to be addressed: How to facilitate comprehension? How to avoid fatigue? How to reduce frustration? How to facilitate answering the questions? It was fundamental to work in close collaboration with a speech therapist. These points are addressed under the subtitle "Method."

ARTICIPANTS

The main selection criterion was people with aphasia who can understand brief questions, answer by pointing to images or saying 'yes' or 'no,' and read brief words. Since this research was conducted in Italy, participants needed to have Italian as first language. Age, gender, level of education, socio-economic level, and time post onset were not selection criteria.

Based on this, the speech therapist contacted people with aphasia who met these requirements, and she had a brief conversation with them, by phone or personally. The goal of the conversation was to inform possible participants about the project. The possible participant was asked if she/he would be willing to contribute to the project participating in an interview about different factors that could affect the assessment.

Three men and two women agreed to participate. Initially the intention was to interview seven patients, but time constraints and availability of patients made it difficult to arrive at this number; at the end five patients were interviewed. It is assumed that using sets of five users will reveal about 80% of all the problems in the design (Nielsen, 2000). This information will allow improving the design and eventually re-evaluating it with five other participants.

METHOD

The interviews have two main goals: a) to collect opinions about feelings of people with aphasia during the test, about interruptions during the test, and about preferences regarding the space and test length, and b) to evaluate the performance of black outline-only drawings and colour drawings to identify fruits and to evaluate the performance of black outline-only drawings, line and tone, and colour to identify characters in a scene (most aphasia tests, regardless of the type of task to perform, use black outline-only drawings).

The interviews were developed in the Department of Neurology at the University Hospital of Padua, and approval was obtained from the Director of Clinical Neurology I.

A legal requirement of the hospital was that the interviews had to be performed by the speech therapist, but I was allowed to sit in and observe the interviews. This allowed me to observe the situation, take notes, and assist the therapist during the interview, organizing and handling the necessary materials. I prepared an interview plan to guide the speech therapist during the interview process (see *Figure 1*).

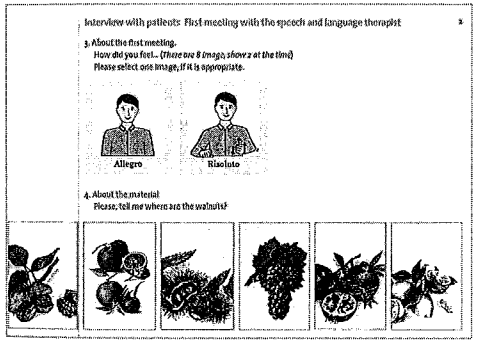


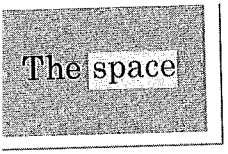
FIGURE 1

The interview opened with a brief account by the therapist about the "first meeting with the speech therapist." It was decided to talk about the "first meeting with the therapist" rather than the assessment or diagnosis of aphasia. The phrase "assessment of aphasia" was considered jargon. Open questions (such as: could you please describe how were you feeling during the assessment?) were considered as not appropriate, since this type of question would present difficulties to some people with aphasia. It was chosen instead to ask brief and concrete questions (for example, Do you prefer a space similar to a regular office or to a doctor's office?). Every question was introduced by the topic (for example, "about the space" or "about the material") and followed by the specific questions.

Interviews were individual. For every question, visual material was designed to support communication, to facilitate understanding of the question, and to answer by pointing. The visual material

created a common territory for the person with aphasia, the speech therapist, and myself. It anchored the topic of the question; as Barthes (1977) explained, "[it] helps me to choose the correct level of perception, permits me to focus not simply my gaze but also my understanding" (p. 39).

Questions 1, 3, 5, 6, 7 and *9* presented a series of options, and the participant indicated which option s/he preferred. The therapist introduced the topic verbally and then presented the topic in a visual modality, a 10.5 x 7 cm card (see *Figure 2*). The typeface used was Century Schoolbook. The x-height of the lower case is 6 mm. The interview used a combination of verbal information, pictorial information and movement. Next, the procedure followed for each of these questions is described.



IGURE 2

Question 1 - About the space: two images were created (see *Figure 3*). These images communicated two concepts: a) the first meeting of the therapist and the patient, and b) the type of space. The first concept is represented by colour photography, the second in black outline drawing. The size of each image is A3 (tabloid). The images were presented side-by-side, and the person with aphasia had to point to the one s/he preferred. The speech therapist asked, "Do you prefer a space similar to a regular office or similar to a doctor's office?" When naming "an office" the speech therapist pointed to the image of the office; when naming "a doctor's office" she pointed to the corresponding image.

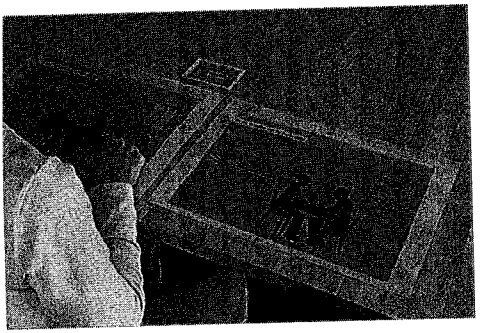


FIGURE 3

Question 3 - About the patient's feelings: eight images were created to communicate different feelings. Initially colour photographs were used, and some "feelings" such as "nervous" were not clear (see *Figure 4a*). Consequently, the "feelings" were communicated through drawings. Drawings allowed features of the image to be exaggerated to avoid ambiguity. For example, adding a wavy outline to the arm of the character to communicate nervousness (see *Figure 4b*). The drawing style is line and flat tone (8.5 x 9 cm). Two "feeling" images were shown side by side (see *Figure 5*). The speech therapist asked: during the assessment did you feel…(for example confused or determined)? As in the previous question the therapist pointed to the image while naming the corresponding feeling. The therapist explained to the participant, to select one, two, or none. The image was selected by pointing.

Question 5 - About the length of the meeting: a set of images was created for this question (see *Figure 6*). The therapist placed the topic card and a colour photograph of a clock to communicate the idea of time. Then she placed four rectangles, each with a different time option: 1 hour, half an hour, 20 minutes, 10 minutes. Then she asked "Did you prefer to work for an hour and then take a break, half an hour and then take a break…" while placing the word "break" between, for example, the hour and the half an hour option. A man relaxing on an armchair communicated the

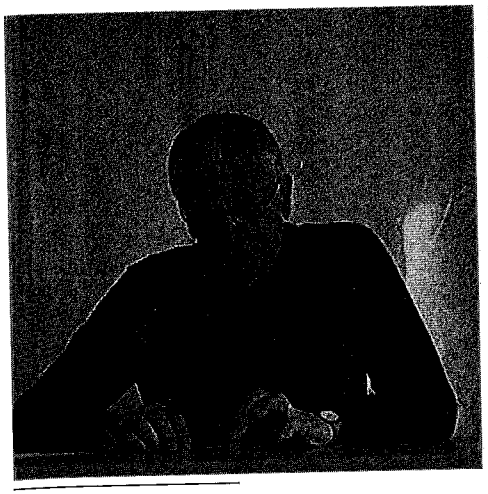


FIGURE 4A

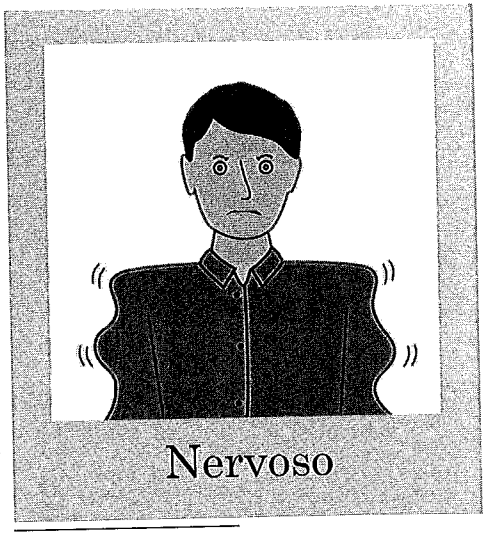


FIGURE 4B

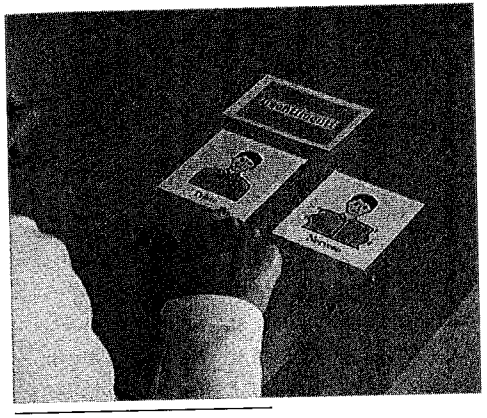


FIGURE 5

concept of taking a break. The person with aphasia indicated her/his preference by pointing.

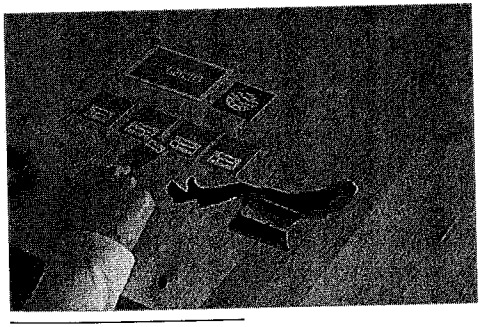


FIGURE 6

Question 7 - About interruptions: the same image used to communicate the concept of the "meeting with the therapist" in Question 1 was used here. A silhouette of a lady bringing a paper was added to this image. Two images to communicate "yes" and "no" (see *Figure 7*) were used to facilitate answering the first part of the question: "If there were interruptions during the meeting. Did the interruptions disturb you?" If "yes," the therapist showed a three step rating scale – nothing, a little, a lot – and asked: "How much did the interruptions disturb you?" If necessary, the person answered by pointing.

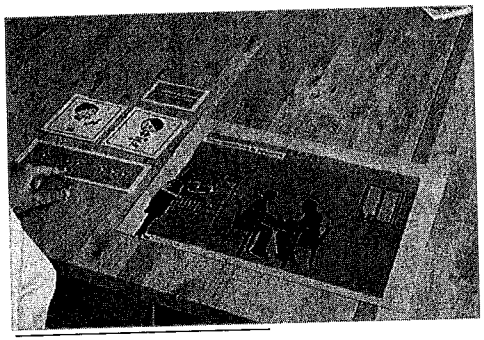


FIGURE 7

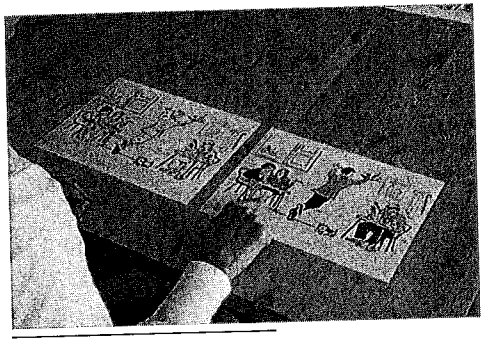


FIGURE 8A

FIGURE 8B

Questions 6 and 9 explored the performance of three different drawing styles: a) black outline, b) line and flat tonal value for the characters, and c) line and flat tonal value for the characters with a red accent for the jacket of the central character (see *Figures 8a & 8b*). The image shows a scene in a coffee-shop, the size of the images is A4 (letter size for North American readers). In *Question 6,* the speech therapist placed the black outline and the line and tone drawings side by side, and asked: "in which of these two drawings is it easier to recognize the dog?" The participant pointed at the image s/he found easier.

In *Question 9,* the therapist placed side by side the line and tone, and the line, tone and red accent drawings. Then she asked: "In which of these two drawings is it easier to identify the lady smoking?" The person with aphasia pointed at the image s/he found easier.

Questions 2, 4, 8, and 10 evaluated the appropriateness of the visual material to perform different tasks.

Questions 2 and 4 explored the performance of black outline and colour drawings when identifying fruits (see *Figure 9a & 9b*). It was explained that we were studying the adequacy of the material, not the person's ability to recognize the image. The therapist placed seven images (7 x 10.5 cm) in a row and said: "I ask you to perform a task. Please

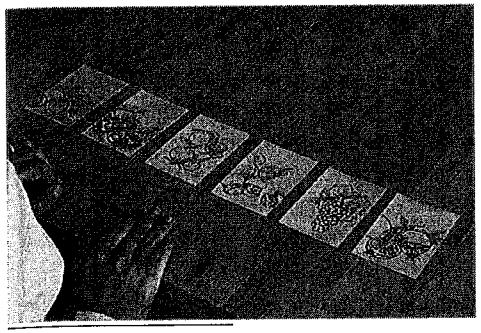


FIGURE 9A

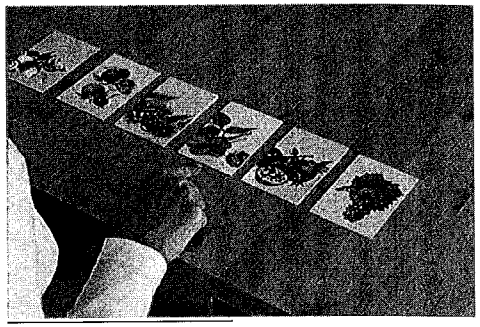


FIGURE 9B

tell me where are the walnuts" (at other times the picture to identify was the oranges). For Question 2 the images were black outline drawings, for Question 4 the images were colour drawings. The number of images was chosen to avoid overloading visual processing capacity (Miller, 1994). Time to find the right image was measured with a chronometer that the patient couldn't see. Questions 8 and 10 are not reported in this article.

DATA ANALYSIS

For questions 1, 3, 5, 6, 7, and 9, each response was recorded with an X on the interview plan set. A set was printed for each patient. The responses were grouped according to choices. In many cases a table was designed to facilitate analysing and reporting the findings.

For questions 2 and 4, times were recorded, totals were added and difference in performance between the two conditions were noted.

FINDINGS

The interview had two main goals. The first goal was to collect the opinions of people with aphasia about the space where the assessment took place, their feelings during the assessment, their preferences regarding the length of the assessment, and their opinions about interruptions during the assessment. Questions 1, 3, 5 and 7 sought to collect this information, relying on visual material to facilitate communication.

A second goal of the interview was to evaluate the appropriateness of the visual material used to perform different assessment tasks. Questions 2, 4, 6, and 9 were developed for this purpose. The findings are presented according to the two groups of questions.

1. About the environment.

Do you prefer a space similar to a regular office or similar to a doctor's office?

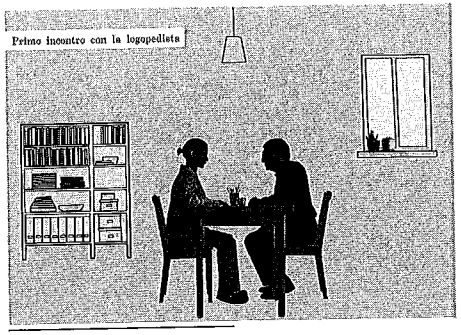


FIGURE 10

The five persons with aphasia selected the image representing the space similar to an office (see *Figure 10*). Participant 3 added: "With the office I feel a more normal rapport. Mentally better disposed. In the other [the doctor's office] I am a sick person." And person with aphasia 4 mentioned: "The doctor's office has a sick look."

3. About the first meeting.

How did you feel…?

Participants reported a combination of feelings experienced during the assessment (see *Table 1*). Consistently, all the participants said they were "confused." Three people reported being confused and nervous, and two people mentioned being confused and tired. Two participants said they were happy, and two indicated that they were sad or a little sad. Participant 1 reported: "I was shaking all over." And Participant 4 said: "I couldn't perceive the totality."

TABLE 1.
Feelings expressed by each person with aphasia interviewed

Participants	Depressed	Sad	Confused	Nervous	Happy	Tired	Determined	Indifferent	Angry
P.1	●	●	●	●					
P.2			●	●	●				
P.3			●		●	●			
P.4		●	●	●					

5. About the duration of the meeting.

Did you prefer to work for… (i.e., 1 hour and then a break, half an hour…)

The information (see *Table 2*) reveals that time preferences vary among people with aphasia. One person indicated that he prefers to work for 20 minutes; two other participants said that they prefer to work for half an hour. Participant 3 mentioned that he prefers to work for an hour but with a pause after 20-30 minutes of work. He said: "There is a need to build rapport. We are here to talk, talking can also be a break. A mental break." Participant 4 said that she could work for an hour without a break. Interestingly she mentioned: "It was not tiring, without a break, without anything. Speech therapy was not a heavy load, with physiotherapy yes. Serena [the speech therapist] is so nice."

TABLE 2.
Preferred time duration expressed by each person with aphasia interviewed

Participants	Preferred meeting duration
P.1	20 minutes
P.2	30 minutes
P.3	1 hour with a break after 20 - 30 minutes
P.4	1 hour without break
P.5	30 minutes

7. If there were interruptions during the meeting.

a). Did they disturb you? Yes - No? (if yes) b). How much did they disturb you?

Four of the five participants responded that the interruptions did not disturb them. Participant 1 indicated that he rested during the interruptions; and participant 3 said: "I took advantage and put the conversation into focus." Participant 4 mentioned: "I took advantage of the interruptions and rested." Participant 5 indicated that the interruptions disturbed him a little, because they distracted him.

2 & 4. About the material.

I will ask you to perform a task. Please, tell me where are the oranges/walnuts?

Table 3 summarizes the comparison between the performance time of patients using material in colour and using the material in line only.

TABLE 3.
Recognizing the orange: performance time with material in colour and in line

Participants	Color image	Line image
P.1	0.5 sec	2 sec Wrong answer: lemon
P.2	0.5 sec	23 sec
P.3	0.5 sec	1 sec
P.4	1 sec	1 sec
P.5	1.5 sec	4 sec
Totals	**4 sec**	**31 sec**
Totals (without P.2)	**3.5 sec**	**8 sec**

As can be seen in table 3, even without counting Participant 2, people with aphasia performed better when using the material in colour than when using the material in line. Even more relevant is the fact that people with aphasia did not make mistakes when using the material in colour. Participant 3 commented: "The hazelnuts are clearer in colour." Participant 4 mentioned: "With colour, the impact is immediate. The lemon is seen immediately."

TABLE 4.
Identifying the dog: ease using the material in line and in line and tone

Participants	Scene in line	Scene in line and tone
P.1		Easier
P.2		Easier
P.3		Easier
P.4		Easier
P.5		Easier

6. About the material. In which of these 2 images is easier to recognize the dog?

Table 4 shows the opinions of people with aphasia regarding the ease of identifying an object comparing a scene presented in line with a scene presented in line and tone.

There was a consistent agreement that it was

easier to recognize the dog when the scene was presented in line and tone.

9. In which of these 2 images is it easier to identify the lady smoking?

Four out of five people with aphasia reported that there was no difference between recognizing the lady smoking in a drawing using tone as well as line and in a drawing using tone and colour. Only Participant 1 found it easier to recognize the lady smoking in the line and tone drawing than in the tone and colour drawing. Participant 3 added: "There are no differences. Colour is not disturbing. I look at the whole and then the specific. If I am searching something I go to the specific. It depends on the attention."

The interviews with people with aphasia provided very valuable insights, such as that the identification of characters in a scene is facilitated by the use of tone, and that some patients take advantage during the interruptions to rest or think about the task they were performing. This new information can help generate ideas for the improvement of the material. These findings are discussed in detail in the discussion.

DISCUSSION OF FINDINGS

The objective of this discussion is to integrate the main findings to get to a comprehensive perception of the results and identify future research directions. The findings are discussed by themes.

FINDING 1: DIFFERENT PEOPLE HAVE DIFFERENT FEELINGS

The interviews with people with aphasia showed that the way patients feel varies from person to person. The five people with aphasia who were interviewed reported different feelings; however, all of them mentioned being confused. In the feelings that people with aphasia mentioned, there was always a combination of feeling confused and tired, or confused and nervous. What did not emerge during the research are the sources for this confusion: if it is circumstances encountered during the situation of the assessment that cause it, or if it is the aphasia itself that causes the confusion. Holland (2007) on people with aphasia confusions stated, "Particularly if they buy into 'rehabilitation magic' and are bewildered by 'rehabilitation mystery,' both aphasic persons and their family members may very well feel uninformed and confused" (p. 173). Further research is needed to identify what caused confusion and to reduce this feeling as much as possible so that patients can perform at an optimum level.

FINDING 2: INTERRUPTIONS CAN BE AN ADVANTAGE FOR PEOPLE WITH APHASIA

During a series of observations I performed previously, I identified that nurses, doctors, colleagues, and phone calls frequently interrupted the

assessment. Interestingly, in the interviews with people with aphasia, they reported that the interruptions did not disturb them. People with aphasia reported that they take advantage of interruptions and rest. As Participant 3 stated: "I took advantage and put the conversation into focus." The fact that people with aphasia take advantage of the interruptions has important methodological implications. It also proves the value of checking the most obvious assumptions we make by consulting with people with aphasia.

FINDING 3: THE ENVIRONMENT'S APPEARANCE MIGHT INFLUENCE RECOVERY

The assessment environment must be created by attending to the psychological needs of people with aphasia. The environment's appearance affects the process of recovery (Ulrich, 1991).

I asked people with aphasia if they preferred an environment similar to an ordinary office or a doctor's office. The five people with aphasia interviewed responded that they preferred a space similar to an ordinary office, since 'the doctor's office makes you feel ill.' An environment that makes people with aphasia feel ill undermines recovery. There is a need for a room specially created for aphasia assessment and therapy. The room must be conceived as a working space that allows flexibility to the therapist adapting it to different needs.

FINDING 4: MOTIVATION PLAYS A ROLE IN TEST LENGTH PREFERENCES AND ATTENTION SPAN

Mental fatigue affects attention, an essential skill in information processing. Attention allows the selection of relevant information to perform a task. When people are tired, they select both relevant and irrelevant information to process, causing further difficulties (Boksem, Meijman, & Lorist, 2005).

Most of the people interviewed reported that between 20 and 30 minutes was the ideal time length for the test. Two people mentioned that it could also be an hour, explaining that a) there is a need to build rapport and this takes time, and b) given that the therapist was so nice, it was not an effort to work for an hour, unlike the case of physiotherapy. This information shows that the problem of sustaining attention is not exclusively cognitive; it is affected by motivation, which partly depends on the therapist's ability to engage with the person with aphasia. Research is needed to identify if the visual material and its topic could also affect motivation.

FINDING 5: USING TONE FACILITATES IDENTIFICATION OF CHARACTERS IN SCENE DESCRIPTION

Scene description provides information about different aspects of language such as the use of grammar, the number of words produced, type and amount of content provided, and subject and organization of discourse. This

information provides different perspectives about speech (Mackenzie, Brady, Norrie, & Poedjianto, 2007). To perform the task, the therapist shows a scene (A4 or letter size) to the patient and then says: "Tell or describe everything you see going on in the picture." Images used for scene description are usually black line drawings. All the lines have the same thickness.

The use of an image when assessing verbal production is indispensable. It provides "a consistent referent… and memory and sustained attention demands are minimized" (Mackenzie, Brady, Norrie, & Poedjianto, 2007, p. 341).

As already mentioned, I created a scene in three different visual appearances (A4 format). One scene is black line drawing, a second has line and flat tonal value only for the characters, and a third has also line and tonal value for the characters with a red accent in the jacket of the main character. It was assumed that adding tone to the characters could segregate these from the background thus facilitating their visual recognition (Koffka, 1955). The three scenes were shown to people with aphasia. First, the line drawing and the line and tone drawing were presented. I asked in which of the two alternatives was it easier to recognize the dog (Figure 8a). All the participants chose the line and tone drawing. After doing other tasks, the line and tone drawing was presented side by side to the line, tone and red accent drawing. Each person with aphasia was asked in which of the two options was it easier to identify the lady smoking. Most participants indicated that there were no differences between the two.

These results are promising, showing that adding tone to line drawings might facilitate the identification of the characters performing the actions.

FINDING 6: COLOUR PLAYS A ROLE IN OBJECT RECOGNITION AND CAN REDUCE CONFUSIONS

As previously mentioned, only shape is used to communicate the object. While shape provides efficient information when recognizing an object (Biederman, 1987), adding information to the image, such as adding colour, might facilitate the recognition of objects.

> For example, when shopping for fruit, 'yellow' is an important cue for differentiating lemons from limes, but yellow would not be critical for selecting lemons from pineapples. Thus, shape and color interact; color facilitates recognition of objects within structurally similar categories (e.g. animals, birds), but not necessarily structurally dissimilar categories (e.g. body parts, musical instruments, tools).
> (Tanaka, Weiskoptf, & Williams, 2001, p. 212)

During the interviews I asked people with aphasia to perform two tasks to identify the role of colour in the recognition of fruits. In the first task, I asked

people with aphasia to indicate where was "the orange" or "the walnuts." They had to recognize the picture among seven black line drawings, and among seven colour drawings. The seven images were displayed in a row. The order of presentation changed; some people saw first the outline images then the colour ones and others saw them the other way around (see *Figures 9a & 9b*).

Responses were faster for images in colour than in black line, despite the differences between individuals, and regardless the order of presentation. The average time to recognize the picture in colour was 0.8 seconds, and in line was 6.2 seconds. One of the participants tilted the results, taking 23 seconds in the line condition. But even without this participant the responses are faster for images in colour, with an average time 0.875 seconds in colour versus 2 seconds in line. Most important, a participant looking at the black line drawing pointed to the lemon instead of to the orange. These results are similar to those reported by Rossion and Pourtois (2004), where the addition of colour speeded up naming responses particularly for the categories of fruits and vegetables.

This data suggest that adding colour could not only reduce the time to recognize the image, but it could also help reduce opportunities for confusions and errors. The above discussion supports the need to further investigate this problem.

It was also identified that sometimes, when looking for the right fruit, showing seven images in a row might not be adequate. Depending on the number of pictures presented, the task becomes a search-and-find task rather than a matching task. When the number of pictures increases, the time to point to the right image also increases. Fisk and Schneider (1983) reported studies indicating, "reaction time performance is a linear function of memory set size (i.e., the number of items in memory to be compared)" (p. 178). Accuracy on visual search tasks depends on the number of items and on the similarity among them (Eriksen & Schultz, 1979). Image-laden material overloads the working memory of people with aphasia, and this might decrease performance. Kirschner (2002) stated: "Working memory load is affected by the inherent nature of the material and by the manner in which the material is presented" (p. 4). The design of the visual material must be user and task appropriate. The increment in cognitive load might lead to errors that are due to the inappropriate design of the materials, rather than to aphasia. The material might influence assessment accuracy. Research is needed to determine the optimum number of pictures to present in word-picture matching tasks.

LIMITATIONS AND CONCLUSIONS

A main limitation is the number of participants. More work is needed to determine for what type of object categories colour plays a significant role, and for what type of patients adding colour is effective. Research is needed con-

cerning how to reduce undesirable cognitive load caused by the material.

Despite the fact that many assessment tasks use images, their impact on the answers from people with aphasia is underestimated or misinterpreted. Several problems need careful attention, such as the number of images presented. There is a variety of wrong assumptions. Simplifying the image does not lead to a facilitation of its recognition. Line drawings are not clear enough. The material must be created according to the task to perform, the users' needs and limitations, and the situation of use. The material has the potential to engage the patient in the assessment activities, to facilitate sustaining attention, and to make assessment less tiring and more pleasant.

Aphasia experts (therapists and patients) and visual communication designers (with the required knowledge and understanding of perception, cognition, and aphasia) must work in collaboration to improve the material. The material can facilitate the therapist's task by reducing confusion and the need for additional explanations. It also has the potential to engage the patient in the assessment activities, to facilitate sustained attention, and to make assessment less tiring and more pleasant.

The material needs to be designed with therapists and patients at the centre and to facilitate the patients' engagement in the assessment activity. This research indicates that the evaluation of the visual material by people with aphasia helps identify and reduce problems. This can certainly lead to an improvement in the quality of materials.

The interviews showed the need to work in partnership with people with aphasia and that visual communication design can make a significant contribution by designing interview tools, 1) to help them to understand what is said, and 2) to answer by speaking or pointing when speaking is not possible.

This methodology and these results were used to inform two other studies: one aimed at arriving at a set of words that are relevant to the person with aphasia, allowing the therapist and the person with aphasia to identify reading comprehension difficulties and possible ways to reduce them, and presenting possibilities for a clear visual representation. A second study aimed at understanding what aspects of the visualization can facilitate the essential processing of the material, aspects that create barriers, aspects of the activity that promote active processing of the information, methods to reduce unnecessary cognitive processing, and methods to create word-picture matching material that is sensitive to cognitive abilities and limitations of people with aphasia.

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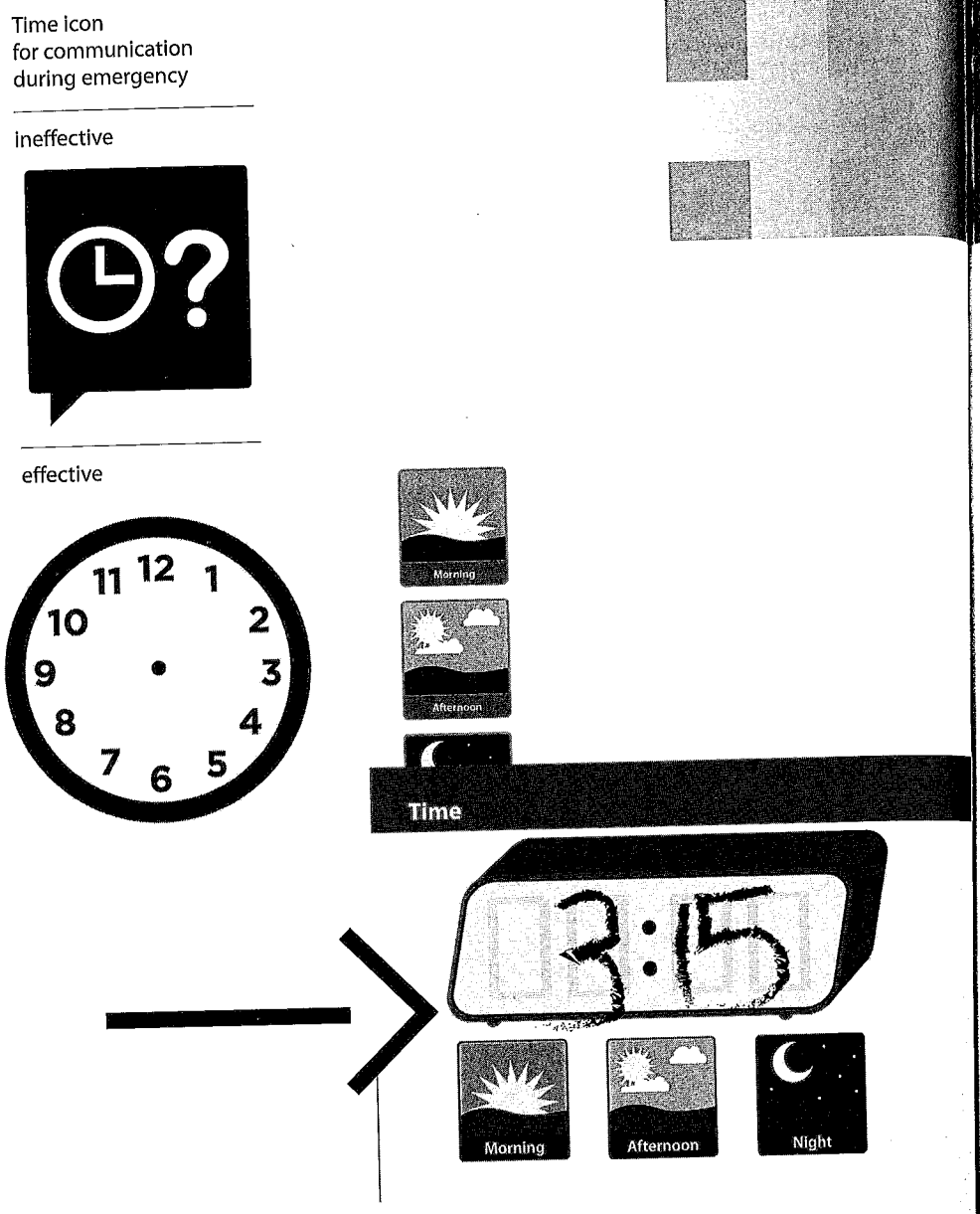


Using Icons to Overcome Communication Barriers During Emergencies: *a case study of the Show Me interactive tools*

Amina Patton MGD; Morgan Griffin, MA; Ana Tellez, MA; Mary Ann Petti, MPH, CHES; Xanthi Scrimgeour, MHEd, MCHES

ABSTRACT

This case study reviews the development of three icon-based tools designed to help workers and volunteers during an emergency communicate with people who have communication challenges, such as limited English proficiency, deafness or hearing impairments, and cognitive delays. Using the classic human figure icons designed by the American Institute of Graphic Arts (AIGA) for the U.S. Department of Transportation (DOT) as a basis, we developed over 250 new icons for the tools, a dry erase booklet and two mobile applications for Apple and Android devices. We outline the challenges we faced researching, testing, and developing the icons. We also explore interactivity, animation, and the grouping of icons and suggest ways to push icon design in new directions. This project was a partnership between CommunicateHealth, a health communication company in Northampton, MA, and the Massachusetts Department of Public Health (MDPH), Office of Preparedness and Emergency Management.

KEYWORDS

Icons, public health, emergency preparedness, nonverbal communication, symbols

It will come as no surprise to designers, or anyone reading a design journal, that people like pictures. But imagery, like photography and iconography, has proved to be an especially powerful tool in communicating messages about health. As Houts et al have shown, imagery in health materials helps people — particularly people with low health literacy — understand and remember information (2006). Given that nine out of ten adults in the United States struggle with complex health information, health communicators have come to recognize that imagery may be more than just a nice adornment to their fact sheets or websites, but an ethical imperative (Kutner et al, 2006).

Designers working on health promotion naturally want to use imagery that conveys information as clearly and quickly as possible, so users can grasp essential messages about their health at a glance. For this reason, designers often gravitate toward one of the best-known and ubiquitous forms of iconography: the human figure icons designed by American Institute of Graphic Arts (AIGA) for the U.S. Department of Transportation (DOT) in the 1970s, which were intended as a standard icon system for global communication (Zender, 2006).

Derived from the principles of Otto Neurath's work in the 1920s to create a system of universally understood icons, the AIGA/DOT icons became known as the "Helvetica of pictograms" because of their visual cohesion and widespread use. Familiar to virtually anyone who's pushed open the door to a public restroom throughout the world, these icons became a model for countless other systems. In particular, designers have used and adapted the male symbol, which Lupton later dubbed "Helvetica Man" (1996).

What's most striking about Helvetica man — and the overall approach to icon design — might be his endurance. As Zender and others have observed, these icons have gone essentially unchanged for decades. And in the 21st century, mobile apps have opened up a new venue for these classic icons. A glance at the App Store or Google Play Marketplace will show hundreds of apps — for fitness, health, medical, and countless other uses — that have pressed the Helvetica man into service for an ever-expanding set of duties (Zender, 2006).

But designers make a mistake if they incorporate these familiar icons into their work reflexively, assuming that their popular use necessarily means that people understand what they're meant to convey. In fact, studies have found that people often fail to understand similar icons in the way their designers intended.

Frascara discusses how designers may passively assume a graphic or icon has an obvious meaning — because of their own personal or cultural context — when it might be baffling to other audiences (2004). He points to the work of Easterby, Graydon, and Zwaga with the International Standards Organization (ISO) as an example; their testing of graphic symbols with users found that these symbols "normally perform much below the designers' expectations." And despite the ongoing work of researchers and groups like ISO to design and test graphic symbols, this gulf between a designer's intended meaning and a user's actual understanding is an enduring problem. Zender cites an international study of medical icons aimed to supplement the AIGA/DOT system that found that only eight out of 54 new medical icons — carefully designed to cross language and cultural barriers — were understood by a percentage of subjects deemed acceptable by the ISO and American National Standards Institute (85%); with Tanzanian subjects, only three icons met that threshold (Zender and Mejía, 2013).

Research showing problems with icon comprehension doesn't negate their value as a communication tool. From the perspective of design, building on the AIGA/DOT icons has obvious advantages — they're immediately familiar to most audiences and they're in the public domain. But the point is that designers can't simply incorporate these icons into new medical and health projects and assume that users will automatically understand them. Designers need to consider how an icon's context will affect a user's understanding (McDougall and Martin, 2004), and how design methods that incorporate user feedback will create a more effective product (Salman, 2012).

In this case study, we discuss the challenges we faced in developing new icons — building on the classic AIGA/DOT set — for the three "Show Me" public health communication tools for emergencies developed by CommunicateHealth, a health communications company based in Northampton, Massachusetts, on behalf of the Office of Preparedness and Emergency Management of the Massachusetts Department of Public Health (MDPH).

During the course of development, research, and testing, our team found how the context of icons could radically affect their meaning to users. After describing the project, we focus on three specific challenges we faced during icon development, testing, and revision that illustrate how we pushed the limits of current icon use and design — and how interactivity, animation, and grouping can help simple icons convey complex messages.

PROJECT BACKGROUND

In 2011, MDPH contracted CommunicateHealth to work on a project to help aid communication during emergencies and disasters. During an emergency — like an earthquake or chemical spill — volunteers and emergency response workers need to communicate clearly and efficiently with people who need help. But MDPH needed new tools to help with a serious public health problem: the difficulty of communicating during these disasters with people who have communication challenges, such as limited or no English proficiency, deafness or difficulty hearing, and cognitive delays.

Communication barriers are amplified during an emergency. Members of the public are likely to be distressed, confused, or angry. Some may have been involved in the disaster, and could be traumatized, injured, or suffer from temporary hearing loss or disorientation. According to the Centers for Disease Control and Prevention, sustained emotional distress can "make community members less motivated and less able to take actions that could help themselves." (USHSS, 2014) In addition, staff and volunteers are also likely to be stressed and overworked; they may have limited technical aptitude and not speak languages besides English. Easy-to-use tools to facilitate clear, efficient conversation between staff and volunteers and members of the public would save time, prevent misunderstandings, and increase trust.

HE SHOW ME TOOLS

The CommunicateHealth design team had a broad mandate from MDPH when developing the first Show Me tool. We needed to create a tool that would improve communication, but the client had no specific requirements about the form the tool would take.

During our initial design scan, we found many tools — such as mobile apps — for first responders during an emergency, but none that were intended to supplement communication during emergencies. Our team knew that we would have to create a new approach to fill the gap.

Over the next 3 years CommunicateHealth team produced three separate tools:

Show Me booklet.

Our first product was a spiral-bound, laminated, dry erase booklet for use in emergency shelters.

Show Me mobile app.

The second tool, an app for mobile phones and tablets, expanded on the content of the booklet. We designed it for volunteers and staff who are either working in a specific location (an emergency shelter or emergency dispensing site) or going door-to-door warning people to evacuate or shelter in place (stay at home).

Show Me FAC mobile app.

We tailored the third app for staff and volunteers at family assistance centers (FACs), where family may gather looking for loved ones after a mass casualty event (MCE), such as a plane crash. We also added features specifically for people with limited or no English proficiency.

We developed the booklet first and, after its successful adoption — over 1,300 copies were distributed in the first 3 months

of printing — then created the mobile apps, which are both available for free on iTunes and the Google Play Marketplace.

ICON-BASED COMMUNICATION

Though the tools were developed in three phases and took different forms — one as a booklet and two as mobile apps — they all hinged on icons, which served as a common language for users.

After conducting an exhaustive literature review and exploring various approaches, the CommunicateHealth team settled on using icons, based on the body of evidence showing they can be an effective way of communicating health information to the widest possible audience. For instance, research conducted by Hablamos Juntos with support from the Robert Wood Johnson Foundation found distinct advantages to using universal symbols (based on the AIGA/DOT set) in hospitals instead of written signs.

- In a trial of 86 participants, only one person preferred the signs with words to the symbols
- In a trial of 85 participants, 70 said that symbols made it easier to find where they were trying to go
- Testing found that people in hospitals walked one foot per second faster when guided by symbols instead of words (Hablamos Juntos, 2005)

We also found evidence that an icon-based approach would benefit one of our specific audiences, people with communication challenges. Studies of individuals requiring additional assistance (IRAA) during emergencies found that pictures, icons, and symbols enhanced understanding and reinforced written or spoken language (Faux, 2004; Jonsson et al, 2011).

While icons have traditionally been a form of one-way communication — a simple instruction to the user — we wanted to use them for two-way communication, a common language for staff or volunteers during a disaster and people with communication challenges. So the icons needed to work for two different audiences. Staff and volunteers might need to tell people to leave their homes or where to get bedding or food in a shelter or FAC. People with communication challenges might need a translator, or want to describe a missing person, or need medical assistance.

With an icon-based form of communication, people with communication challenges could point to icons in the book or on the app — showing the staff member or volunteer exactly what they wanted. They could then hand it back to a volunteer, who could do the

same, allowing for a real conversation.

In adopting this approach, we drew from the principles of augmentative and alternative communication (AAC) systems. The American Speech-Language-Hearing Association website defines AAC as "including all forms of communication (other than oral speech) that are used to express thoughts, needs, wants, and ideas." Aided communication tools — such as picture and symbol communication boards — help people express themselves beyond their use of sign language, body language, or gestures (Light and McNaughton, 2013).

METHODS

We followed the user-centered design (UCD) process — a method for developing materials that involves end-users as co-creators in every step of development. Rather than finishing a product and then testing it, we test at each stage of development and revise based on the results. Research for each tool included staff or volunteers as well as members of the public with communication challenges, such as limited English proficiency, deafness or hearing impairments, and cognitive disabilities.

At the start of the Show Me booklet project, we conducted in-depth interviews (N=9) with professionals to provide a qualitative base for the project in assessing communication challenges during an emergency. Focus groups with public health professionals (N=12) and people with communication challenges (N=22) helped assess existing types of communication tools and identify the communication needs our tool would address.

Based on this foundation, we developed paper prototypes of the tool that we tested with users in a second set of focus groups (N=9) and informal interviews (N=7). After another round of feedback and revision, we tested icons in one-on-one usability tests (N=6).

Lastly, to assess the overall usability of the tool, we conducted 6 dyadic usability tests (N=12) — in each one, we paired a public health professional with a person who had communication challenges. This somewhat unusual method of testing was crucial, since it allowed the team to see how well the icons really worked as a common language for communication.

When we started developing the mobile applications, our research followed a similar trajectory, although instead of testing paper prototypes we tested wireframes and eventually the app itself on Apple and Android devices. The Show Me for Emergencies app research included in-depth-interviews (N=8), icon testing in one-on-one usability sessions, including card sorting (N=6), app prototype usability testing with remote users via a desktop simulator (n=3), and dyadic testing on mobile devices (n=3).

The Show Me for Emergencies FAC app research included in-depth interviews (N=7), icon testing in one-on-one usability sessions (N=9) with a particular focus on limited or no English proficiency, app prototype usability testing with remote users via interactive wireframes (N=5), a second round of icon testing in one-on-one usability sessions (N=3), and on-device usability testing (N=3).

CHALLENGES AND SOLUTIONS IN ICON DESIGN

While our design team settled on the basic style of the classic AIGA/DOT icons, the project had very specialized requirements. The large number of messages we had to convey were specific to the setting of an emergency and also needed to work as a form of two-way communication. We eventually developed over 250 new icons for the Show Me tools. Our task was made easier by the accommodating three-year timeline. We created an initial set of 65 icons for the first tool (the booklet), built on that initial set when creating additional icons for the next tool (the Show Me app), and then added more for the final tool (the Show Me FAC app). The iterative design and testing process helped us adjust and refine the icons as we went. We also designed the icons in groups so we could use symbols more than once; for instance, we reused elements like the "prohibition sign" along with different foods to signify specific food allergies. This approach helped create cohesion that would help users understand the icons in context while also simplifying the challenge of designing such a large number of icons.

Designing icons often involves stripping a concept down and expressing it as simply as possible so people can understand the message at a glance. However, as we have discussed above, this process — which Neurath called reduction (Lupton, 1986) — does not ensure an effective icon. Often, simplifying an idea, action, or message can make an icon so generic and bland that it loses meaning — or takes on a host of possible meanings that the designers never intended. Throughout the testing process, we were often surprised by the unexpected ways that participants interpreted our icons. But thanks to our reliance on the user-centered design process, we were able to revise and retest our icons as needed, so that they eventually conveyed the messages that we intended.

LESSON LEARNED: ADDING INTERACTIVITY

We had particular challenges with the icon we designed to represent time. The initial design as shown in Figure 1 focused on the asking of the question "When?" and distilled this into an image of an analog clock and a question mark. Our intention was that people could use it in many ways. Volunteers and responders might use it to convey a time for an information briefing, for instance. The public could use it to state how long a loved one has been missing.

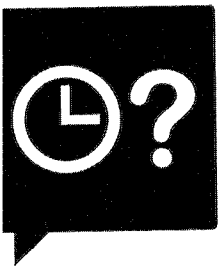


FIGURE 1

Draft of the "When?" icon.

But our participants during testing seemed to find that the open-endedness of the icon made it a challenge to understand. Instead, they tended to suspect it had a very specific meaning, although weren't certain what it was. One Deaf or hard of hearing participant stated that it might mean "my question will be answered at this time." Another responded, "[It] could mean 3:00 or 12:00 [because the similarly-sized hour and minute hands were pointing to 3 and 12]" and "[you] need to be clearer with time." Another participant suggested adding more interactivity, stating: "It would be nice to [be able] to give people a specific time. Like come back to get lunch at 12:00."

In Figure 2, our revised way of conveying time expanded beyond a single icon into a grouping that participants could interact with. In the Show Me book, users could draw hands on a page with a blank clock face using a dry erase marker to indicate a specific time. The time of day icons — morning, afternoon, and night — allow users to indicate a less precise time of day. One participant noted, "People always confuse the whole AM/PM thing. It's great that you can just point to the time of day." Overall, users rated this iteration of the time icon more positively, but people with cognitive disabilities struggled with telling time on an analog clock.

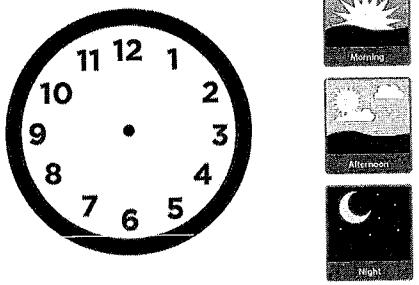


FIGURE 2

Draft layout of the Time page, including a blank analog clock and time of day icons.

Some participants suggested that a digital clock might be easier to understand. In the final iteration as seen in Figure 3, we followed their advice and created a digital clock that allowed users to write in numbers using a dry-erase marker in the laminated booklet.

While we originally designed the time icon for the Show Me book, it adapted well to the mobile application as seen in Figure 4. Users can set the time using a spinner and then the time appears on the digital clock icon. The time of day icons appear below the clock automatically based upon the user's input.

Through testing, it became clear that using a single, static icon to convey time would not meet our users' needs. By adding additional icons — sequentially depicting times of day — we created an environmental context for the icon set that made them collectively easier for users to understand. The most vital addition, however, was interactivity. Allowing users to set the time on the clock allowed for a customized conversation based on each person's need.

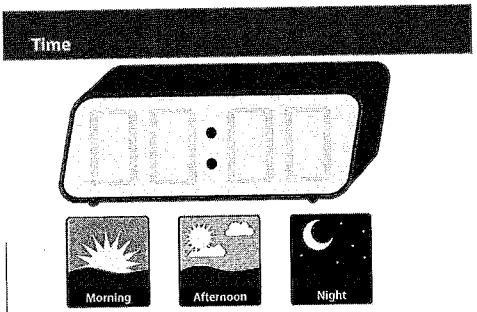


FIGURE 3

Final design of the Time page using a blank digital clock.

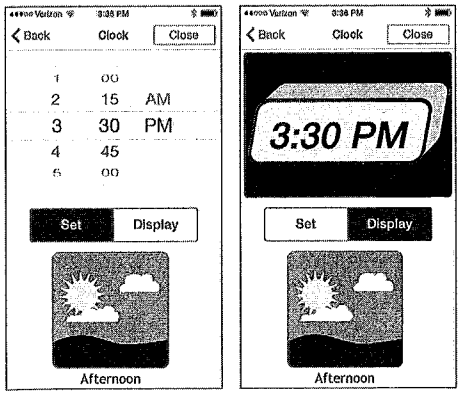


FIGURE 4

Screenshots of the Clock feature in the Show Me for Emergencies app showing how users set time (left) and display time using a digital clock icon (right).

LESSON LEARNED: ANIMATING ICONS

As part of our research process, we conducted a survey of existing AAC communication boards and icon-based tools and found that many focus on identifying feelings, language, body parts, and other ideas, constructs, or objects. However, we found very few that used icons to convey actionable messages.

For our development team, it was essential that we devise a way to convey such messages. For instance, in an emergency, when volunteers go door-to-door before a storm warning people, they have to tell them to evacuate or stay at home. These two scenarios require different, explicit messages, such as "pack" or "move away from windows."

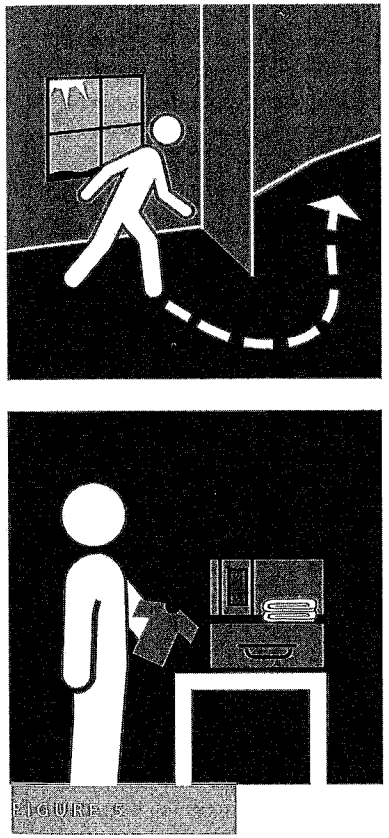
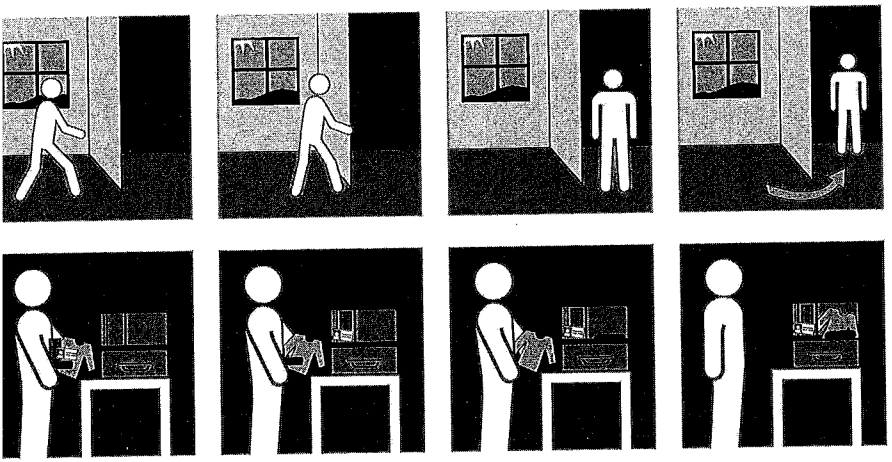


FIGURE 5

Draft of the "Move Away From Windows" (top) and "Pack" (bottom) icons.

As seen in Figure 5, the initial designs of these icons attempted to communicate actions in singular, static icons. We represented motion through body gesture and directional arrows.

Though users understood some aspects of these icons — like individual symbols within an icon — they missed the overall intended message. For example, one Deaf participant described the "Pack" icon as meaning "I would open my suitcase." Even when the moderator stated that a first responder would be showing the participant this icon during an emergency, the participant still only saw the action of opening a suitcase — not opening a suitcase, packing it, closing it, and leaving. Similar responses to other icons for actionable messages led us to conclude that, at least for



GURE 6

ames from the animated ons "Move Away From indows" (top) and "Pack" ottom) icons.

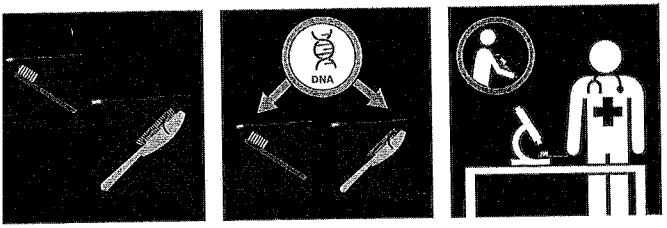
some instructive messages, body language and additional instruction were key to conveying the meaning.

While we still used these static icons in the Show Me book, once we started developing the mobile apps we had the opportunity to address this problem in a new way. We decided to animate the icons, so they would run in a loop, a technique that users responded well to. In Figure 6, the frames for the "Move Away From Windows" and "Pack" icons can be read from left to right.

GURE 7 (BELOW)

eries of icons conveying formation about NA, from left to right: oothbrush/Hairbrush, DNA ample, and DNA Testing.

Developing the actionable message icons showed us that movement can enhance meaning — essentially creating a narrative of the steps involved — and convey a more complex idea. However, we knew that too much animation could get overwhelming, so we used it only on the nine icons that we thought required it.



LESSON LEARNED: GROUPING ICONS

The iterative icon design process wasn't only about fine-tuning the appearance of the icons themselves; it was also about deciding how the icons were grouped and organized, so they are easiest to understand and use contextually.

We confirmed that for some icons, the correct use of grouping was essential to conveying their meaning. For example, the Show Me FAC app — designed for use in family assistance centers after disasters — needed a series of icons about DNA testing. To help identify

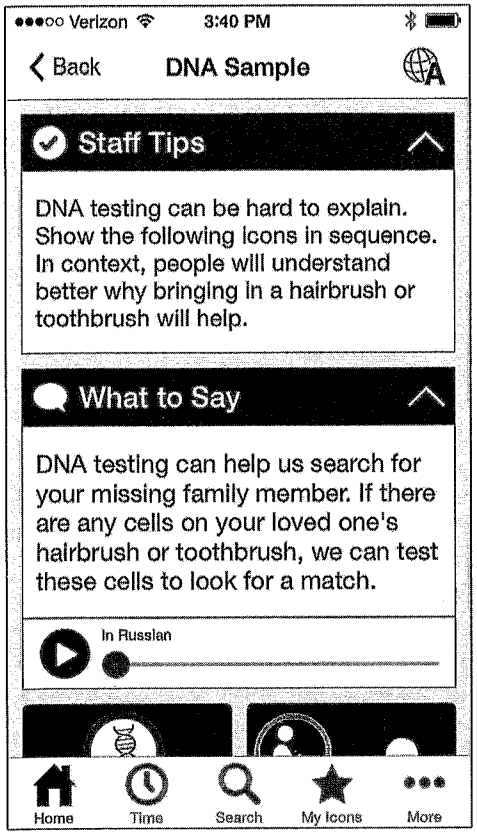


FIGURE 8

Screenshot from Show Me for Emergencies FAC app showing the Staff Tip and What to Say messages that are grouped with the DNA icon series.

missing family members, people waiting at the center often need to bring in a sample of their loved one's DNA, usually from a toothbrush or comb. The message is a deeply upsetting one for grieving family members, and we expected that expressing it with icons would be a challenge. While we always intended to group the DNA icons together, we still tested these images individually to gauge responses. We found that most participants identified certain symbols in the "Toothbrush/Hairbrush," "DNA Sample," and "DNA Testing" icons as shown in Figure 7. But they struggled with the concept of actually *gathering* personal items as a way to help identify a missing person.

Some participants made connections as they noticed symbols, like the toothbrush and hairbrush, that were reused across multiple icons. One participant with limited proficiency in English understood that the toothbrush from the "DNA Sample" icon was the one being tested in the "DNA Testing" icon. Another Deaf or hard of hearing participant stated that "Toothbrush/Hairbrush" icon made the "DNA Sample" clearer and "she'd get a brush with missing person's DNA on it to help identify him."

As we expected, when we presented these DNA icons together as a series, users had a clearer sense of what we were trying to convey. We reinforced the message further in the FAC mobile app with staff tips (see *Figure 8*) that coach workers and volunteers on how to use the DNA icon set. By carefully considering the organization of icons, labeling, and messaging, we were able to create new meaning from a sequence of icons that users couldn't understand in isolation.

IMPLICATIONS

For the CommunicateHealth design team, developing the icons for the Show Me tools was an inspiring challenge — from both a design and public health perspective. We were acutely aware of the serious implications of our work. These tools have the potential not only to help a segment of the public with special needs during an emergency, but to save lives — getting people to understand how to protect themselves and their families during life-threatening emergencies. Developing icons that worked — that people could understand quickly, regardless of communication difficulties — could make all the difference during a crisis.

Because this is a case study, it does have obvious limitations. For instance, we were not able to field test the tools, and we do not have data about how the Show Me tools have been used during actual emergencies. While we did test the tools and icons with over 100 people over three years, the budget limitations of a state health department prohibited testing on a wider scale. We do hope to learn more from public health departments that use these tools during a crisis. If possible, we could then refine the tools in the future.

Our paper has clear implications for designers working in the field of public health — and outside of it. As Zender has argued, while the AIGA/DOT icons are still valuable tools, exploration of icon design has remained static for decades (2006). By focusing not only on the design of new, traditional icons but by adding interactivity and animation, and carefully grouping related icons, we have helped push forward what designers can achieve using icons as a form of communication for a broad audience.

The icon systems that designers developed for the 20th century fit their cultural moment — the need for mass reproduction and the aspiration to create a universal visual language. As design moves forward in the 21st century, icon designers will need to consider new contexts, the needs of fragmented and specialized audiences, and the implications of the rapidly growing field of mobile health applications (mHealth). To meet the challenge, designers need to question assumptions about how people understand traditional iconography — and create new systems that will help people understand important messages about their health and safety.

ACKNOWLEDGEMENTS

This project would not have been possible without the funding and support of the Office of Preparedness and Emergency Management of the Massachusetts Department of Public Health (MDPH), and the oversight and guidance of our project officer Samantha Stone, MA and Kerry Evans, MPA from MDPH during the development of the Show Me tools. We'd also like to acknowledge team members from CommunicateHealth that worked on this project over the years: Ariana Adams-Gregg; Matt Allen; Amy Behrens, MS; Mel Choyce; Caroline Conena; Joshua Frank; Cassidy Hayes; Sandy Williams Hilfiker, MA; Molly McLeod; Aimee Petrosky; Stacy Robison, MPH, MCHES and Huijuan Wu, PhD, MS, MEng.

AWARDS

Federal Emergency Management Agency (FEMA) recognized the Show Me series with the 2014 Individual and Community Preparedness Award for Survivor Empowerment and Integration. Our project officer at MDPH, Samantha Stone, was recognized by the White House's Champions of Change program for Individual and Community Preparedness, in part for her work on the Show Me series of tools.

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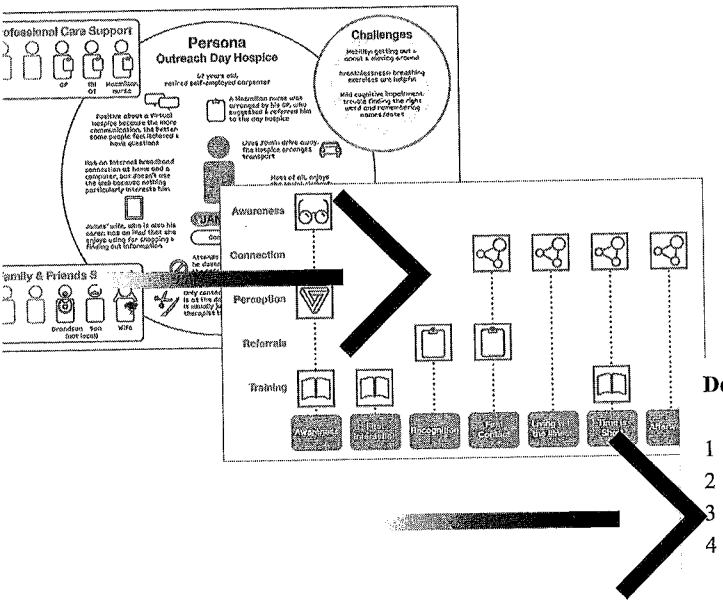

Design Brief:

1 Crafting the Message
2 Building the Virtual Hospice
3 Testing the Virtual Hospice
4 Look, Feel and How

6

Developing a Design Brief for a Virtual Hospice Using Design Tools and Methods: *a preliminary exploration*

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ABSTRACT:

Providing equitable access to specialist palliative care, regardless of diagnosis or geographical location, with relatively limited resources and an ageing population, will become increasing difficult for all hospice services. This paper describes the development of a Design Brief for a Virtual Hospice using design tools and methods. The main aim of the Virtual Hospice in this case is to improve access to services provided by the Highland Hospice in Inverness, Scotland. The project began by observing Hospice staff and their interactions with patients. Three User Personas were then created based on data gathered through interviews with a small number of patients and professionals. Each Persona's progress through the Highland Hospice service was visualised on a User Journey Map in the form of insights and opportunities, with five key themes emerging. The final step involved producing a Design Brief that synthesised the research findings in the form of a plan for creating, prototyping and testing the Virtual Hospice.

KEYWORDS

design methods; end-of-life care; health; hospice; palliative care; virtual hospice

INTRODUCTION

Hospice is a philosophy of care that focuses on providing physical, social, emotional, and spiritual support for people with life-shortening illness. The first hospices date from the Middle Ages, where hospice referred to a place of shelter for weary or sick travellers. The modern hospice movement began in the UK with the opening of St. Christopher's Hospice in 1967, which transformed the approach to death and dying from "there is nothing more that can be done" to "there is so much more that can be done." The hospice movement has since spread across the world. Services are provided within a definable building or are purely community based, can include art and complementary therapies, bereavement counselling, chaplaincy and spiritual care, occupational therapy and physiotherapy, as well as direct nursing and medical care.

In Scotland, Highland Hospice is contracted by the NHS (National Health Service) to provide specialist palliative care in Highland, Scotland. Highland Hospice serves a population of 220,000 people distributed over an area of 10,000 square miles comprising the largest and most sparsely populated part of the UK, with a mountainous terrain and limited transport and communication infrastructure. The Hospice provides a 10 bed In-Patient Unit, a Day Hospice, a Day Therapy Center, and a Bereavement Counselling Service at its base in the principal concentration of the population, the city of Inverness. It also provides a Day Hospice in outlying areas, currently Fort William and Thurso. A multi-professional team supports primary and secondary healthcare professionals to provide palliative care in individual's homes, care homes, and hospitals. The Hospice also works closely with two cancer charities: Macmillan Cancer Support and Marie Curie Cancer Care.

However, most clients access services based within the Hospice building in Inverness, tend to live within a 30-mile radius—given the difficulty of travel for a population who are often physically frail, have a diagnosis of cancer, and, if not inpatients, have contact only within office hours. Indeed, the total number of patients supported equates to 18% of the 2,500 people that die in the catchment area of the Hospice each year. In the near future, the number of people seeking specialist palliative care is expected to increase considerably because more people are living longer with long term and life-limiting conditions. The vision of the Hospice is to create a "Virtual Hospice" to improve access to its services for individuals and their families regardless of geographical location, diagnosis, or time of day. To this end, collaboration was forged with the Glasgow School of Art to develop a Design Brief for progression through the Digital Health Institute (DHI). The DHI is a Scottish Funding Council innovation center that aims to transform health and social care delivery in Scotland (Digital Health Institute).

This work contributes to the growing body of research within User Centered Design (UCD) on hospice care. The main contributions include new insights and opportunity areas for a Virtual Hospice that significantly extends the well-established and successful Canadian Virtual Hospice model (Canadian Virtual Hospice) gathered by directly engaging with potential end users, and three User Personas representing key types of users.

RESEARCH QUESTION

What are the opportunities for, and challenges to, improving access to hospice services for individuals and their families regardless of geographical location, diagnosis, or time of day?

RELATED WORK

This work builds upon existing approaches to improving access to hospice care, principally the well-established Canadian Virtual Hospice and the remote care of patients in their own homes using technology.

VIRTUAL HOSPICE

There are a small number of services entitled "Virtual Hospice" operating around the world, albeit in different forms. The Canadian Virtual Hospice is a website launched as the result of collaboration among Canadian palliative care clinicians, academics, and researchers that allows anyone in Canada to correspond via email with a palliative care nurse specialist or doctor (Canadian Virtual Hospice). However, the service is predominantly an information resource with limited interaction between professionals, patients, and caregivers. The Virtual Hospice being developed by Highland Hospice (Highland Virtual Hospice) will significantly extend the Canadian Virtual Hospice model by encompassing a broader package of services to facilitate the provision of a greater level of support at the time and in the place of an individual's choosing. Potentially, this could include all the current services provided by Highland Hospice—from clinical consultations and on-going symptom assessment to creative therapy and bereavement support, and from psychological counselling to practical, physical care advice for family caregivers.

In Australia, the Maitland Palliative Care Trust has developed a Virtual Hospice where the term refers to a network of supportive relationships connected in the desire to care for people at the end-of-life (Maitland Palliative Care Service). Support tools for patients, caregivers, and healthcare professionals are provided as part of the community based service. In the UK, several NHS organizations also offer such a Virtual Hospice enabled by collaborative work among community teams. Here, the term typically refers to caring for patients and their families in their own homes, rather than in an in-patient unit within a hospital or hospice, and/or providing beds in community settings such as a nursing home—programs that are set against a UK Government policy driver to shift care closer to home. How-

ever, while it is envisioned that the Highland Virtual Hospice will improve collaboration between the multiple organizations and individuals who provide palliative care by providing a platform to facilitate communication and learning, it differs in its focus on the use of digital technology to overcome time, geographic, and other barriers of access to hospice services.

ELEHEALTH (REMOTE CARE)

Telehealth is the remote care of patients in their own homes using technology. Examples include telephone advice lines, video consultations, and telemonitoring involving clinical review of data from equipment in the home that monitors vital signs and symptoms. The UK Government's Whole System Demonstrator Program, the largest randomised control trial of telehealth in the world, shows that at least three million people living in the UK with long-term conditions could benefit from telehealth (Department of Health, 2011). A systematic review that includes 26 articles published from 2000–2010 concludes that telehealth technologies hold promise to be useful and important tools for the delivery of hospice care, and that there are potential clinical outcomes and cost benefits (Oliver, Demiris, Wittenberg-Lyles, Washington, Day, & Novak, 2012).

A separate review of telehealth in palliative care in the UK included 21 published and unpublished research documents from 1999–2009 (Kidd, Cayless, Johnston, & Wengstrom, 2010), including a report of a pilot study involving Highland Hospice that demonstrates the feasibility and acceptability of using mobile phone technology to monitor symptoms reported by patients being cared for at home (McCall, et al., 2008). The review identifies a lack of evidence-based research and finds no evidence that telehealth is integrated into palliative care services in a systematic fashion. Both reviews conclude that telehealth technologies are acceptable to staff, patients, and family members.

ETHOD

The project employs a research method being developed by the Glasgow School of Art entitled "Three Cubed," which seeks to provide an exploratory and open approach to research through a process of extreme collaboration in short periods of time (cf. McHattie, Cumming, & French, 2014). "Three Cubed" comes from the word cubed or the power of three: the approach involves a core interdisciplinary team of three people working together in three stages of three days (3^3) with research participants. The stages of the Cube are entitled "Orientation," "Immersion," and "Validation." The core team members have disciplinary backgrounds in Service Design, Psychology, and Interaction Design, and worked in collaboration with the Consultant Physician in Palliative Care at Highland Hospice and other members of staff. The Three Cubed method was chosen as an appropriate method given the preliminary, exploratory nature of the project.

ORIENTATION

Stage 1 involved defining the research question through consultation with Highland Hospice staff and consideration and review of previous research conducted by the Hospice and other relevant literature.

IMMERSION

Stage 2 involved the researchers immersing themselves within the research context, starting with a tour of Highland Hospice facilities that included observing staff and their interactions with patients in the Day Hospice and In-Patient Unit in Inverness, and the Outreach Day Hospice in Fort William. Here, the purpose was to go "on location," to observe key stakeholders, and to record the experience by taking written notes and photographs in order to gain inspiration and a rich understanding of Hospice services and how they deliver value (see *Figure 1*). The visits included conversations with a range of specialist staff – doctors, nurses, an occupational therapist, a social worker, a chaplain and a bereavement counsellor – centered on the topic of their roles.

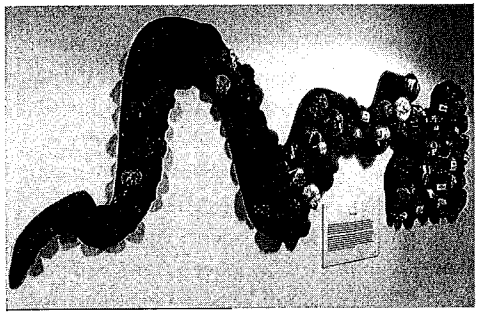

FIGURE 1.

A photograph of an artwork created by patients and staff at an Outreach Day Hospice depicting a journey that someone with a life-limiting illness might take. The dark cobblestones represent loss. However, there can also be profound gains progressing along the path, represented by the coloured cobbles and annotations, many of which refer to attending the Outreach groups with words such as 'advice' and 'fun and laughter'.

Each researcher then outlined a User Persona representing a key type of user: a middle-aged patient with a young family living in Inverness, an elderly patient living outside Inverness, and a healthcare professional living and working in a remote location. A User Persona is a fictional character that synthesises information about similar people and helps to maintain focus on the needs of users as services are developed. Individuals that matched the Personas were then invited to take part in an unstructured interview with the researchers. Interviews with healthcare professionals took place over the phone due to logistics of travel. Interviews with patients took place in Inverness and at the Outreach Day Hospice centers. The interviews focused on the topic of participants' experiences with Highland Hospice services and lasted up to one hour. Data gathered from the interviews and further discussion with Hospice staff informed the detailed development of the Personas.

The researchers then collectively created a User Journey Map, a visual representation of a user's journey through a service that allows for the identification of challenges and opportunities. The journey map was segmented into key stages of the care pathway. Insights revealed by each User Persona were succinctly written on post-it notes and affixed to the relevant key stage. These insights were translated into opportunities by imagining future possibilities concisely written on post-it notes and placed beneath the relevant insights. Different color post-it notes were used to visually separate the User Personas. Mapping each Persona's journey

through the service in the form of insights and opportunities, on a single map, facilitated the identification of themes.

ALIDATION

Stage 3 involved validating the research findings. A Design Brief was produced that synthesised the findings. Then, the research findings and Design Brief were presented to an expert panel, including Highland Hospice staff, invited by the Glasgow School of Art for validation and final refinement.

ARTICIPANT RECRUITMENT

The intention was to recruit three individuals per Persona. Highland Hospice staff reviewed their patient administration system to identify potential patients, suggested appropriate healthcare professionals, and made the initial approach to potential participants. The staff also supplied an information sheet explaining the purpose of the research, the nature of their involvement, and a consent form. Six cancer and heart failure patients (4 females, 2 males) agreed to take part in the project. A single patient matched Persona 1, reflecting the much lower proportion of younger hospice patients; therefore, this Persona was created based on both patient and professional insights and experience. The other five patients matched Persona 2. Three healthcare professionals (2 females, 1 male) based over 60 miles from Inverness also agreed to participate: two nurses working part-time as a Macmillan nurse and part-time as a community nurse, and a GP (General Practitioner doctor). The North of Scotland Research Ethics Committee approved the project.

ESULTS AND DISCUSSION

The following section presents the User Personas, the key insights and opportunities arising from the User Journey Map, emerging themes, and the Design Brief.

SER PERSONAS

Three User Personas were created: Maria, James (see *Figure 2*), and Leesa. The Personas do not cover all types of users accessing Highland Hospice services as a consequence of the limited timeframe of the project; however, they do represent key user groups for a Virtual Hospice.

Persona 1 – Maria

"I was left to get on with it."

Maria, 42 years old and in remission from cancer, has always been aware of hospice through her employment in the healthcare sector. When she was first diagnosed, Maria was not initially referred to Highland Hospice. It was a difficult time as she was supporting her young family who struggled to

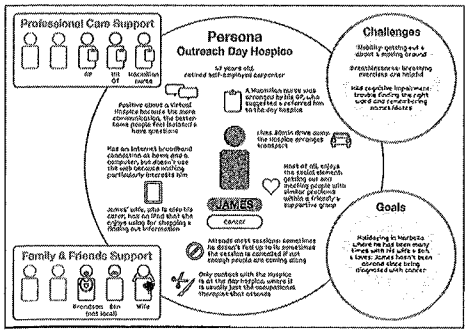

FIGURE 2.

One of three User Personas created based on user research, representing a key type of user accessing Highland Hospice services.

come to terms with her treatment. It was not until Maria began experiencing feelings of low mood and anxiety that she was referred to the Day Therapy Center to take part in a 12-week activity program of her choice. Maria was not keen on attending at first, and the first session was upsetting because she was the youngest person there. Sometimes it was difficult for her to get to the sessions since she worked during the day.

Maria is comfortable with technology: she has an Internet Broadband connection at home, a computer, and a smartphone. She feels that a Virtual Hospice could be a convenient way for people with work and family commitments to access services, especially if they feel apprehensive about what to expect inside the Hospice buildings.

Persona 2 – James

"Talk to me; I'm still a person."

James is 76 years old and is living with cancer. A Macmillan Nurse, contacted by his GP, suggested and referred James to the nearest Highland Hospice Outreach Day Hospice service, which is a 30-minute drive away. The Hospice arranges community transport for James and other individuals. Most of all, James enjoys the social element – getting out and meeting people with similar problems within a friendly and supportive group. James attends most sessions: sometimes he doesn't feel up to it, and sometimes the session is cancelled. James has never been to the Hospice building in Inverness. His only contact with other patients and a very few staff members is through the Day Hospice.

James has an Internet Broadband connection at home and a computer, but he doesn't use the web because there is currently nothing of particular interest to him. However, his wife, who is also his caregiver, has an iPad that she enjoys using especially for shopping and finding out information. James is positive about a Virtual Hospice because he believes the more communication the better, and that some people feel very isolated and have questions they want to ask but are afraid to.

Persona 3 – Leesa

"If I had a magic wand, I would sprinkle the Hospice bed and environment to create that calm for the families."

Leesa is a nurse living and working on a remote Scottish island. Leesa is well connected to clinical staff in local GP surgeries, care homes, and hospitals. Her interactions with Highland Hospice are of a practical nature; she particularly values telephone advice on pain relief, symptom control, and domiciliary visits by Hospice staff. Unfortunately, it is often just too far for

her patients and their families to travel to Inverness for care. Leesa supports around a dozen patients at any one time, most of whom have cancer, which involves extensive travelling time each week. Challenges of island life include patient privacy (as her car is recognised), little scope for drop-in visits due to travelling distances, and limited exposure to Hospice staff and their approach to care.

Leesa carries an Internet-enabled smartphone with her. She would love a "pocket Hospice clinician" for inspiration and knowledge and feels that a Virtual Hospice that reproduced the Hospice environment in community settings, especially the calmness, would be hugely beneficial to the islanders.

USER JOURNEY MAP

A User Journey Map was created with seven key stages based on a palliative care pathway provided by Highland Hospice: awareness (of Highland Hospice); first interaction (between healthcare professionals and Highland Hospice); recognition (of life-threatening nature of illness); first contact (between patients and Highland Hospice); living with the illness; time is short; and afterwards (see *Figure 3*). This section collectively describes the key insights and opportunities associated with each User Persona at each key stage of the map.

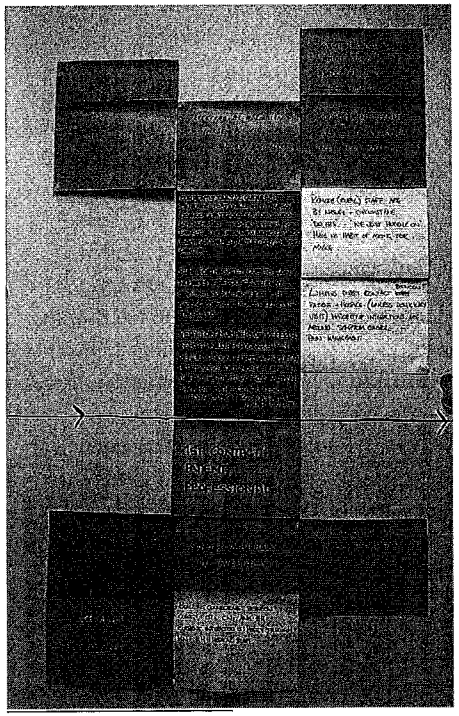

FIGURE 3.

Insights and opportunities relating to each User Persona were written on different coloured post-it notes (one colour per Persona) and affixed to the relevant key stage of the User Journey Map.

Awareness

Only those patients with previous knowledge of hospice, through their job or someone they knew having entered hospice, were aware of services prior to referral; other research also points to a limited understanding of end-of-life care among patients (Davidson, Whyte, & Richardson, 2012). Misperception of hospice among patients, e.g. hospice is only for people with cancer, and among professionals, e.g. hospice is only for pain and symptom control, was also revealed, although it was said to be changing among professionals. Finally, while the need to prepare for an ageing population is recognised among professionals, NHS staff training is viewed as ad hoc. The key opportunities identified included raising awareness of the services and support that hospice can offer, partly as a consequence, changing people's perceptions of hospice including fear, generating demand for support beyond clinical care, and providing online training programs for healthcare professionals.

First Interaction

Training sessions on palliative care at Highland Hospice are highly valued; however, those travelling long distances require a stopover in Inverness, which can be problematic for part-time staff. In addition, while Macmillan nurses are sent on an informal educational visit(s) to Highland Hospice as part of their training, they are not picking up the benefits of psychosocial support such as creative work and story telling. Funding for education and training on palliative care is also diminishing. The key opportunities identified included offering online learning programs and education resources for healthcare professionals, crafting a message that better communicates the psychosocial element of hospice care and the day hospice services available, and exploring alternative funding streams for delivering education.

Recognition

Healthcare professionals may not introduce the subject of hospice care in their early discussions with patients for reasons including that it is a sensitive and potentially upsetting topic to broach. Partly as a consequence, there can be a significant lapse of time before a referral to hospice, which can engender feelings in the individual of having been left unsupported. Interestingly, other research has identified key models of GP use of specialist palliative care services that includes seldom using such services (Shipman, et al., 2002) and has found large variation in GPs' knowledge about palliative care and available services (Higginson, 1999). The key opportunities identified included exploring why GPs do and do not refer patients to Highland Hospice services, building on the findings of Shipman, et al. (2002), using the feedback to improve referral rates at the earliest appropriate point, and allowing patients to self-refer (currently, patients must be referred by a healthcare professional).

First Contact

A relatively low number of individuals are referred to the Outreach Day Hospices, which, partly as a consequence, are run once fortnightly or even closed. Further, younger patients can find it problematic to attend Day Hospice services due to work and family commitments and upsetting to be put in a 'sick' role within a group that is typically much older. For patients not accessing Day Hospice services, direct contact with Highland Hospice is typically limited to domiciliary visits by clinical staff for pain and symptom control. The key opportunities identified included exploring why healthcare professionals do and do not refer patients to the Outreach Day Hospices, providing support for patients in the evenings outside normal office hours, and building connections between healthcare professionals and the full team of staff at Highland Hospice, as current interaction is mostly through Macmillan nurses and the Hospice clinical staff.

Living with the Illness

Patients attending the Outreach Day Hospices are consistent despite considerable travel time for some, with people particularly enjoying the social element. However, sessions are cancelled if numbers are too low, with patients additionally missing around one in four sessions for health reasons. Further, patients attending the Outreach Day Hospices generally only have contact with the few members of Hospice staff who facilitate or join the sessions. Healthcare professionals also find peer-to-peer support, e.g. sharing tips and experiences, extremely valuable. The key opportunities identified included video conferencing to improve the connection between patients attending the Outreach Day Hospices and Hospice staff in Inverness that do not regularly attend the sessions, using social media to support social interaction among patients, and online forums to support learning among professionals. Highland Hospice has no social media channels. However, research into new media usage within the hospice sector has identified a range of benefits using social networking sites as places for self-expression, finding out information, and feeling connected to friends and family—although usage is currently limited to patients and caregivers (Miller, 2013).

Time is Short

Hospital nurses deal with death and dying on a regular basis but have limited exposure to hospice staff in action compared to Macmillan nurses who liaise more closely with Highland Hospice staff. Domiciliary visits are appreciated, e.g. they confer value onto patients signed off by other consultants on a "there is nothing more we can do" basis; however, visits are by necessity planned around critical need due to time constraints and distance of travel. Travelling distance is also an issue for some patients living in remote areas far from Inverness who are reluctant to be admitted to the In-Patient Unit because the journey can be daunting for both them and their family. The key opportunities identified included improving access and training for nurses who work in hospitals on hospice care in action, connecting Highland Hospice staff with patients and their families in their own homes via video-conferencing when needed, and supporting enhanced caring for patients in their own homes through close collaboration with community teams.

Afterwards

Highland Hospice offers a range of bereavement support services. However, support groups for healthcare professionals are based in Inverness, which can be problematic for those travelling long distances. Nonetheless, Macmillan and community nurse teams do meet, sometimes to just cry together. While deriving great benefit from attending Day Hospice, including a real sense of comradeship, it can be upsetting each time a group member dies, partly due to missing the individual and partly fearing that they will be next. The key opportunities identified include establishing bereavement support groups across Highland, otherwise encouraging patients to talk about death and dying, and to plan for death to reduce the fear of dying, and to help caregivers return to living the life they led before becoming a caregiver.

THEMES

Five themes emerged from mapping each User Persona's journey through the Highland Hospice service experience, some of which were recurring (see *Figure 4*). Collectively, these themes frame the fundamental design challenge to the Hospice: raising public and professional awareness of Highland Hospice services, supporting connections between Highland Hospice and patients and healthcare professionals, changing perceptions of hospice to avoid delayed admission, increasing the number of referrals to Highland Hospice, and boosting training on palliative care.

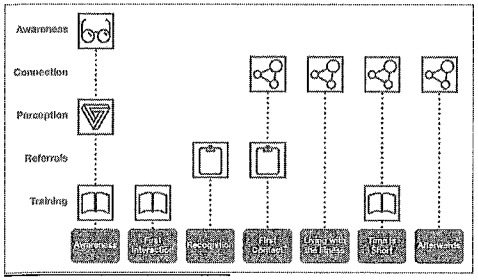

FIGURE 4.

DESIGN BRIEF

Lastly, a Design Brief was produced that synthesised the research findings in the form of a plan for creating, prototyping, and testing the Virtual Hospice through a series of Experience Laboratories. Experience Laboratories are at the core of the Digital Health Institute innovation model and are led and developed by the Institute of Design Innovation at the Glasgow School of Art. Experience Laboratories provide the opportunity to try new ideas and co-design solutions together with users in a realistic environment (Digital Health Institute). The Laboratories aim to bring together academics, business, and civic partners to collaborate in order to design sustainable solutions to health and social care challenges.

Four Laboratories were proposed, and the key aims are summarised here:

Lab 1

"Crafting the Message" aims to better understand health professionals' awareness and perception of Highland Hospice services and barriers to referral as the basis from which to move forward with the new Virtual Hospice service; if necessary, to more clearly define the current service offering ("message") potentially resolving the cause for some non-referrals.

Lab 2

"Building the Virtual Hospice" aims to co-design the Virtual Hospice with healthcare professionals through imagined removal of barriers to referral, to draft a Service Blueprint where the primary channel through which users will interact with the Virtual Hospice will be the web, and to identify areas to prototype. A

Service Blueprint is a design method that provides a visual and holistic view of a service and defines "front stage" (customer facing) and "back stage" (behind the scenes) activities.

Lab 3

"Testing the Virtual Hospice" aims to check that the proposed Virtual Hospice is acceptable and desirable to patients and their families by mocking up the home page of the Virtual Hospice website and navigation menu to show the full service offerings, making prototypes of parts of the service, and using established usability testing methods such as think aloud, where people say what they are thinking as they perform a task, and role playing, to gather feedback to iterate and improve the overall design of the Virtual Hospice.

Lab 4

"Look, Feel and How" aims to co-design initial concepts for the branding of the Virtual Hospice with stakeholders; to provide a consistent look and feel across services, focusing on key visual identity and user interface elements such as logotype, colour palette, fonts and widgets; to consolidate the learning and create a strategy for implementing the Virtual Hospice; and to identify creative and technical partners through the DHI Team Building service to assist with detailed service development, branding, and technology infrastructure set-up.

CONCLUSION

The number of people seeking specialist palliative care is expected to increase significantly in the near future. A Virtual Hospice would enable more equitable and convenient access to Highland Hospice services and a higher quality of community-based support. This is likely to increase the confidence of patients and their lay and professional caregivers, and improve the patient and family experience of palliative care. The challenges that face Highland Hospice in delivering services across a wide geographical area and around the clock are not unique to Highland; potentially, the Highland Virtual Hospice model could be reproduced by other hospices in the UK or overseas. Although this work involved a very small number of patients and healthcare professionals, the resulting Design Brief proposes engagement with a larger number of service users across Highland to build on and validate the research findings. The Design Brief has been accepted by the DHI and will be taken forward by the Experience Laboratory team.

ACKNOWLEDGEMENTS

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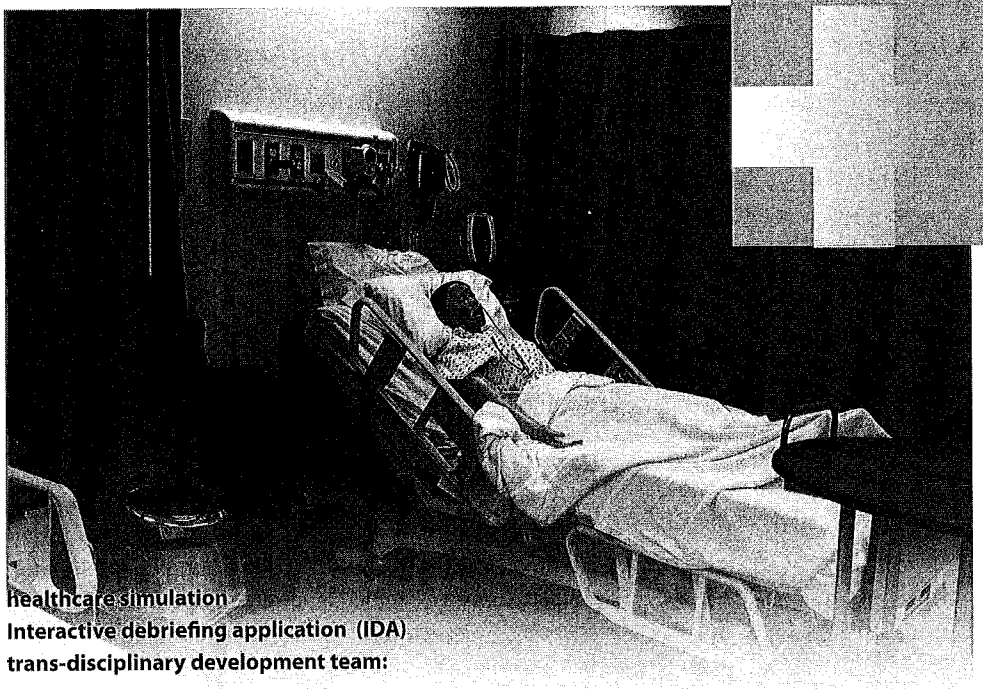
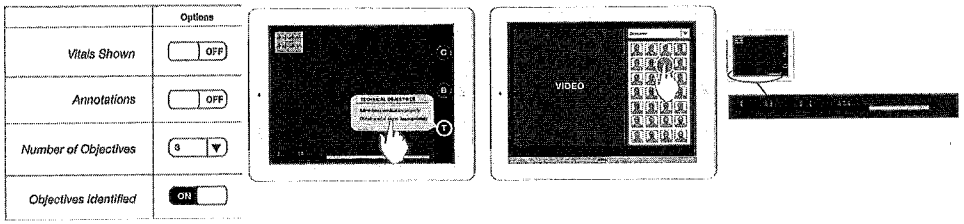


healthcare simulation
Interactive debriefing application (IDA)
trans-disciplinary development team:

dashboard team | data capture team | debriefing team | data analysis team



7

Trans-disciplinary Partnerships in IT Health Software Development: *the benefits to learning*

Sarah Lowe, Tami H. Wyatt, Xueping Li, Susan Fancher

ABSTRACT

Healthcare has followed the footsteps of the aviation industry with respect to teaching and learning. Pilots practice endless hours on simulators prior to flying solo. Likewise, healthcare workers increasingly use simulation to practice skills and clinical judgment prior to providing care to patients in a professional setting. With the growing interest in healthcare simulation, there are increasing needs to enhance the learning that occurs within a simulation to ensure the effectiveness of this practice in healthcare education. In an effort to meet this growing demand, the University of Tennessee, Knoxville builds technologies to enhance simulation learning. This paper presents the process and benefits of using trans-disciplinary teams to build healthcare products. Specifically, the paper discusses the experiences of a team of designers, engineers, and nurses in a university setting who work together with their students, to build and test healthcare products including educational tools to support simulation.

KEYWORDS:

simulation, trans-disciplinary partnership, educational software design, Health IT, graphic design classroom

. INTRODUCTION

Just as airline pilots use simulated flight experiences to gain understanding of the variability surrounding flight, so too does the field of healthcare use simulation scenarios to prepare for the clinical world beyond the classroom. Simulation activities provide opportunities to link theory and practice in an experiential learning environment (Cantrell, 2008) by placing learner(s) in settings that mimic medical facilities and asking them to perform an activity that will result in the learner's knowledge of identified skillsets. Simulation facilitators typically use one or more, or a combination of different types of simulation activities[1] to achieve the classroom objectives. In particular, high-fidelity digitally enabled manikins are manipulated remotely via observation booths where a learner's every move in relationship to the manikin is documented and video recorded for discussion post-simulation.

Due to the large learner to facilitator ratio in simulation classroom settings, it is necessary to have active participants, those performing patient care activities, and observers, those who are not participating, but watching. Typically observers watch on monitors outside the room or possibly inside the room, neither of which requires any type of interaction on behalf of the observers thereby resulting in a lack of engagement and subsequent missed opportunity for learning (Kolb, 1984).

Simulation software used in today's classroom setting has only just begun to consider a simulation scenario that includes the passive observer. The software detailed in this paper is unique in that it not only addresses the tacit needs to transform the passive observer into an active observer, but represents a trans-disciplinary partnership across the Colleges of Nursing, Engineering and Arts & Sciences in seeking a solution. This blending of the team disciplines, in conjunction with a graphic design class served as a catalyst for a simulation software concept based on intuitive input and meaningful output.

As a result of this collaboration and outcome, we argue the need for mobile health (mHealth) initiatives to seek solid partnerships between commercial development and higher education in responding to the increased demand of technology software in healthcare education. Aside from the clear benefit of beta-testing directly with the intended audience, the expertise that arises in trans-disciplinary partners working on-the-ground in educational institutions allows for outcomes focused on documented methods of learning within an experiential learning space.

. SIMULATION IN NURSING EDUCATION

Simulation based medical education is defined as any educational activity that utilizes simulation

[1] There are five different simulation activities that are considered effective in nursing education executed through simulation scenarios: Standardized patients, Task trainers, Software-based simulation, High-fidelity manikins and virtual reality (Rosen, 2008).

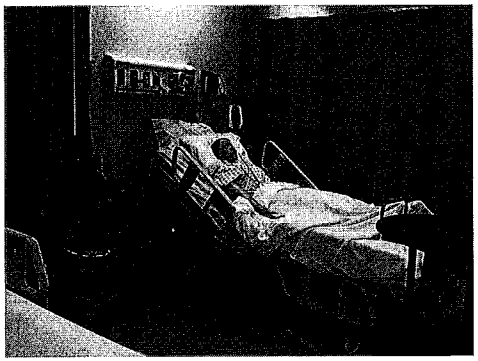


FIGURE 1

Simulation classroom

aides to replicate clinical scenarios (Al-Elg, 2010). In turn this furnishing of the conditions in which learning can occur is thought to improve clinical skills, clinical reasoning, patient safety and team building. A simulation can take place within either a modified space or a full-scale replica of a medical facility. (see *Figure 1*) Trained facilitators who execute the simulation activity range from instructional technologists to tenured professors. This variability in a facilitator's background places an increased reliance on the simulation software to assist in staging an effective learning experience.

Simulations are constructed within what is known as a scenario with a fictitious patient in the form of either a high fidelity manikin or an actor representing a standardized patient with a pre-determined sequence of events, both of whom respond to the actions of the learner. Scenarios can be as simple as taking vital signs to as complex as life or death situations. For this paper we will focus on simulation scenarios using a high-fidelity manikin. Running upwards of $100K, these human stand-ins have eclipsed the widely known Resusci-Annie to become complex technological devices that exhibit incredibly life-like functions such as breathing, palpable pulses, bleeding, pupil dilation and perspiration. Procedures such as catheterization, intubation and IV insertion can be completed and are accompanied by the display of real-time patient data such as blood pressure, heart rate and oxygen saturation on the bedside monitor. For a learner, this culminates in an experiential environment in which knowledge is built from observation through to reflection (Kolb, 1984) in a low-risk setting.

To stage a scenario, a facilitator working with a high-fidelity manikin in an equipped simulation setting, will interface with a piece of software to preset the outcome for the select number of learners actually participating with hands-on activity in the scenario (participants). The remaining learners are left to observe (observers). When the luxury of a small facilitator-to-learner ratio is present, the observers can be in the room within clear sight of the activities. However as classroom numbers increase, observers may be asked to monitor the activity on a screen from a remote location and make notes as needed, thereby exponentially decreasing the ability of the facilitator to maintain engagement of the observers. Therefore, the physical limitations of the venue can have a direct impact on learning outcomes.

2.2 KNOWLEDGE DOMAINS IN SIMULATION SCENARIOS

For an active simulation participant, the scope of understanding within a scenario grows in complexity to result in higher order learning via the pre-determined set of objectives identified by the facilitator. Objectives are events of cognitive, technical or behavioral skills that advance from novice

to expert following the same order of Bloom's domains of learning, from cognition/knowledge to behavioral/clinical judgment (Bloom et al., 1956).

Cognitive skills: skills based on knowledge such as the ability to cite the signs and symptoms of influenza.

Technical skills: skills that require knowledge and the ability to perform those tasks such as the technical skill of an intramuscular injection for an influenza vaccine.

Psychomotor or Behavioral Judgment: decisions about clinical actions requiring critical thinking and communication based on one's cognitive, technical and/or behavior skills. For example, the ability to communicate with the patient effectively to recognize, assess, and relay the signs and symptoms of influenza in a clear and concise manner that lead to interventions for the patient.

2.3 DEBRIEFING

Similar to after-action review, a Socratic method using leading and open-ended questions to understand what happened in a military training scenario and why (Baker, Dickieson, Wulfeck & O'Neil, 2008), debriefing is a discussion-based process that is critical to the pedagogical value gained through conducting medical simulation scenarios (Cantrell, 2008; Fanning, 2008). Per the Gold Standards set forth by the International Nursing Association for Clinical Standards of Learning, (INACSL), effective debriefing includes a trained facilitator to lead the debriefing session who is skilled in both diagnosing learner needs and managing group processes (Decker, 2013 INACSL Standard VI). Upon conclusion, all learners should have a clear understanding of the scenario and the levels of learning (cognitive, technical, behavioral) that led to the outcomes. Effective debriefing will allow the learner to create new knowledge through examining the meaning and implications of actions during a simulation, while ineffective debriefing can lead to detrimental outcomes such as negatively transferring a mistake into practice without realizing it had been poor practice.

3. CURRENT SIMULATION TECHNOLOGIES

The use of software-based simulation began in the early 1980s in the form of computer-based training platforms accessed through a single computer (Rosen, 2008). Today there many different educational software packages on the market designed to assist in a simulation setting[2]. Many of these were developed to first and foremost help with scheduling, inventory, and managing multiple simulation scenarios at once. It was not until increased facilitator demand did the products expand to include more robust learning features.

Current software is highly effective in participant(s) learning by providing an ease-of-use interface for the facilitator who structures the hands-on manikin scenario and leads the face-to-face post-simulation debriefing session. It also allows for digital manipulation in the form of diagnostic machine output (blood pressure readings and the like) and the administering of the manikin activities via remote control. However, providing an effective digitally mediated tool for the observers who are observing the simulation remotely has been slow developing and shows the most promise through the use of mobile technologies. Aside from the obvious advantages of locational flexibility, mobile technology allows for learning to occur in a direct context of understanding; one which is both individual and collective, and holds greater opportunity for the transfer and retention of knowledge (Brown 1989; Lave & Wagner 1991) for the observer. In addition, the Interactive Debriefing Application (IDA) presented below further advances simulation software through its grounding in learning theory.

4. METHODOLOGY

Representing a collaborative partnership across the Colleges of Nursing, Engineering and Arts and Sciences at the University of Tennessee, Knoxville, the IDA is built upon today's simulation software with the goal of transforming the passive observer into an engaged learner through both real-time interaction and archived activities; each of which build the learner's competencies in cognitive, technical and behavior skills that improve clinical judgment and patient safety. This partnership included a Professor of Nursing with extensive background in Instructional Design and Technology, a Clinical Instructor who serves as the Simulation Coordinator for the College of Nursing, an Associate Professor of Industrial and Systems Engineering with expertise in complex systems and simulation modeling and an Associate Professor of Graphic Design with expertise in information, experience and interaction design.

The 16 Junior students working on the project were enrolled in an Intermediate Graphic Design course that explores research methodologies and practices as they pertain to the design process including in-depth investigations into audience and context in relationship to form and meaning. The very nature of the design process identifies the early iterative stages as critical to the final end result however in the development of software, the process is imperative in identifying the interactions before the time is put towards implementation (Buxton, 2007). Therefore the class was divided into 4 focused teams each tasked with strategizing for a specific user experience (UX) within the IDA. The first three teams represented the core functionalities:

2 Software which the authors include as current developments in the field include: SimView, CAE Replay, KBPort, B-Line SimCapture and EMS Simulation IQ.

DASHBOARD TEAM

Develop a dashboard that allows a learner and facilitator to access all of the data related to simulation scenarios in which they have both been active participants as well as active observers; as well as identify scenarios they still have left to cover.

DATA CAPTURING TEAM

Develop an interface that allows for real-time intuitive observer engagement with a simulation; engagement that can be captured, measured and assessed and re-presented via the dashboard.

DEBRIEFING TEAM

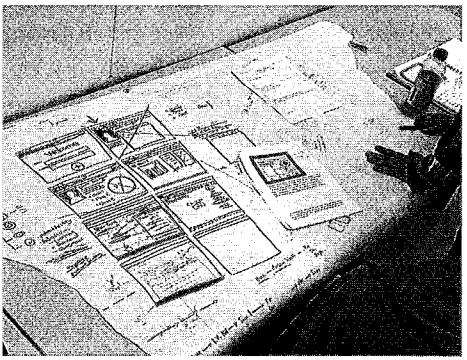
Develop a robust interface for retrieving annotations and selected snippets of video for review across a given timeframe and across 1-12 students to be expedited by the facilitator in a face-to-face debriefing session with all participants and observers.

The fourth team focused on the visualization of data generated by observer engagement with the IDA:

DATA ANALYSIS TEAM

Develop both a visual and textual manner in which the collected data can be quickly compared across multiple variables for display in the dashboard.

Parsing the students into discreet teams allowed for targeted research into UX precedents and patterns unique to each function, thereby diffusing the notion that the project would be 'designed' by any one person or any one team; presumptions that can often derail professional projects that are brought into a classroom setting. What was to be the primary challenge for the design students lay in the goal of imbuing known learning theory paradigms throughout the observer activities in an intuitive and meaningful manner. Identifying methods for translating this theoretical knowledge into practical application was guided by detailed and iterative mapping of mobile technology affordances, user workflow scenario building and wireframe prototyping (see *Figure 2*). This was coupled with tours of simulation settings on campus and in-depth lectures from, and team meetings with, the involved project faculty to best understand the



IGURE 2

n-process development of DA wireframes

FIGURE 3

Graphic Design students working directly with team partners

definitions of both a nursing simulation scenario and the subsequent knowledge domains (figure 3). In order to allow the focus to remain on the UX the design faculty outlined the end goal as a strategic brief that would go as far as the development of low-fidelity wireframes.

5. RESULTS

The following chronicles the outcome of this interdisciplinary partnership designed to be deployed on a mobile device.

5.1 LEARNER DASHBOARD

The learner dashboard consists of the typical features associated with today's digital dashboard (profile, preferences, reminders, etc). Within the IDA it is also a personalized, secure interface allowing access to all of the content needed for participating in a simulation in addition to storing and retrieving critical reflection of learner performance when reviewing past simulations. Critical reflection as defined by Sociologist Jack Mezirow is a self reflective process that takes place after an experience when the learner evaluates their actions and attempts to view them from an objective viewpoint (Mezirow, 1990). The ability to review and reflect on their own simulation experiences across time will assist the learner in revealing patterns or concerns as they matriculate through future simulations

The dashboard is also the gateway to engaging with an upcoming simulation. All learners involved will receive critical information prior to the simulation that requires review such as objectives and patient profiles. Once a learner has reviewed this material, they are granted authorization to participate in the simulation via a notification from the facilitator. This step assures observers, who will be watching in real-time, are prepared for the upcoming simulation thereby increasing their accountability in the activity.

5.2 FACILITATOR DASHBOARD

The facilitator dashboard supports pre-simulation information in regards to patient data and objectives as well as a post-simulation review of each student's engagement activity. At any time the facilitator can provide needed feedback to a selected student. Most unique will be the ability for the instructor to scaffold the objectives of a simulation to the learning level of the observer. For example, if an observer is demonstrating that he/she is not properly identifying a set of technical skills critical to advancing higher levels of clinical judgment, the facilitator could limit the variables in that student's simulation objectives to ensure that those particular skills are brought to the

	Options
Vitals Shown	OFF
Annotations	OFF
Number of Objectives	3
Objectives Identified	ON

FIGURE 4

Facilitators have the capability of scaffolding the experience for the learner

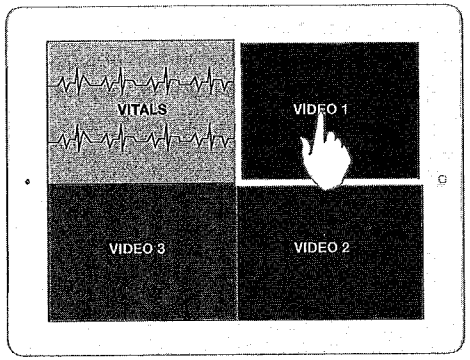


FIGURE 5

The observer can select which camera angle to enlarge.

foreground (see *Figure 4*). This type of customized educational scaffolding allows for the facilitator to constrain options with or without the learners knowledge to allow personalized focus on particular tasks (Pea, 2009).

5.3 DATA CAPTURING

Active learning, which is in direct opposition to passive learning, is a state in which the desire to learn is triggered through active participation (Bonwell and Eison, 1991). Therefore, the heart of the IDA is in the data capturing component, the active process of converting an observed experience into a form that can be analyzed. Real time video will be transmitted from the simulation scenario documentation cameras directly to the mobile device making it the premiere element in connecting the observer directly with the simulation. This interface provides for engagement through flagging capabilities, interactive checklists, specific profiles, and accessible vitals, granting the observer autonomy to contribute to the overall learning environment thus leading to greater accountability.

In order to effectively balance the potential to overwhelm the observer with the required tasks, the interface applies intuitive gestural affordances to minimize the "cognitive burden" that can arise when a user is forced to step outside of content engagement to address a confusion in using the interface (Turner, 2008). For example, dragging screens for repositioning (see *Figure 5*), pinching inward to minimize, or swiping are all gestures that are inherent affordances within the use of mobile devices.

Throughout a simulation, the observing student will be asked to acknowledge moments within the activity in which the participant met, or did not meet, a particular learning objective. When one of these conditions is observed, the student would select either 'C' for cognitive, 'B' for behavioral, or 'T' for technical event; modeled on the knowledge domains as identified in Bloom's Taxonomy learning theory (Bloom et al., 1956). If students observe a success they would select the corresponding letter and swipe their finger up to indicate success. Likewise a down swipe would indicate a mistake (see *Figure 6*). This gestural movement references known paradigms of thumbs up for success or thumbs down for a deficit. For the beginning observers, the facilitator can opt to

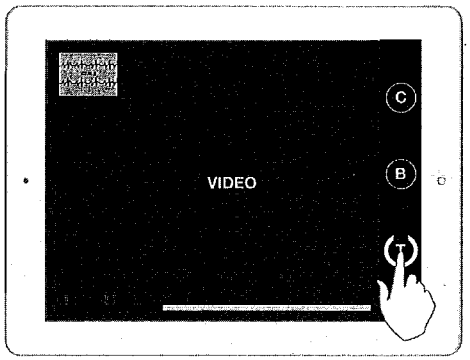


FIGURE 6

Swiping a Technical event upwards to flag a success in the simulation.

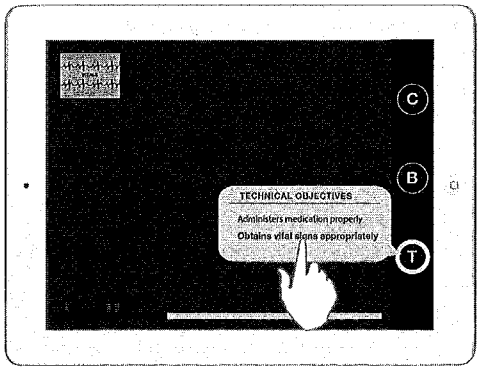


FIGURE 7

Selecting the exact type of Technical event being observed in the simulation.

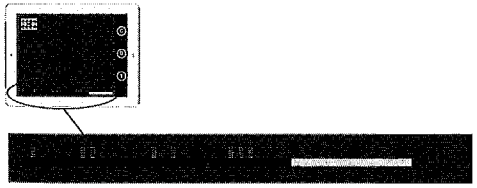


FIGURE 8

Flags above timeline are success while below indicate mistakes.

show titles of specific events (see *Figure 7*) while more advanced observers may be asked to type in what event they are witnessing in accordance with the scaffolding needs of the observer. Students are granted a set amount of time post- simulation in order to review their annotations and flags and add any additional thoughts prior to debriefing.

Upon selecting an event and indicating success or misstep, the timeline at the bottom of the interface will receive either a flag on top of the timeline for an accomplishment or a flag below the timeline indicating a mistake (see *Figure 8*). Each flag is synced directly with the point in the video where the observation was made.

5.4 DEBRIEFING

Interaction with the collected data during the debriefing will take place in three phases: initial reflection, discussion, and final reflection thereby widening the opportunities for student learning.

Initial reflection: Observers will begin with a quick reflection activity in which they submit a written summary of the observed simulation. This information will be available to both the instructor as well as in an anonymous form to the participant(s) who performed the simulation.

Video Discussion: All notated flags will be compiled into a single visual timeline indicating the category of the observation (cognitive, technical, behavioral) through color and the number of instances through size. It will take only a glance to determine exactly where in the simulation an error (or a greater number of errors) were noted by the observers (see *Figure 9*).

Final Reflection: The final stage of the debrief is similar to the first—observers are given a brief time to compose a reflection on the scenario and add in anything new that they learned in their debriefing discussion (Dreifuerst, 2009).

Instructors will have a visual student roster to the right of the main video allowing a one-click projec-

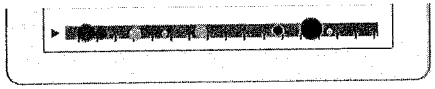


FIGURE 9

Aggregate of all flags across three events; the larger the circle, the more errors that were observed

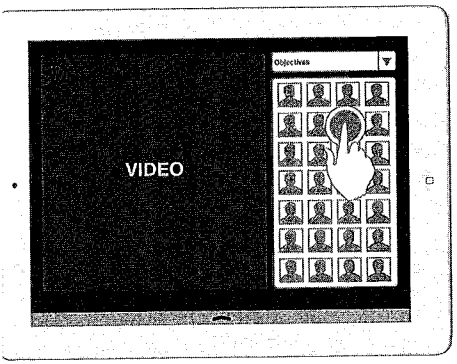


FIGURE 10

Student roster is projected on the right of facilitator's screen

tion of any student screen allowing student to go directly to the point of conversation to for the class to see (see *Figure 10*). All information displayed and submitted within the debriefing session will be archived and accessible via the observers' dashboard in the future.

5.5 DATA VISUALIZATION

The IDA will employ interactive visualizations of all collected data to be delivered to the student via their personal dashboard. The ability for a real-time data-driven assessment interface that can be customized and filtered provides both the learner and facilitator a means of understanding performance across time (Johnson et al., 2014). Students will be able to compare across multiple variables to reveal patterns, isolate concerns, assess outcomes and identify potential patterns and trends. In turn, pattern identification allows the brain to more easily absorb information and transfer knowledge accordingly (Mayer & Sims, 1994).

6. DISCUSSION

To date, simulation debriefing software has focused on the learners performing the simulation. The scenario is developed for *their* engagement with the manikin while subsequent debriefing activities focus on *their* specific actions. Due to high numbers of students enrolled in simulation classrooms and limited resources, students may serve more as observers than actual participants throughout the course of a semester; increasing the need to better develop an experience in which observers can be engaged and their engagement can be measured and assessed.

Digital technology provides the benefit of real-time feedback, a speed of delivery in-line with increased motivation and learning, and advances assessment beyond just post-simulation accountability (Stiggins & Chappuis, 2005). The design of the IDA to organize the learner's simulation history as a visually-driven interface provides better assessment of their learning needs over time. This is a valuable set of information as the perception of low performance from an individual event does not always take into consideration the understanding of knowledge to date, therefore the ability to see performance across time is a constructive comparison (Stiggins & Chappuis, 2005). This aligns with the needs of a learner to be scaffolded through their experiences and witness evidence of success or weakness.

When developing educational software for learning today it is no longer sufficient to simply follow an execution model that concentrates predominately on content access. Technology has developed to a degree in which it can, and should, provide an experience that is cognizant of the learning objectives inherent within the interaction. While there are many similarities between the IDA and known simulation software paradigms, this outcome is unique specifically because it was developed within the context of higher education. We contend that when the goal first and foremost is learning based on theory and practices and led by experts in the fields of educating practitioners, the end result is a product designed to meet the needs of the learner and the educator; including reporting mechanisms and analytics to identify more detailed student learning needs. In reorienting the process of simulation software development from one born from necessity to meet market demand to one that anticipates the needs of the learners, the outcomes of educational software products such as the IDA will fill current gaps in addressing all learners. Designing with this focus on learning will also aid trained facilitators who may be excellently versed in the use of the software but lack the pedagogical background to ensure the transfer of knowledge. A concern that increases as the growing market demand for nurses places more emphasis on the need for simulation education.

The involved design students were placed in their own simulation scenario wherein they were tasked with the practicable objective of applying their newfound research skills and design knowledge towards the development of a strategy for the IDA UX; one in which the interactions of the users were grounded in theoretical knowledge. This required an education on their part as to the relevant theories, which by the very nature of their being current students enrolled in higher education courses, felt familiar yet appeared foreign due to the theoretical terminology. The advantages of first-hand design classroom involvement with both design students and a design educator were many including: 1) ability to empathetically approach the design of a technology-driven tool for student peers who are also active consumers of today's digital culture; 2) rapid prototyping for project partners to quickly illustrate the affordances of the interface in relationship to the theoretical needs; 3) an overall advancement of the suite of tools and interactions to be developed for the IDA, including the addition of the dashboard to display learner analytics in a highly visual format. The next phase of the project will include the construction of the beta with a class of Industrial Engineers and its subsequent testing in a simulation classroom with nursing students continuing to advance the interdisciplinary emphasis of this project.

The inner-working of the interdisciplinary partners was benefited from a certain level of prior experience in past collaborations, however the manners in which these prior partnerships developed echoes the difficulty many design faculty have in identifying successful collaborative teams within the context of a large campus community (Spivey 2015).

And while the project partners were able to meet as needed, class scheduling proved an insurmountable obstacle in allowing the design class to interact directly with the potential IDA users. Rather user interviews were executed through informal gatherings driven by design students with peers enrolled in the nursing program. Software development does not often have to schedule around classes and critiques, however for inter-disciplinary partnerships to filter down into the classroom so that all stakeholders benefit from the interaction, this must be a consideration from the beginning planning stages as curriculum and course schedules are often set months, if not years, in advance.

7. CONCLUSION

Given how technology has affected healthcare simulation education in combination with how quickly digital advancements are eclipsing expectations, it is feasible to anticipate a future in which simulation scenarios are fully capable of allowing the live annotations of the faculty and observers to have an immediate effect on the unfolding scenarios and participant learners. It is also feasible to conceive of partnerships that include experts in the fields of educating practitioners in instructional technology, clinical instruction, complex systems and interaction design. Of course this is not without careful thought and strategic alliances to avoid impetuous partnerships. These are relationships that take time to cultivate, a critical factor for progress and development when working within the transitory nature of technology.

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8

Co-designing for Healthcare: *visual designers as researchers and facilitators*

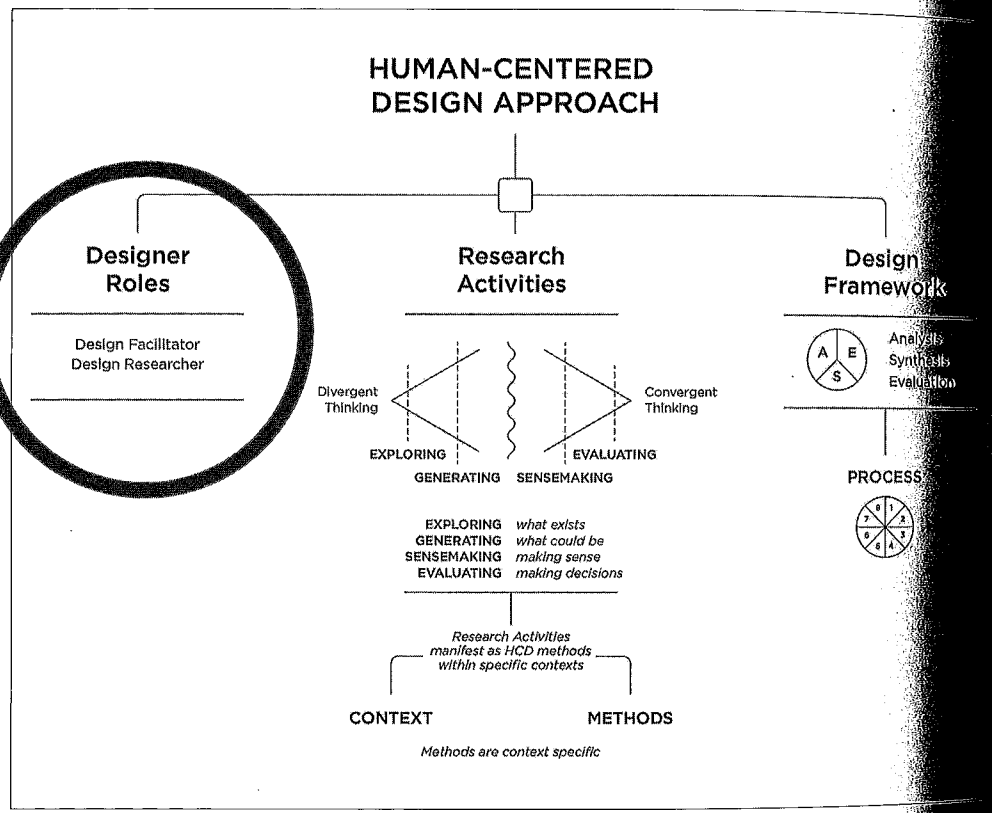
Pamela Napier, Terri Wada

ABSTRACT

This article describes the process, methods, and outcomes of a project that included multiple stakeholders in a participatory design process to re-design an indispensable service in the healthcare sector. The project explores how visual designers are taking on new roles as design researchers and design facilitators and what a human-centered design approach might look like within the healthcare sector of emergency management. Design methods included collaboratively visualizing the complexity of an existing context, including content development, production processes, distribution processes, issues, and perceptions; using generative tools to examine and discuss content, use, form, and function; prototyping toolkits to visually model processes, themes, devices, and technological capabilities; and evaluative surveying to collect and assess user feedback. The outcome of this project includes a completely redesigned product and service that has increased user subscription and satisfaction, as well as suggestions for future implications and improvements.

KEYWORDS

participatory, design research methods, design facilitation, stakeholders



INTRODUCTION

Given the increasing involvement of designers and the utilization of design processes to address broader issues that span beyond the traditional realm of the visual communication design field, this case study serves to provide an example of how visual designers can begin to step into new roles as design facilitators and design researchers.

Through the use of both transferable design skills and visual communication expertise, today's visual designers are uniquely positioned to manage and communicate complexity while enabling effective collaboration across diverse stakeholders within the design process. In this article we will describe our process, experiences, and outcomes of a professional project that included multiple stakeholders—from the clients and their staff, to end-users, to technology facilitators, to an external graphic design team who would give the resulting product an entirely new look and feel. These examples are meant to help illustrate new ways in which visual designers can incorporate a human-centered approach in their practices.

PROJECT OVERVIEW

MESH is a non-profit, public-private partnership that enables healthcare providers to effectively respond to emergency events and remain viable through recovery. Among their many services they offer the "Daily Situational Awareness Brief" (DSAB), a daily digest highlighting important news, research, and practice developments within healthcare sector emergency management as well as MESH publications and events. This service has become a vital part of the everyday rituals of people in healthcare and emergency management, from nurses sharing pertinent information in their daily huddles, to Disaster Management Coordinators presenting information in key meetings. However, several years after its inception, MESH determined that the production process was becoming taxing, the distribution process was in need of an overhaul, and—based on subscriber feedback—the experience of receiving, viewing, and sharing the "brief" could use much improvement.

MESH, in needing to entirely re-think and re-design this valuable service, called upon Collabo Creative, our human-centered service design firm, to conduct an engaging, participatory process that included the following: re-examining current goals and user needs; exploring and defining content, look and feel; envisioning, prototyping, and evaluating distribution venues, devices, and processes; and developing and managing an action plan for implementation. As human-centered designers and design researchers, this brought about the following question: *How might design facilitation and the use of exploratory, generative, sensemaking, and evaluative methods enable diverse groups of stakeholders to collaboratively improve an existing service and product?*

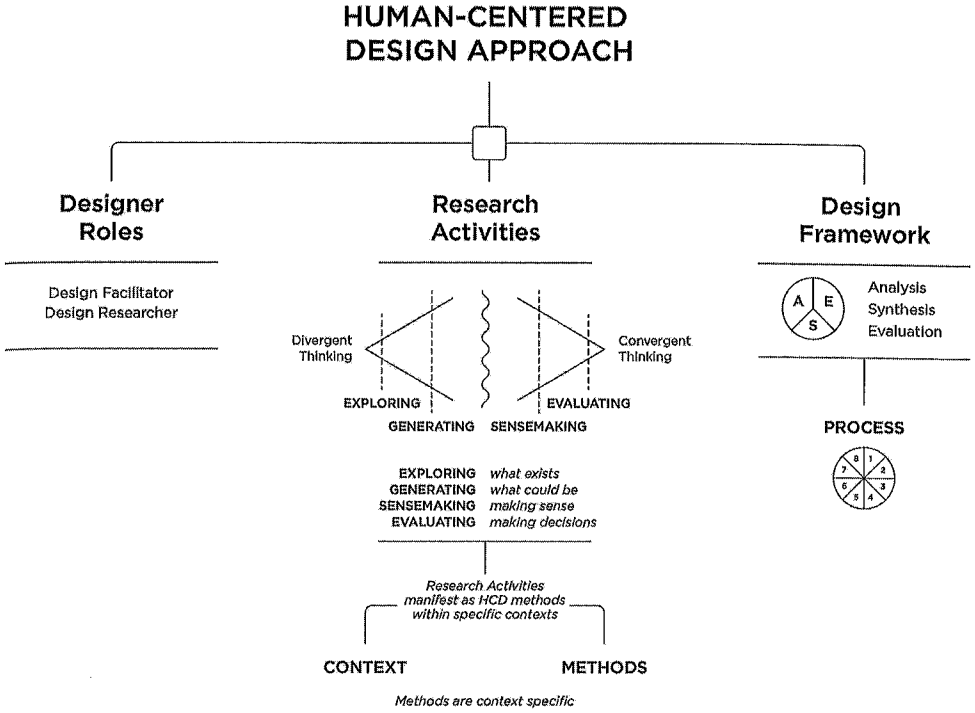


FIGURE 1

Human-Centered Design Approach developed by Collabo Creative

To provide an overview of the entire process through which the redesigning of the DSAB occurred, we began the project by conducting a "preconsult" (Basadur, 1994, p.. 270) meeting with the client. Through this initial meeting the design team was able to develop a research plan based on the specific needs and resources identified by the client. The research plan outlined the need for several rounds of exploratory research that were to include both internal and external stakeholders, along with end-users, or subscribers, in order to gather information about existing situations and current experiences. Through analysis and synthesis of data gathered through exploratory research, *key insights, considerations,* and *areas of focus* were identified and utilized in framing generative research activities to enable client, subject-matter experts (SMEs), graphic designers, and IT implementors to codesign prototypes together.

Once rough prototypes were collaboratively developed in these codesign sessions, the graphic design team was able to seamlessly move toward refinement and implementation of a new DSAB product and service. In subsequent sections, we will describe in further detail each specific step in our process.

PRE-CONSULT

Part of our process when engaging with clients and partners is to set up an initial pre-consult meeting before beginning any project. The content of

these meetings varies depending on the needs of the client/partner, but the meetings are generally intended to establish an understanding of the scale and scope of the project, the current context and problem/opportunity spaces, and initial needs and expectations. With this particular project, because we had previously worked with MESH, an initial introduction to the project was discussed over the phone. The pre-consult was then designed to be a meeting with a few of the key project team members at MESH in order to assess the current context of the DSAB, including current content, production processes, distribution processes, issues, and perceptions.

We facilitated the pre-consult meeting by first allowing the MESH team to identify the main purpose and goals of the DSAB service as well as key users and contributors. The team was able to engage in a discussion while we captured their thoughts on whiteboards. Once the current context of the DSAB was defined, the team members then began to list key issues and concerns they had with the brief from an internal perspective. Some of the main concerns identified by MESH had to do with subscription and sponsorship; MESH offers a valuable service that is paid for by the city, and it is difficult to manage subscription and distribution in MESH's current system. There were concerns raised around "turf issues" over the ownership of knowledge and the amount of time it takes to navigate those issues. The team also expressed struggles with the time and involvement of the collection and creation of content, as well as logistical capabilities for distribution.

Once all of the key internal issues were identified, we then had the team verbally explain the processes for content development, production, and distribution, while we visually captured and made sense of the processes in real time on white boards.

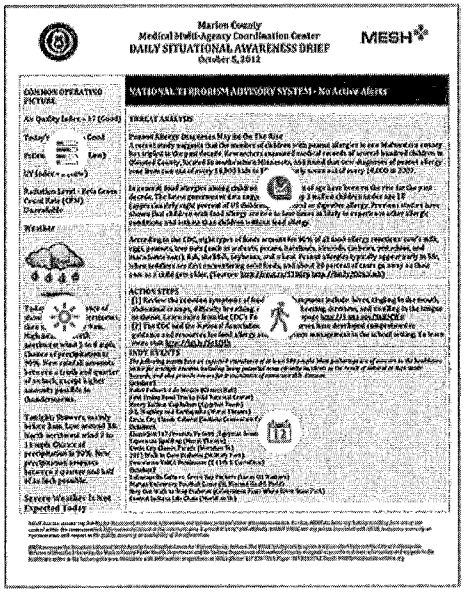


FIGURE 2

Content Areas

CURRENT CONTENT

There are 5 main areas of content within the DSAB: topic/threat analysis, common operating picture, weather, action steps, and events. While most everything can be automated (excluding the threat analysis and action steps), someone within MESH must be designated every day to pull content from various bookmarked websites, including links and icons. And because there is no central location/site to find current events happening in the city, multiple sites have to be visited to find the most current events approved by the city, which makes this is the most time consuming content area

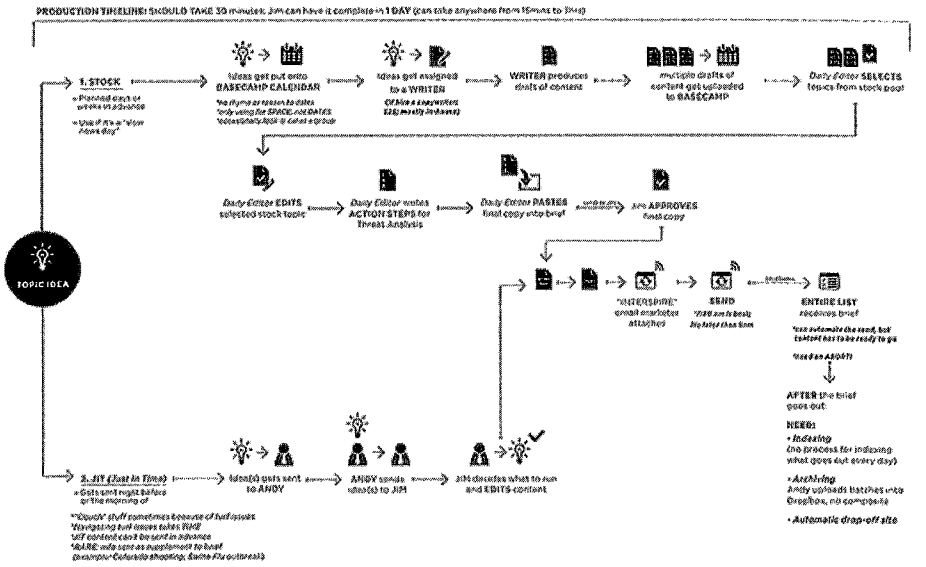


FIGURE 3

Current Production Process

to populate. Formally, from MESH's perspective, the "National Terrorism Advisory System" seldom changes, and takes up valuable landscape within the page.

CURRENT PRODUCTION PROCESS

The current production of the DSAB always starts first with the topic idea, with two different routes the content can take: "Just-in-time," or JIT which gets sent the night before the brief goes out and "Stock," which is planned days or weeks in advance, and can be used if it is a "slow news day." However, each route poses different but significant issues. With the JIT content, navigating "turf issues" takes time, and sometimes, while it may be pertinent, the content has to be "couched" due to those issues. In addition, this particular content cannot be sent in advance. In regards to Stock content, while the mechanism for storing the content is housed in a calendar in Basecamp (a web-based project-management tool), there is no rhyme or reason to where or how the content gets placed within the calendar. With one of MESH's staff members acting as the primary daily editor and content director, the production timeline can take anywhere from 15 minutes to 3 hours, and no more than 1 day to be complete and ready to be sent.

CURRENT DISTRIBUTION PROCESS

There are three main functioning parts to the distribution of the DSAB: Sign-up, Email, and Fax. While people can sign up for the brief by either emailing someone at MESH, or completing the marketing form on MESH's website

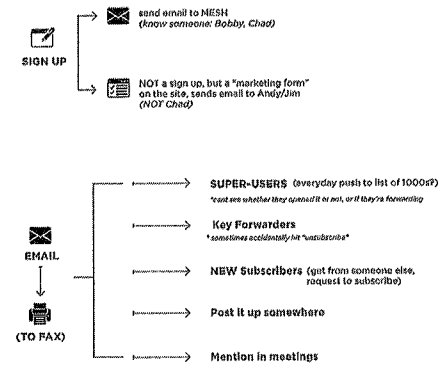


FIGURE 4

Current Distribution Process

homepage, there is no consistent way to tell people how to sign up for the brief, nor are there parameters for subscription to the brief. And, because the DSAB is paid for by the city, there is the need to be selective in subscription; many people who receive the brief are considered "Super-users" who push the brief out daily to their own personal networks of 100's to 1,000's of others. In addition to forwarding the brief, many key constituents who do not have work email or everyday access, are receiving the content by in-person visual or verbal forms (such as being told about a specific event or threat in a daily meeting or reading a printed version of the brief that is posted to work bulletin boards).

The pre-consult enabled us to understand the current context around the DSAB, as well as MESH's own internal issues and concerns with the development and distribution processes for the brief. However, this was only the internal perspective. In order to gain a holistic understanding of perceptions, usage and issues, we needed to collect the voices of the key stakeholders and users of the brief.

PARTICIPATORY STAKEHOLDER RESEARCH

Recruitment of participants can sometimes be an arduous task; knowing where and how to elicit participation takes time and must be carefully considered when developing a timeline for a project. Based on recruitment challenges experienced in previous projects, we chose to rely on the MESH team to tap into their networks and communicate to others how valuable their participation, ideas, and feedback would be. Working from our suggestion for a wide sampling of user types based on background and use, MESH then crafted messages, both verbal and written, to recruit a diverse collection of key stakeholders and users to participate in one of two sessions that would allow them to share how they felt about the brief, how they use it, and why they use it the way they do. This strategy of capitalizing on existing provider-user relationships proved promising, while still remaining unbiased as MESH staff were not present during the sessions, and participant data expressions remained anonymous. These "Participatory Stakeholder Sessions" were designed to enable actual users to externalize their behaviors and interactions with the DSAB on a daily basis, and express underlying wants and needs in the reshaping of content, format, and usability.

PARTICIPATORY STAKEHOLDER SESSION 1

The first Participatory Stakeholder Session was held in one of Indianapolis' hospitals and included key stakeholders such as ER Managers, Nursing Students, the Director of Ambulatory Services, Disaster Management Coordinators, Security Department Managers, and an Operational Coordinator/Respiratory Therapist. The goal of this session was to enable the group members to share and discuss how they use the DSAB in their daily lives. Why did they choose to forward it or not? How do they rank its usefulness? Why do they use it the way they do? What are things that are most and least valuable to them? What would they change or keep the same?

For this first session, we focused on the development of divergent thinking, "Generative" methods, enabling participants to explore "what could be." We created templates on large post-it easel pads with pre-written questions and hung them up in the space. We facilitated the participants through each question, allowing them to first share their thoughts and opinions individually. Then we gave participants 2 different colors of post-its and had them walk around the room and read what they each had written, giving them the opportunity to reinforce and build off each other's comments. They used red post-its to write down what they did not like and green post-its to write down what they did like.

The mix of people gave us a range of perspectives and allowed the participants to identify where their ideas and concerns either overlapped or opposed one another's. They were eager to share their opinions about both the formal aspects of the brief, as well as the functional qualities.

PARTICIPATORY STAKEHOLDER SESSION 2

The second Participatory Stakeholder Session was held at MESH's headquarters and included stakeholders such as Nurse Program Managers, a Medical Manager for a local hospital's Library, an Educator and Researcher, and the Director of the Indiana Intelligence Fusion Center.

While the goals for this session were the same, this particular group of stakeholders was more eager and willing to engage in conversation about the future of the DSAB, especially in considering both form and included/desired content. There were repeated concerns with the amount of content and how the content is being represented. Most stakeholders in both sessions valued the length and the 1-page format, though they had many suggestions for how to make it more engaging through the use of visuals.

Once the sessions were completed, we needed to go through a process of analysis and synthesis in order to make sense of the large amount of data that was collected and to inform the types of methods that would be appropriate for the Ideation and Prototyping phase.

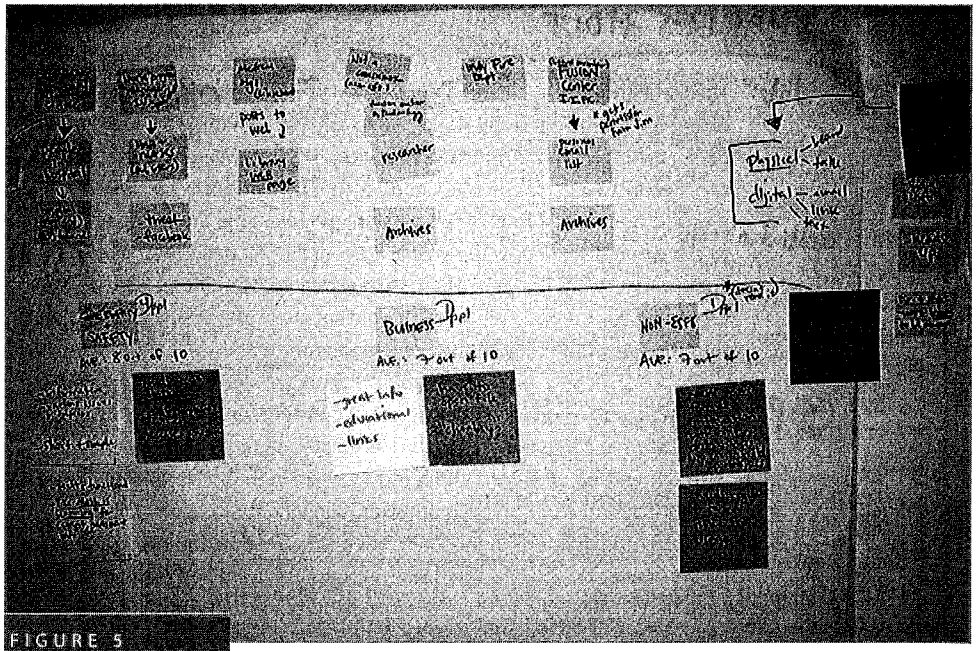


FIGURE 5

Affinity Diagraming in progress

ANALYSIS & SYNTHESIS OF DATA

In order to analyze the collected data, we utilized more convergent thinking "Sensemaking" methods. We began by externalizing the information collected from the templates onto color-coded post-its and large sheets of butcher paper. Through affinity clustering, a sensemaking method, which allows organic patterns or themes to define the clusters or categories that emerge, (Martin & Hanington, 2012, pp.12-13) we were able to define four categories of subscribers/users, as well as understand and articulate their behaviors and their values.

TARGETED SUBSCRIBERS AND THEIR BEHAVIORS

The current targeted subscriber profiles resulted in four main groups: Health Care (Medical) which included doctors and nurses, public health, venues of care, emergency healthcare coalitions; Health Care (Admin/Non- Medical) which included healthcare and hospital administrators; Emergency & Safety, which included public safety; and Non- ESF8 (Emergency Support Function (ESF) #8 – Public Health and Medical Services) which included a technology researcher, non-healthcare individuals, event venues, NGO's, and government agencies.

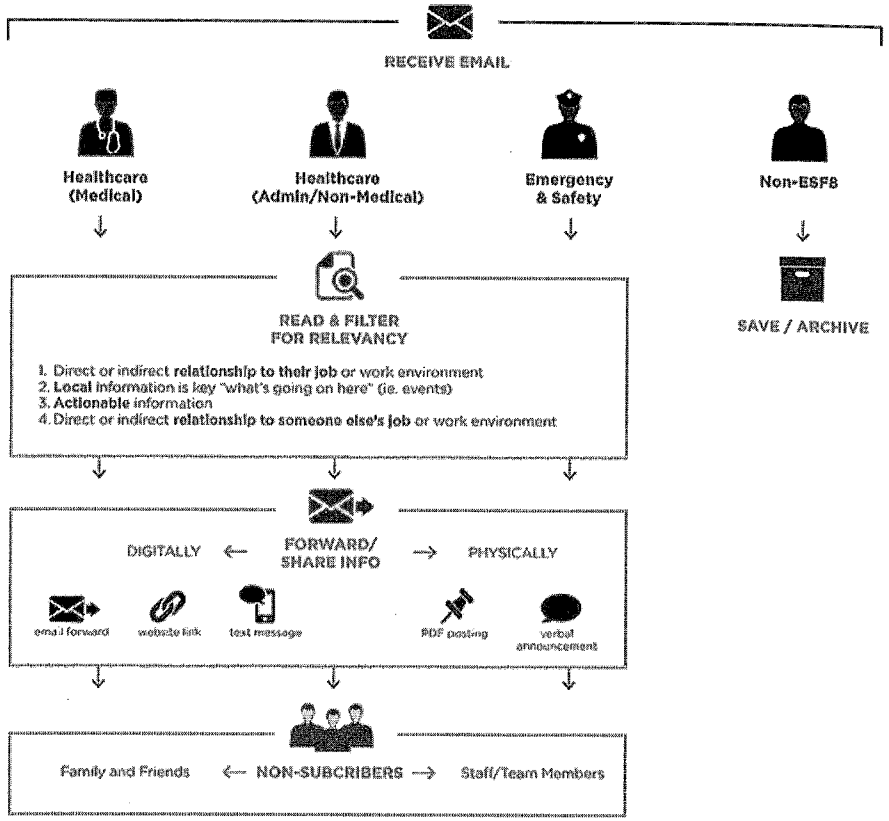


FIGURE 6

Subscriber Behaviors

Within the targeted subscriber groups, we continued to sensemake through building *user journey maps* (Kumar, 2012, p.182) for each group. By mapping each group's user journey, we were able to identify a pattern of use that emerged across the subscriber groups in how they utilized the DSAB. The findings showed that a typical user first received the brief by email, second read and filtered the information based on personal relevancy, and third forwarded the information (either digitally or physically) to non-subscribers they felt would benefit from the content.

KEY INSIGHTS

Through insight sorting (Kumar, 2012, pp. 140-141) of all the information that was collected from the two Participatory Stakeholder Sessions, three key insights about subscribers' behaviors and values were identified:

1. Nearly all subscribers forwarded and shared the information from the DSAB in some way, shape, or form.

2. Subscribers were highly interested and motivated to action by discipline-relevant information.

3. Subscribers want to know about what is happening locally.

OVERALL REDESIGN CONSIDERATIONS & AREAS OF FOCUS

Once all external user data had been analyzed, these findings were then compared to and synthesized with the internal findings from the earlier pre-consult session. A rough form of the design principles generation method (Kumar, 2012, pp.188-189) was used to identify redesign needs based on both internal processes of MESH, along with those identified by key stakeholders. The outcome of this method points to two main facets for consideration in the redesign of the DSAB which were engageability and accessibility.

A concern for the DSAB's engageability came about mainly from subscriber perspectives, while accessibility was important for both MESH and subscribers groups. In order to focus the design team's efforts in moving forward, MESH was asked to identify a few main areas for Collabo to address. These areas were: Functions, Format/Layout, and Distribution. These focus areas were then used to frame and shape the activities developed for the following prototyping sessions.

IDEATION AND PROTOTYPING

Once the key insights and areas of focus were determined, we were able to frame a challenge to take into the ideation phase. We wanted to know "How might we make it easy for subscribers to forward/relay/share information (physically and digitally)?"

In this phase of the project, we needed to utilize more divergent thinking, and therefore focused our method development within the "Exploratory" category. Methods for this phase needed to enable participants, both MESH staff and the key stakeholders, to come up with ideas for "what the DSAB *could* be."

IDEATION AND PROTOTYPING SESSION 1

The goal of the first Ideation and Prototyping session was to specifically work with MESH to first determine how they might categorize the DSAB content, how to make it easy for subscribers to share information, and how to visually model both the form and function of the DSAB.

We began having members of the MESH team diverge on existing and possible content, individually writing down topics on index cards. They spread the cards out on a large table and began to sort and categorize the content, looking for larger groupings and overlaps.

Different colored cards were used to sort and code the content, to signify overarching categories and topics that fit within them.

Once the content was categorized, we moved into another divergent activity, utilizing another Exploratory method. The team was given the question, "How might we make it easy for subscribers to forward/relay/share information (physically and digitally)?," which facilitated a more traditional brainstorming activity. The MESH team said their ideas aloud while we captured on the whiteboard.

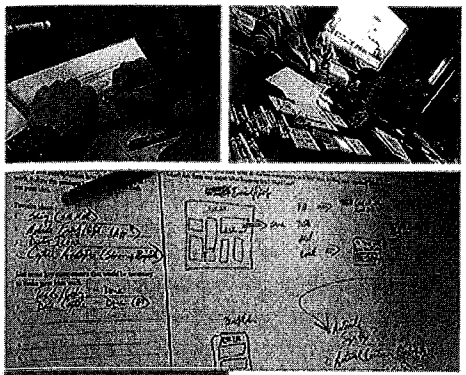


FIGURE 7

Participants prototyping

The intentional scaffolding of activities led to the final Exploratory method, which was intended to give participants the tools to begin to visually model both the form and function of the DSAB. We developed worksheets that first prompted participants to diverge on key components of both form and function in a list form. Once they had a list of ideas to pull from, they began to sketch and label those key components, how key components worked together, and their functioning processes.

By going through this series of activities, we were able to gain an understanding of the types of content that are both desired and used, and of key components for the DSAB's form and functions from MESH's internal perspective.

IDEATION AND PROTOTYPING SESSION 2

Once the internal team at MESH was able to share and define its most important needs and desires regarding the form and function of the DSAB, it was time to bring together all of the constituents that would be making decisions throughout the process. This included key players from MESH, a design firm that would be doing the graphic design of the final product, and two representatives from Crown, the partner of digital messaging firm ExactTarget.

The second prototyping session was intended to develop and define processes, themes, and devices using tailored "Protokits." The Protokits were created by utilizing the ideas and prototypes generated by MESH in the previous session so that the new prototypes would be more refined, integrating the feedback from both the graphic design and technology sides. Having each group at the table enabled them to collaborate around the format and layout of the DSAB, while also allowing the opportunity to discover capabilities and limitations of the functionality.

The Protokits could be viewed as being both a Generating and Evaluating method. They included blank canvases to visualize the format and layout, as well as multiple options for buttons, icons, and

content to be included. Both the MESH and the graphic design team were purposely integrated, and they worked together to create prototypes based on MESH's needs and the design team's visual communication expertise. Once the new prototypes were created, members from the Crown team joined the session remotely. The MESH/design teams talked through their prototypes, while the team from Crown offered feedback based on its technical capabilities.

This session enabled the graphic design team, who would be implementing the final layout and format of the brief, to listen to and integrate the needs from MESH, as well as the capabilities on Crown's side, and synthesize the two into refined prototypes that could accommodate both.

UTCOMES, IMPLEMENTATION AND UTURE RESEARCH NEEDS

The outcomes from the stakeholder and prototyping sessions resulted in refined prototypes of the DSAB that not only incorporated the desired content, format, and function from MESH and the users but also the technical capabilities from Crown's side. This provided the graphic design team a holistic understanding of how to design an appropriate and meaningful solution.

An unexpected challenge that we discovered through working with outside constituents was the inability to control their working processes and timelines. We developed specific checkpoints throughout the development of the final solution, where the graphic design team was able to present their iterations to MESH in order to receive feedback. However, we did not anticipate the shortcomings of the graphic design team; there were missed deadlines, challenges with consistent and timely communication, and longer than projected turn-arounds for revisions. While we tried to mitigate these obstacles for MESH, it was difficult to ensure a seamless transfer of responsibility of the product.

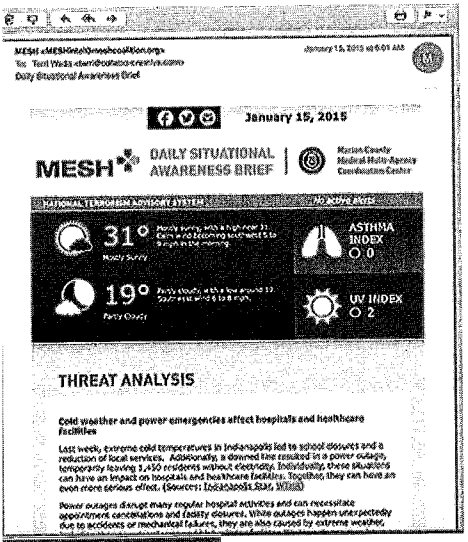


FIGURE 8

inal DSAB product

The graphic design team continued to iterate on the form and layout of the DSAB and worked directly with MESH and Crown to refine those iterations until they reached the desired result: a dynamic, responsive, highly visual product that was co-designed by the client, the users, and the team of implementors.

Once the new product was launched, we developed "Evaluative" methods in the form of surveys that were sent to users to collect feedback on the new format, layout, and functional qualities.

These surveys enabled the graphic design team to create a new and final iteration.

Though the focus was on creating an html email, there were needs expressed throughout the process for a more intuitive integration into MESH's website in regards to how subscribers sign up for and access the brief. This insight led to an understanding that there would need to be future research into how to filter subscribers, subscriber access through the site, and the development of a dynamic social/community piece.

CONCLUSION

The results of this project have led to increased user subscription and satisfaction, and an easier, more efficient process for content development and distribution of the Daily Situational Awareness Brief for the MESH staff.

This particular project showcases the value of utilizing a human-centered design approach and how the development and facilitation of Exploratory, Generative, Sensemaking and Evaluative design research methods can enable a diverse group of stakeholders to collaboratively and creatively solve problems. The approach, process and methods used in this project can serve as an example for not only how people within the healthcare sector can think about approaching problem-solving but also for how visual designers can incorporate a human-centered approach into their practices.

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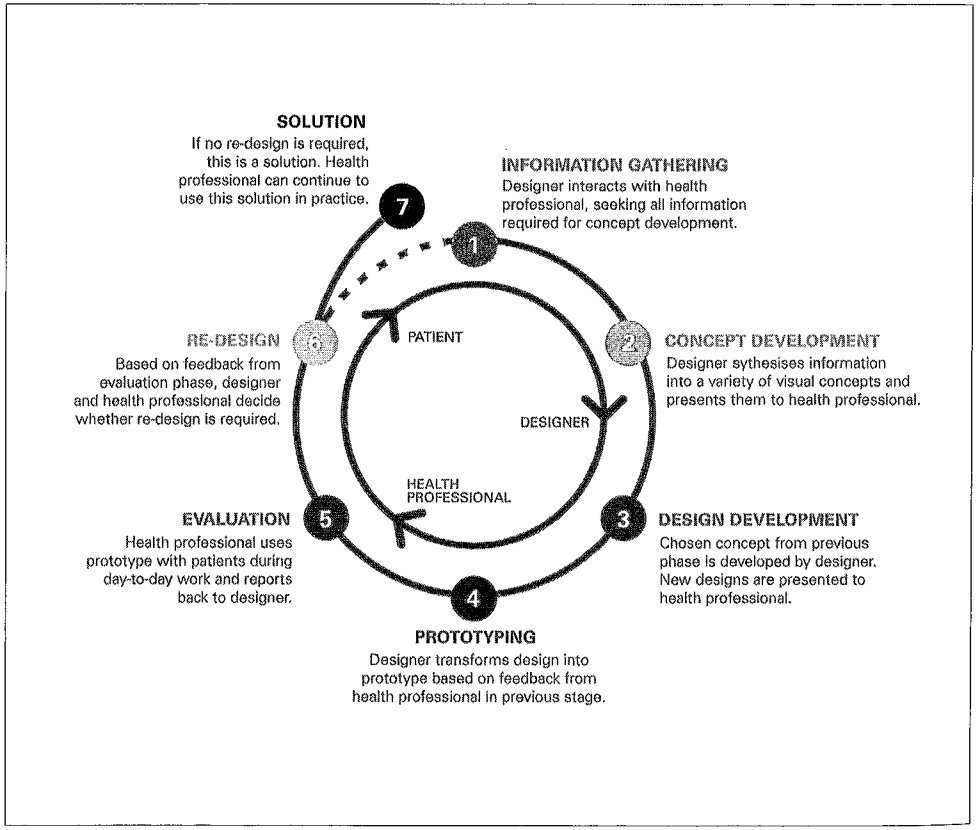


9 Design to Improve the Health Education Experience: *using participatory design methods in hospitals with clinicians and patients*

Belinda Paulovich
Charles Sturt University

ABSTRACT

Poor communication in health is a persistent problem. Transient conversations, extreme time constraints, stress, trauma, clinical factors and the restrictive environment make effective communication between health professionals and patients difficult to achieve. Children, especially, are often positioned as passive participants in the healthcare paradigm. It is hypothesized that providing children with visual health information (well-designed, accurate, age appropriate, and presented in a way that they can understand,) can empower them to take charge of their health and well-being. For visual health education materials to be effective, accurate, and engaging, they need to be designed with input from design practitioners, health experts, and the target audience. However, constraints within the health field, such as restricted access to patients, make this difficult. Furthermore, when children are involved, ethical and practical obstacles can hinder the process. The research presented in this paper navigates the complexities of the health field and presents a realistic participatory design model that responds to the specific challenges associated with designing in a healthcare environment. The efficacy of the approach is demonstrated through successful designs and positive health professional feedback.

KEYWORDS

health communication, health education, participatory design, qualitative research, user-centered design

INTRODUCTION

Graphics are not generally seen by health authorities as the primary way of communicating information to children (Dowse, 2004), yet it has been shown that picture-based messages are preferred by most people (the "picture superiority effect") (Dowse, 2004; Katz, Kripalani, & Weiss, 2006; Lidwell, Holden, & Butler, 2003). As well as being more accessible, visual materials that are distributed to patients are a permanent source of information (Dowse, 2004; Groves & Fitzgerald, 2010). They can be referred to in the patient's own time, making them less transient than face-to-face verbal communication. The material can be viewed and comprehended at a pace dictated by the patient (Klug Redman, 1993; Purtilo & Haddad, 2002), rather than received by verbal communication which must often be comprehended within time constraints.

The literature surrounding visual communication design for children is sparse, with the majority of studies being market-research oriented and commercially driven. While it is important to understand the target audience and their motives, greater importance should be given to children's comprehension of vital health information. It has been demonstrated that young patients are less anxious if they are told what is going to happen to them clearly and honestly. They find it useful to know the order of events (Lloyd & Bor, 2009, 112) and are more interested in concrete information on current experiences rather than possible consequences in the distant future (Rapoza, 2003, 260).

It may be argued that children lack the maturity to understand complex health information. Children may be perceived as lacking the knowledge and experience needed to make informed choices (Buckingham, 2011). Furthermore, issues such as low health literacy and age-related cognitive abilities may impact children's comprehension of presented information (Terre, 2009). There are also several psychosocial factors specific to children that may affect their healthcare experience. For instance, child patients are dependent on a parent or guardian in relation to medical care and decision making. This lack of power positions child patients as passive bystanders in the healthcare paradigm (Lambert, Glacken & McCarron, 2010). In addition, the culturally defined power dichotomy that exists between patients and health professionals adds to the passive positioning of the patient. However, by making health information available and accessible, we can empower child patients to take control of their own health, giving them a sense of independence and competence which may foster better health outcomes and psychosocial well-being. Working with children to increase their understanding positions them as active participants in the education process (Lambert, Glacken & McCarron, 2010).

Participatory and user-centered design methodologies can be implemented across health settings to generate site-specific, end-user focused, and holistically informed education materials.

User-centered design considers the subjective experience of end-users (patients and health professionals) and is able to identify a purpose for the design. Participatory design involves these end-users in the design process to create products, services, and designs that are user-friendly. The project that will be discussed in this paper straddles the boundaries of both user-centered and participatory design. It is user-centered design because it is design for child patients and health professionals as users (Ryan & LaBat, 2009), and it is participatory designed because the author works with health professionals in a collaborative manner to build a picture of the patient experience to inform design outcomes (Ryan & LaBat, 2009). It is best positioned as a participatory design approach that contributes to a user-centered outcome. This paper puts forward a participatory design model specific to pediatric health that is not currently presented in design or health literature.

RESEARCH DESIGN

A multiple case-study approach was employed to gain a comprehensive understanding of health professional and patient interaction with designed materials in a real-life context. This reflects the need to examine complex social phenomena whilst preserving the interwoven variables that arise in real life (Yin, 2009, 4). Three qualitative case studies were conducted within the pediatric areas of Rehabilitation, Gastroenterology, and Asthma, informed by the methodological principles and methods of ethnography and grounded theory. Qualitative approaches unite the research with reality (Barach & Johnson, 2008, 192), while the inclusion of multiple cases offers diversity, variation, and a number of perspectives, helping to diminish the danger of developing a biased point of view (Stern & Porr, 2011, 51).

Throughout each case study, the author collaborated with health professionals to produce design prototypes that were trialed in patient education sessions in an Australian public hospital. The goal for these prototypes was to attempt to break down the power dichotomy between patient and health professional and to move patients away from the sick role and passive bystander position by making health information available, accessible and engaging. Furthermore, we wanted to distill the most successful aspects of this process into a model that other health professionals and designers could implement in their own practices. The case studies consisted of three core phases: collaboration, prototyping, and evaluation. Collaboration involved working with health professionals and exploring ideas for design prototypes. This was a practical, collaborative, and reflexive process aiming to understand and improve collaborative design practice in the field of health (Kemmis & McTaggart, 2005, 566-567). In-depth, semi-structured interviews were conducted focusing on information that could be better communicated to patients and identifying tasks that the end-users (both health professionals and patients) were required to perform. Over the course of the case studies, 15 digitally recorded in-depth

interviews took place ranging in length from 30 to 60 minutes.

Prototyping involved the development of design concepts. The initial visual concepts were developed by the author and were reviewed at regular intervals by the health professionals involved to ensure that the concepts were appropriate, accurate and clinically relevant. During this project, prototyping was used to evaluate the developing design and to elicit health professional perspectives as the design evolved. The prototype and review cycle continued until a design prototype was resolved and produced. Visual milestones were recorded to document the prototype development journey from concept to completion. Rather than providing only a hypothetical solution, this research is translated into design practice with tangible visual results.

Evaluation was initially ethnographic and involved observation of health professional-patient interaction with the design prototype during an education session. An interview was conducted with the patient directly after the session. The health professional was to be interviewed upon completion of the case study, as it is important to note that usability of the design prototype applies not only to patients but to other end-users and stakeholders (Ryan & LaBat, 2009). However, after one patient observation and interview, it became clear that the research design would not work long term. The author's experience was that gaining objective information from the patient was extremely difficult and this likely would have been the case with subsequent interviews. Furthermore, recruiting suitable patients and gaining informed consent was a time-consuming process for all involved, and this may have become excessive if we were to recruit more patients. As the appearance of patients and their parents could not be predicted or managed, this process involved a level of coordination on the part of the health professionals that the author felt was unethical.

Instead of working directly with patients, the author decided that working directly with health professionals (the people who have the greatest insight into patient comprehension) was the most suitable alternative. They work with these patients over the course of days, weeks, or months. They can obtain a sense of how well the patients understand the health material presented, and they are able to keep a record of this information. While user-centred design methodologies advocate working with all user groups directly, in this case patient-designer interaction was omitted from the research design in favour of health professional-patient interaction due to the ethical and practical restrictions imposed by the field. Designer-patient interaction was not required in this instance because the information needed to generate prototype content and design could be extracted from the health professionals, the health professionals could provide in-depth insight into patient education needs, and the health professionals could evaluate the resulting designs with patients on behalf of the designer.

The amended evaluation method involved providing the health professionals with copies of the design prototypes to use

as they would any other educational device in their day-to-day work. The only restriction was that they had to be used with patients rather than staff, students and the general public. The health professionals had full control over how often they used the design prototypes and which patients they used them with. A checklist was stored with the design prototypes and the health professionals were required to complete this after each use. The checklist requested the perceived level of patient understanding, as well as any comments that may have impacted the patient's comprehension ability (for example, this is the patient's first presentation, the patient has been using the design prototype at home, the patient is agitated).

The amended evaluation phase departed from ethnography but sought to maintain ethnography's methodological principle of naturalism whereby people's behavior is studied in an everyday setting rather than under experimental conditions set-up by the author. This amendment recognized that the author's presence would affect the study setting and results (Allen, 2010). Allowing the health professionals to use and evaluate the prototypes assisted in gaining a true representation of how the materials would typically be used in the field and would be more likely to elicit genuine responses from patients. Surveys, questionnaires, and the presence of an unfamiliar researcher, on the other hand, could disrupt the care paradigm and generate false data. This approach also aligned better with the case-study method where research is constructed out of naturallyoccurring situations, unlike the manipulation and control of variables that occurs in experimental research (O'Reilly, 2009).

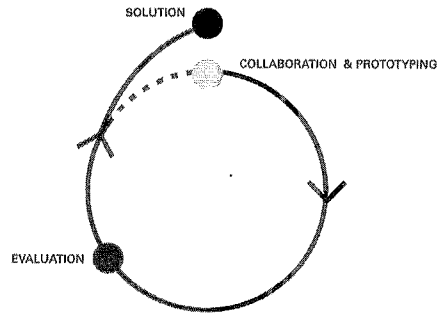


FIGURE 1:
Case Study Structure

Structuring the case studies as shown in *Figure 1* and utilizing the health professional as the evaluator solved a number of patient access issues. First the health professionals had access to patients that the author did not, such as non-English speakers, non-verbal patients, patients with guardianship issues, critical and acute patients, and inpatients and outpatients. Additionally, the health professionals did not have to organize times for the author to come in to speak to parents and times to come back to conduct the observations and interviews. The health professionals were able to implement the design prototypes at the patient's first presentation and to monitor usage at follow-up appointments, whereas the author could not due to having to gain informed consent after the patient had first presented.

THEORETICAL PARTICIPATORY DESIGN MODEL

Constraints within the health environment and the research experience informed the development of a participatory design model that facilitates interaction between designer, health professional, patient, designed object, and environment. The *3-Corner Collaborative Design Model (Figure 2)* was developed by the author and is a framework for creating highly effective, audience-specific, patient education materials. It is a synthesis of two different phenomena: the design process (outer circle) and designer and end-user interactions (inner circle).

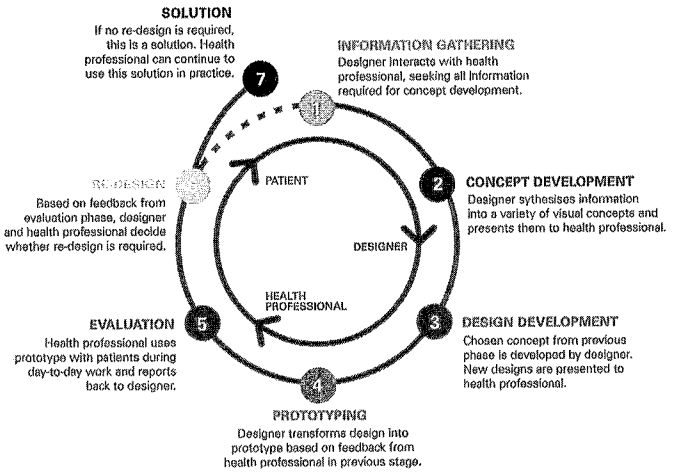


FIGURE 2

The 3-Corner Collaborative Design Model

The design process is based on a synthesis of existing design models and the author's experience of designing throughout this project. It is specifically informed by the iterative nature of the *Communication Research Institute Design Process Model* developed by David Sless (Sless, 2008, 52). The research design ultimately shaped the way in which the participatory design process unfolded over the course of the three case studies, with collaboration, prototyping, and evaluation the core components (see *Figure 1*). Figure 2 breaks down the case study model stages into smaller, critical areas beginning with information gathering. While the process is presented in a cyclical form with each step progressing logically backtracking often occurs in practice. Constant self-reflection by the designer, recognizing when problems occur with the design, or revealing new information that wasn't mentioned in the earlier stages, mean that adjustments to the process are made as needed.

The evaluation stage of the model is critical as the feedback provided by patients and health professionals guides the design process. At this stage the health professionals report back to the designer about the efficacy of their education. The efficacy of the design needs to be distilled and extracted from this information. In this project the author asked the health professionals a set of interview questions about the designs as shown in Figure 3.

1. Is there a type of patient that responds particularly well / poorly to this prototype? Why do you think that is the case? Patients may be discussed in terms of age, gender, clinical background, native language, etc.
2. How do patients indicate that they have understood / not understood the material?
3. Have any patients provided feedback about the prototype? What was it?
4. What impact has the prototype has on your education technique/ experience? Has the prototype had a positive/negative impact on your practice?
5. Do you think this prototype has longevity? How long do you think you will continue to use it? How can the life of the prototype be extended?
6. What were the most positive aspects of the prototype?
7. Were there any problems with the prototype? What were they? How can they be overcome? Are changes to the design required?

FIGURE 3

Interview Questions

These questions helped extract focused, specific information from the health professionals which could be used to determine the strengths and weaknesses of the designs and to identify our next course of action.

At the re-design stage the designer and health professionals need to decide whether the design prototype can continue to be used in the health field in its current form. The critical questions are as follows: Have we arrived at a suitable solution? Can the prototype be improved? Does the prototype meet its objective of effective communication and education of the target audience? If not, what can we do to make it better? If re-design is required, then the designer and health professional restart the process at the information gathering phase. If re-design is not required, then the cycle ends at the solution stage.

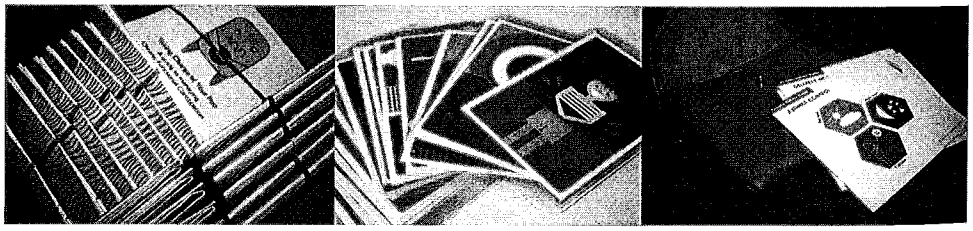
Built into the earlier stages of the *3-Corner Collaborative Design Model* are ethnographic principles. During the first four stages (but especially during information gathering), the designer regularly visits the environment to observe and interact with health staff. Designers using this model in the future should adopt an ethnographic approach, regularly visiting the health field to gather information, interact with health professionals, and immerse themselves in the hospital environment. This is critical because the interactions between designer and health professional that take place over time allow an understanding of each other's culture to be developed. These ethnographic interactions create a holistic, interdependent design approach that is highly effective in generating site-specific, user-centered designs. However, during the evaluation phase, the designers should consider whether their presence in the field might alter the normal health environment, leading to inaccurate responses. If this is likely, leaving the field and allowing the health professionals to assume the evaluator role by using the design prototype in their day-to-day practice is a good compromise. This is described as an anti-interventionist approach, which minimizes disruption to the normal healthcare paradigm. The health professionals relay patient feedback, as well as their personal feedback about using the design prototype to the designer at the re-design phase. The nature of this feedback ultimately determines whether any design amendments are required.

The designer and end-user interactions that take place over the course of the design process shape the design outcomes and are an example of the interdependent nature of participatory design. The fact that the designer regularly interacts with health professionals (who are end-users in their own right) to achieve design solutions, makes this a user-centered approach. Patients remain subjects rather than a participants or collaborators, but their views as an end-users are gauged by the health professionals during practice. This is described as a 3-cornered approach where designer and health professional interact, health professional and patient interact, and patient and designer interact indirectly using the health professional as an intermediary, as shown in *Figure 2*. In this particular scenario, the designer depends on the health professional and the patients to obtain the information the designer needs to complete the project, generate meaningful data and produce the required solution. The health professional and the patients depend on the designer to deliver visual materials that facilitate effective patient education. Each party has a different motivation and a different end-goal, but the result is mutually desirable.

The *3-Corner Collaborative Design Model* is beneficial in the development of patient education materials and has demonstrated engagement of staff and patients by taking a participatory design approach. The model is multi-layered, offering both a way to design and a way to source, understand, and integrate the perspectives of end-users. This way of working (participating, designing, evaluating, and re-developing the designs based on feedback) is not always used in the development of patient education materials. While ethnography is a common approach to gaining qualitative data in the health field, and participatory design is becoming more widely accepted in health, there is little documentation of a combined approach for the development of site-specific health education materials. Certainly, the health professionals involved in this study had not encountered this approach. They were working with patient education materials that were generic, text heavy, not always appropriate for their patients, and poorly designed. They were able to see the benefits of the participatory design process in the form of tangible design outcomes that met their needs (as shown in *Figure 4*), demonstrating the validity and value of the *3-Corner Collaborative Design Model*. Furthermore, involving the health professionals in the design process ensured that they were familiar, comfortable, and confident with the content and form of the design prototypes and were able to use them to enhance the way they deliver information to patients.

FIGURE 4

Design prototypes (Gastroenterology, Rehabilitation and Asthma)



In terms of education practice, all of the health professionals found that using the design prototypes assisted several aspects of their education process. Some said that the design prototypes produced these positive outcomes:

- ..... Streamlined the education process
- ..... Allowed them to follow or go through a process (systematisation)
- ..... Acted as an insurance policy by making sure that all of the critical information was covered
- ..... Acted as a prompt (helped them remember the more intricate aspects of their education topic)
- ..... Enabled education to be delivered in layers (if education was interrupted, the design prototype served as a good indicator of where to resume the education session).

Furthermore, the *3-Corner Collaborative Design Model* provided a brief but structured way for the health professionals to think about the way in which they were delivering patient education and sparked reflective practice. One health professional noted that "it has been an interesting exercise actually … [because] it does make [me] think a bit more about [the information] I'm giving them" (Gastroenterology CPC 2013, 30 September). Participating in design activities encouraged the health professionals to question the impact they were having on patient education. Self-reflection most often occurred at the information gathering phase and during reviews of designs at the concept development and design development phases. The *3-Corner Collaborative Design Model* provides an excellent framework within which health professionals can reflect upon and evaluate their educational practices. This shows that the model has major practical benefits beyond the design outcomes.

Levels of patient understanding were gauged by the health professionals and documented on a checklist. Of the 65 patients who interacted with the various prototypes, 37 showed a high level of understanding, 20 showed a mid level, 6 showed a low level and 2 were unable to be classified. While there are some reliability limitations associated with self-reported data, the fact that the majority of patients were positioned in the mid to high level of understanding was encouraging.

DISCUSSION

The *3-Corner Collaborative Design Model* has been created by the author from an ethnographic understanding of healthcare and health education and has been developed in response to the particular limitations of the field. After exploring the potential of including patients as participants in the

design process, we decided against this due to the problems associated with engaging vulnerable and traumatized children in research activities, and the excessive level of coordination required.

The *3-Corner Collaborative Design Model* involves no disruption to patients. However, it does integrate the perspectives of patients indirectly, using the health professional as an evaluator. This model is suitable in situations where accessibility to patient groups is limited and problematic. The evaluation approach is non-invasive and ethically sound which is important in scenarios that involve vulnerable people.

The model can be integrated into everyday healthcare practice which is critical in the health environment as there is often a sense of urgency in terms of time. Health professionals must balance their duty to patients with administrative tasks, staff meetings, and other scheduled events. While participatory design sessions do need to be scheduled with the health professionals involved, these take up relatively little time. In each of these case studies, five formal sessions ranging in length from 30 minutes to one hour were scheduled over the entire process. This approach was designed to cause minimal disruption to the working life of health professionals. Likewise, the process of using health professionals in the evaluation phase to assess patient understanding of the design prototypes has been designed to be convenient. Evaluation was integrated into the health professionals' day-to-day work meaning that there was no additional time outside of working hours required to evaluate the design prototype. The fact that the design prototypes are able to be completed in a short amount of time, and consume very little of the health professionals work time, urges us to explore the impact that this might have on future health education development and practice.

The model helps facilitate a blending of skill sets that are essential to a good design outcome. The ethnographic nature of the model, combined with formal participatory design sessions, allows for exchange and synthesis of both health specific knowledge and design specific skills. The model incorporates designer and health professional input at every stage. Having health professionals review and comment on the designs regularly (at the concept development, design development, prototyping, and re-design phases) is crucial in facilitating this exchange. While the approach taken in this project was to work with a key individual on a one-on-one basis, the model may also work in group situations, though this has yet to be trialed. The merging of health and design knowledge bases is essential in producing design prototypes that are clinically accurate, well-designed, and empowering to patients and health professionals as end-users.

During the course of the case studies, the health professionals explained that the design prototypes allowed them to develop their own education process or system. While it is difficult to quantify, the design prototypes appear to be efficient ways of communicating with patients. Furthermore, the systematic approach to education facilitated by

these design prototypes can be incorporated into existing hospital practices, such as criteria-led discharge. This is a process through which patients can be discharged by a nurse (rather than a doctor) if they meet certain criteria. One component of this is that patients have to receive targeted education. This is where the design prototypes have the potential to be extremely useful. Following the design prototypes ensures that each patient has a consistent quality of education and receives the full breadth of information. So whilst having the ability to streamline the education process, the design prototypes could also assist in facilitating timely patient discharge.

While the *3-Corner Collaborative Design Model* is broadly applicable, it is important to note the limitations of the approach. Most significantly, the lack of direct designer-patient interaction limits the weight of the claim to a user-centered approach. While there were valid reasons for omitting patient-designer interaction from the research design, the approach cannot be defined purely as user-centered in the strictest sense of the term. This research was limited to child and adolescent audiences and to specific health conditions. While we can hypothesize that the design model would work just as well in the production of materials for adult patients and for different health topics, we do not have any data to support this. In many instances, the design prototypes were used to effectively educate parents, which is encouraging. However, further evaluation would need to be conducted with adult patients to confirm this hypothesis. Data collection was conducted solely in South Australia, limiting observation geographically and culturally. While a broad demographic was studied, the design model needs to be trialed more broadly (in other countries, for example) to assess its functionality among a wider socio-geographical audience and to validate the approach.

CONCLUSION

There is a need for health education materials that engage child patients. The literature shows that there are challenges associated with communicating with young people; however, it also demonstrates that children are capable of understanding complex health information if it is presented in an appropriate manner.

This paper has demonstrated that an opportunity exists for communication strategies to be improved within health and medicine which may benefit the wider community by enhancing the delivery of health information. Potential exists to streamline and enrich the way that health education materials are designed. There is capacity for both hospital-employed designers and external designers to work together with health professionals using the theoretical model outlined in this paper. This is a crucial way forward for design and health collaboration which will save time and mistakes. This paper suggests that user-centered and participatory design approaches are appropriate as they consider audience factors such

as poor health literacy, comprehension ability, cultural norms, and age-related cognitive abilities, and they involve end-users in the design process to ensure a relevant result.

Due to limited access to children in health settings, the *3-Corner Collaborative Design Model* employed in these case studies sought information about the needs of child patients from key informants – the professionals who deliver health information to these patients on a day-to-day basis. As well as detailing a participatory design approach to the design of user-centered health education materials, this paper also offers a method for evaluating the impact of such designs. By allowing health professionals to use and evaluate these materials, we are able to gain insight into how they function in the real-world. By evaluating the results we have determined that this is a worthwhile approach to be adopted by others. The next step is to disseminate the model more widely to encourage and facilitate positive change and development through multi-disciplinary design and health collaboration.

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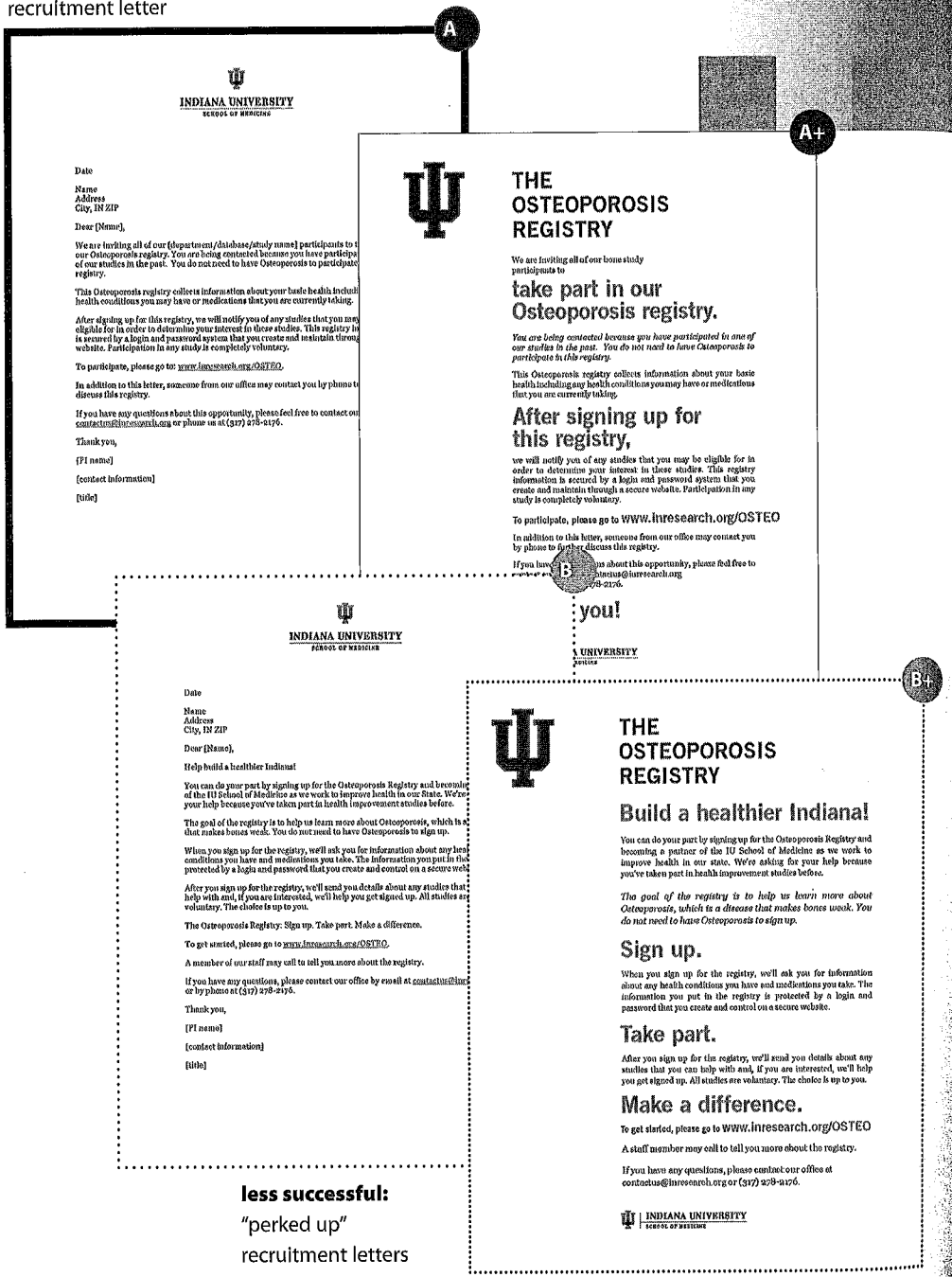
most successful:
conventionally worded
and typeset
recruitment letter



less successful:
"perked up"
recruitment letters

10

Design and Language Impact on Study Volunteerism in Medical Research: *learnings from a controlled study of recruitment letters*

Helen Sanematsu, Brenda Hudson, Amanda Nyhuis, Siu Hui, Paul Dexter

ABSTRACT

Research on human subjects in health and medicine is a necessary part of studies ranging from taking online surveys (less invasive) to taking blood draws (more invasive). Without them, our ability to learn about and improve health is limited. However, recruitment for such studies is difficult. Patient registries aim to speed up scientific advancement by reducing the time and effort spent to recruit participants by maintaining a cadre of ready volunteers. Invitation by mail is an effective route to approach a large number of potential registry volunteers at relatively low cost. Our research question was whether the letter recipients' response (by signing up on the patient registry) to the invitation could be increased by "perking up" the letter content using 1) more motivational language, and 2) enhancing the graphic design of the invitation. We tested four models and sent them out to 10,000 recipients. Our results showed that in this application, a conventionally worded and typeset letter is more effective in recruiting altruistic volunteers than one that uses motivational language or modernist design principles. This has implications for how designers apply their skills in this context.

KEYWORDS

health research, graphic design, study recruitment, applied linguistics, design for volunteerism and altruism

INTRODUCTION

Medical breakthroughs and innovation in public health are dependent on the volunteerism of research participants in order to gather new knowledge about health and health behaviors and validate and make relevant scientific discovery. However, recruitment for such studies is difficult. Patient registries aim to speed up scientific advancement by reducing the time and effort spent in recruiting participants by maintaining a cadre of ready volunteers. Invitation by mail is an efficient way to approach a large number of potential registry volunteers at relatively low cost, but its response rate is low. Our research question was whether we could make a more effective letter by "perking up" the content using 1) enhanced visual communication tactics, and 2) applying "call to action" language. We tested four models sent out to over 5,000 recipients. A classical, two-by-two factorial study design allowed us to test the effectiveness of each factor independently and in combination. Our findings show that overt attempts to appeal to readers both visually and verbally are ineffective and actually decrease the likelihood of study volunteerism. A conventionally worded and typeset letter is more effective than one that uses motivational language or modernist design principles for altruistic individuals.

BACKGROUND

Recruitment is a critical component of any research study. It was estimated that in 1999, only 5% of the public who contacted a researcher about a study was eligible and completed the study procedures (Sung, 2003). A review of a sample of studies conducted in the United Kingdom from 1994-2002 found that less than 33% (McDonald, 2006, pp.7–9) of the studies met their recruitment goals, and this percentage did not substantially increase—even with approval to increase the recruitment timelines. In fact, less than 4% of cancer patients in the U.S. participated in a clinical trial (Raeth, 2011). Difficulty recruiting participants into studies is not a new problem (IOM, 2012); however, meeting study recruitment goals is becoming increasingly difficult (Treweek, 2013). To combat this problem, it is essential that researchers develop a well-designed recruitment strategy and appropriately estimate the number and types of contacts they need to meet their goals. One mechanism to expand the reach to potential participants is to create a registry of volunteers who permit their medical record information to be accessed by researchers. When future studies start recruiting participants, the registrants' up-to-date medical records can be screened for eligibility for each study to expedite the recruitment process. Sending letters to patients to engage them in research is often less effective than other mechanisms of talking directly to a participant about a study (Hicks, 1998, pp. 295–302), but letters can be a low cost alternative (Junghans, 2005) for reaching large numbers of patients. Since research participant registries are recruiting for non-specific studies, it is even more important for the invitation letters to draw the attention of the letter recipients and to motivate the volunteerism in them.

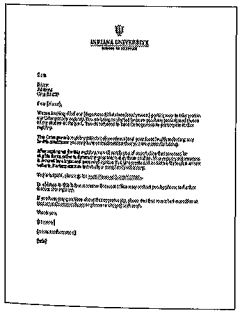
In the field of visual communication, our understanding of graphic design is that application of Modernist design principles enhances clarity and impact (Tschichold, 1928) and thus draws attention. In written language, call-to-action rhetoric is commonly applied to enhance motivation and effectiveness (Connor and Gladkov, 2004, p. 259).

We conducted a study to test empirically whether a modernist design and call to action rhetoric, separately and in conjunction, could improve the response over a standard recruitment letter inviting patients to sign up on a registry to volunteer for future medical and health studies. The design of four different styles of a recruitment letter are described in detail in the next section

RATIONALE FOR THE DESIGN OF THE LETTERS TESTED IN THIS STUDY

In this study, we started with a standard conventional recruitment letter (Letter A), and enhanced it in two different directions by 1) adding "call-to-action" language, and 2) using modernist designs. Letter A was written on university stationery using standard business letter conventions (U.S.) regarding elements and layout (date, letter address, salutation, body, complimentary close, signature block). Paragraphs were laid out using block style (line space between paragraphs with no indents), and a standard serif font (Georgia) was used throughout. The first enhanced style (Letter B) had essentially the same appearance as Letter A but employed rhetorical strategies used in direct mail communication to motivate the letter recipient. Letter A+ and Letter B+ used the same content as Letter A and Letter B, respectively, but replaced letter conventions with a modernist convention optimized for enhanced legibility through typographic hierarchy, and roughly aligning with contemporary conventions of editorial design / magazine layout. The rationale for the design of these letter types, as shown in Figures 1–4, is explained below.

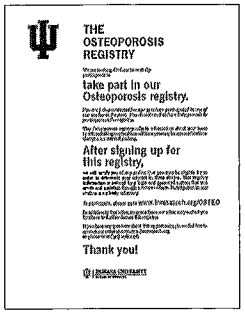
FIGURE 1



Letter A:

Letter A was written to emphasize a straightforward description of the purpose of the letter and its content. It did not attempt to integrate rhetorical strategies to enhance motivation. Its layout is in the standard business form.

Letter A+:


THE
OSTEOPOROSIS
REGISTRY

take part in our
Osteoporosis registry.

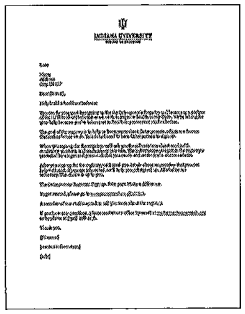
After signing up for
this registry,

Thank you!

Letter A+ uses the same text as Letter A, but applies additional graphic design elements and principles with the goal of enhancing legibility (making it faster and easier to read) and emphasizing the action requested and the results that follow. The design also attempts to foreground the institutional affiliation of the letter by enlarging and spatially isolating the Indiana University logo (the logo of the largest and most prominent public University in the State. Its logo is generally familiar to Indiana residents). All business letter conventions have been abandoned in favor of typographic differentiation through size, color, and typeface choice; left justified alignment of all text; and exaggerated left-hand alignment.

FIGURE 2

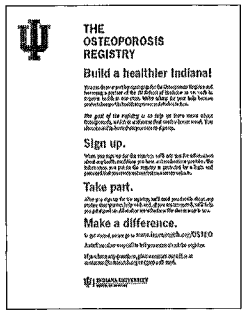
Letter B:



Letter B replaces the text with writing characteristic of letters whose aim is to spur altruism. By following conventions used in direct mail communication, particularly those that ask for funding support for not-for-profit organizations, we attempt to motivate potential participants through a "call to action" to contact the study office and find out more. We maintain the content of Letter A, and in addition, we appeal to a spirit of participation and belonging ("*Help* build a healthier Indianabecoming a partner of the IU School of Medicine"); of contribution ("You can do your part"); of improving health and personal identity ("Help build a *healthier Indiana*!"); and a sense of agency ("The choice is up to you.").

FIGURE 3

Letter B+:


THE
OSTEOPOROSIS
REGISTRY

Build a healthier Indiana!

Sign up.

Take part.

Make a difference.

Letter B+ applies both language characteristic of direct mail letters and Modernist design elements. We maintained all the text from Letter B and used the design from Letter A+ as a template. The writing style of Letter B lent itself readily to more typographic variety, and we were able to use a grouping strategy (similarity of type and color) to build in an additional level of meaning ("Build a healthier Indiana! Sign up. Take part. Make a difference.")

FIGURE 4

METHODS

The Indiana University Internal Review Board approved this study.

STUDY DESIGN OF THE RANDOMIZED CONTROLLED TRIAL

Our study used a randomized controlled trial design to test the differences across the four letter types in recipients' response to a letter inviting patients to participate in a research participant registry. This classical two (language styles)-by-two (graphical designs) factorial study design allowed us to test the effectiveness of each factor and in combination.

The research participant registry was set up as a web-based site where any volunteer could enter and sign up for invitations to participate in future studies for which they qualify. In particular, we were recruiting for future studies on osteoporosis. As part of the registration process, the registrant gave consent for researchers to screen their electronic medical records to determine their eligibility for any future study.

The target group of invitees came from a list of participants who had participated in previous osteoporosis studies and had consented to be re-contacted. These subjects were randomly assigned in equal numbers to receive one of 4 letters (A, B, A+ or B+). A positive response to the letter was defined by the presence of a letter recipient's registration record in the research participant registry within two months of the mailing. Non-responders were then sent a second invitation letter, re-randomized to be one of the four letter types. Again the response in the registry was tracked for two months.

Analysis-of-covariance was used to test for differences in response to the letter types in the first mailing, while controlling for the subjects' age, gender, and length of time since the last contact with our health system.

FOCUS GROUP

After the completion of response tracking for both mailings in the randomized trial, we held focus groups with groups of responders and non-responders to determine the salient characteristics of the invitation letters that impacted their response.

ANALYSIS AND FINDINGS

QUANTITATIVE RESULTS

Out of 5,151 recruitment letters mailed, 3,704 of the letters were not returned. Excluding subjects with incomplete data, e.g. missing gender, the responses to the first mailing of the four letter types summarized in Table 1.

Letter Type 1st mailing	Number of Subjects	Number of Responses (%) after First Mailing	Cumulative Response after Two Mailings (%)
A	877	83 (9.5)	112 (12.8)
A+	936	54 (5.8)	95 (10.1)
B	952	42 (4.4)	83 (8.7)
B+	931	36 (3.9)	84 (9.0)
Total	3696	215 (5.8)	376 (10.1)

ABLE 1

For the first mailing, the response rate was significantly higher for Letter A than for any of the other three letters ($p<0.01$). We also found that, 1) female participants had a higher (2.50 times) response rate than males, 2) African American participants' response rate was only 30% of the white participants, and 3) for every year that the person had not been in touch with the health system, the response rate decreased by 50%. We treated the enhanced graphics and activation language as two additive effects and found that each had a negative effect on the response.

The second mailing generated only a 4.6% response among non-responders compared to the first mailing. We did not detect significant differences in response rate across the letter types in the second mailing, but those who received a second letter that was different from their first letter had a marginally higher response than those who received the same letter twice.

The cumulative response to the two mailings in Table 1 (last column) shows that Letter A in the first mailing still had the highest overall response rate, which was still significantly higher than the cumulative response rates to Letters B and B+ but only marginally higher than Letter A+ in the first mailing.

OCUS GROUP FINDINGS

Focus groups were conducted within two groups of a total of thirteen responders and a group of 10 non-responders. Each focus group member was given all four recruitment letters to look at during the meeting. Most of the responders said that they responded primarily because they wanted to contribute to the advancement of medical science, but they would have liked to have a telephone contact available to answer questions. Non-responders indicated that the most important reason for non-participation was the lack of immediate compensation regardless of the letter type. They also thought that the opportunity for compensation for future studies should be emphasized more in the letter.

The majority of responders and some non-responders preferred the look of a letter (Letters A and A+) to the look of a flyer (Letters B and B+). They thought that the standard Letter A looked professional and "credible." However, more non-responders preferred letter B+; some noted the motivational language of "a healthier Indiana," and said the appearance was "cleaner," "direct," and "grabbed my attention." Some

subjects, even the responders, said that having to sign up on the Internet was a barrier and more of a deterrent than any style of invitation letter.

SIGNIFICANCE

To our knowledge, this is the first rigorous study that uses a randomized controlled trial to empirically test the effectiveness of applying design theory and motivational rhetoric to direct mailing for recruitment of volunteers in the context of medical research.

Our findings are significant for designers in the health fields, particularly those working with volunteers and potential volunteers in human subjects research. As design advances in medical and health care environments, it is critical that designers modify their practice in order to be effective in these highly contextualized settings. Effective written and visual language in health communication for altruistic outcomes departs from conventions characteristic of the direct mail genre and from modernist principles in graphic design that emphasize clarity and textual hierarchy. While application of typographic strategies might heighten "access" to information through greater visual differentiation of textual meaning, such a tactic is not effective in motivating altruism in regard to health. Our study confirms Moys' findings of the sensationalist and discredited association of documents with high degrees of visual differentiation (2014, p. 63). In both conventionally worded and motivationally worded documents, the modernist designs were less effective at motivating participation in the patient registry. Thus, a thoughtful designer would shelve a strict Bauhaus approach in preference to typography that embodies qualities more aligned with the values of potential study volunteers.

Nor should designers in this context limit their practice solely to graphics and type. Findings from the focus groups—the internet viewed as a barrier, the desire for additional contact by phone, and the significance of immediate and/or potential compensation, all indicate a service design approach that takes into consideration the overall experience of study participation from initial contact through study completion. Additionally, the discrepancy in responses between different populations indicates that a standardized approach might not be as effective as one better tailored to individual demographics.

Finally, the structure of the study itself is significant for design researchers as the large number of participants required for research registries yields empirical evidence from randomized, controlled trials in large enough numbers to be valid. The opportunity to work directly with biostatisticians and other health researchers can introduce designers to rigorous research standards in other fields while helping us advance research in our own.

NEXT STEPS

In the context of recruiting volunteers for medical research, direct mailing had a low response rate and was made even lower by our attempts to enhance the invitation through text and type. Even when the target audience noticed and appreciated the motivational language in the invitation, it did not seem to alter the letter recipient's action. Similarly, catching their attention with modernist design, even when well received, did not translate into action. However, there are other potential improvements that can be tested. For example, the language can put more emphasis on personal benefits, such as increasing their access to future studies that provide tangible compensation, or some kind of public recognition if they so choose. Better segmentation of target groups may also help because one responder said that osteoporosis in her family was a motivator, whereas one non-responder said she ignored the invitation because she did not have osteoporosis.

There are also other features of direct mailing regarding language that may impact the response; conventions for direct mail in commercial settings and profit-driven organizations offer a plethora of other design-driven variables (Caples Awards 2013a, Caples Awards 2013b). It is clear that options in the overall category of direct mail are unlimited, and that the job of the designer is to determine what approaches have the best chance for success in this area. But rather than focus solely on the careful crafting of this one artifact, we must remember this: that when asked about the form and content of the letter, we received feedback regarding the study purpose and the study experience as a whole. Our next step as designers is to address problems with patient registries through the eyes of the patient along the continuum of patient experience.

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Conference report

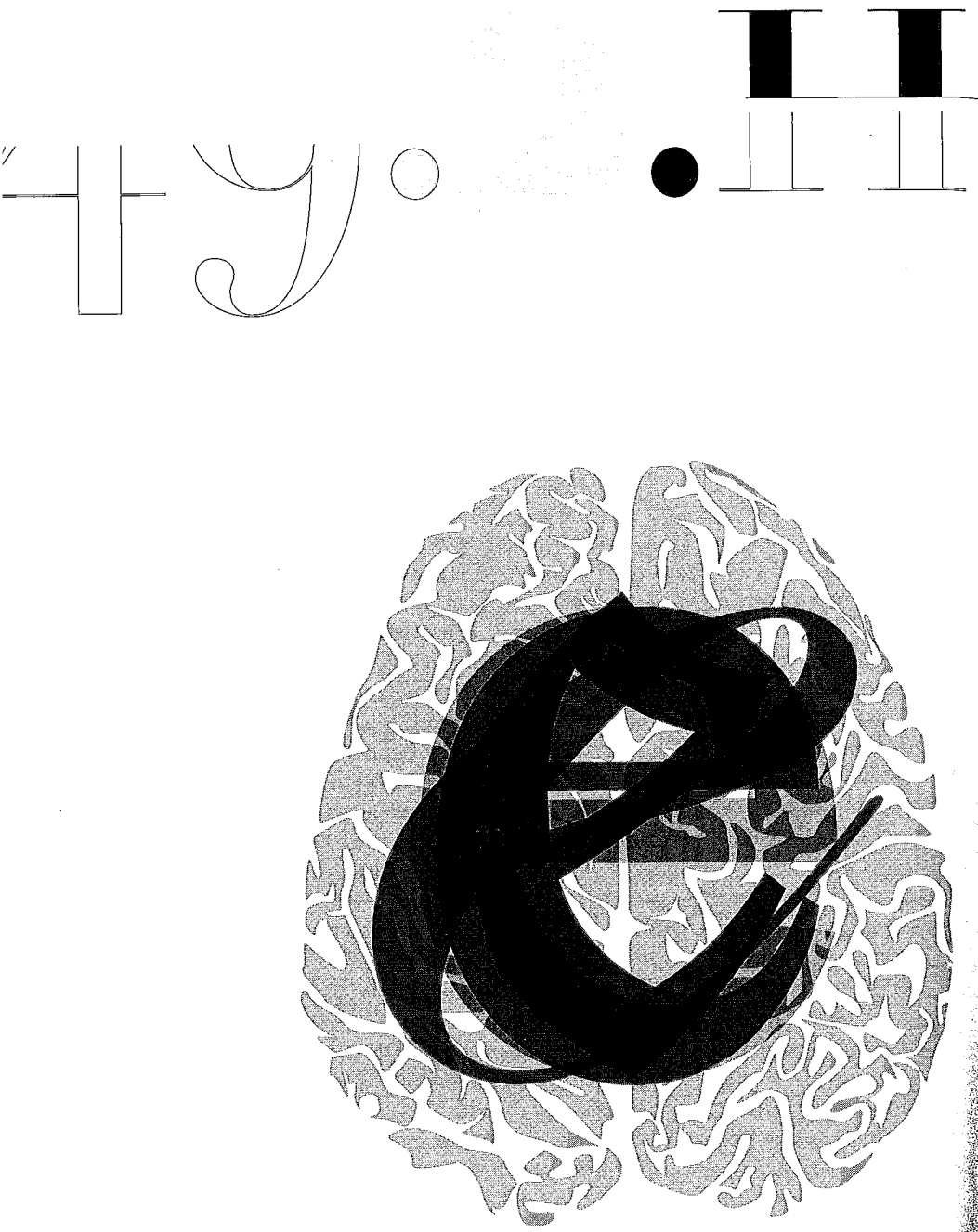
Anne Ghory-Goodman & Roger Remington

MEDICINE+DESIGN: An international conference at Rochester Institute of Technology

Five international design programs exploring demonstration projects on the theme of health and wellness have partnered under the umbrella of the MEDdesign educational initiative. Participating institutions in MEDdesign are the Vignelli Center for Design Studies at Rochester Institute of Technology (United States of America), the Helen Hamlyn Centre for Design (United Kingdom), Sheffield Hallam University (United Kingdom) The University of Venice (Italy) and the Technion (Israel). Each institution developed its own set of project responses to the challenges of innovating inclusive design solutions. These outcomes were made public in presentations devoted to cutting edge case studies from around the globe during the Medicine+Desigh Conference on November 7-8, 2014 at Rochester Institute of Technology. The goal of the conference was to begin a new interface between regional education institutions and the healthcare community, bringing the power of design to the real needs of medical professionals and their patients. Jeremy Myerson, Professor at the Helen Hamlyn Design Centre, Royal College of Art gave the keynote presentation, "Make it Better: How Inclusive Design can have an impact in Healthcare." He followed this with a participatory workshop, "Make it Better: User Research Methods to Drive Design." Mark Shikowitz, M.D. described his work in "Medical Missions to the World." Professor Dan Harel of RIT followed with a talk about his collaborative, inclusive design project with Dr. Shikowitz. RIT Graphic Design Professor Bruce Ian Meader showed how information design projects provided health education. Other presenters were Professor Paul Chamberlain, Sheffield Hallam University; Dr. Medardo Chiapponi , University of Venice, and Professor Noemi Bitterman from the Technion, Israel Institute of Technology. The conference concluded with presentations by Professor John Caruso, Milwaukee Institute of Art and Design on MIAD☒s project with GE Healthcare addressing "Medical Experience Design for Women," and Dr. Patricia Moore of Moore Design Associates. http://www.rit.edu/cias/meddesign/projects/ provides illustrated descriptions of all recent MEDdesign projects.

- Cordless Operating Room
- Design Concepts For Improved Crutches
- E- Health System
- Engagingaging / Stigmas
- Exhibition in a Box
- Haemobility
- Head Up
- Health Posters
- Hospital Communication
- Hospital Simulation Lab
- Human Health Book
- Information Design Basics
- Lab4Living
- Medical Connectors
- MuscleCast
- Open Design
- Outpatient Services
- Photography in Care Homes
- Prosthetic Arm
- Redesigning the Ambulance
- Sensory Feedback Ergo Suit
- System Signs: Venice Hospital
- Trec Pictograms
- User-centered Healthcare Design
- Vitality ECG
- War & Medicine

Sponsors of the conference were the Vignelli Center for Design Studies and the College of Imaging Arts and Science at Rochester Institute of Technology, the RIT/RRHS Alliance, the Rochester Academy of Medicine, and the Alliance Graphique International Foundation.



Brainy Type: *a look at how the brain processes typographic information*

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ABSTRACT

Despite a growing body of knowledge around how readers interact with texts, our understanding of how the brain processes that information is relatively limited. This multidisciplinary (typography and cognitive neuroscience) study examines how the brain processes typographic information using EEG technology and shows the value of neuroscience methodologies to legibility research. By measuring the brain's response to a range of typographic stimuli, we have shown that it is more difficult for the brain to process single letter information presented in harder to read compared to easier to read typefaces. This effect was evident at both the most basic levels of letter identification (0–300 milliseconds from stimuli onset) and also during sustained activity involving the working memory (after 300ms). This has implications for our understanding of legibility and how legibility research is further explored with the aim of developing a body of knowledge that has a wider application to how typographic design is practiced.

KEYWORDS

legibility, letter identification, neuroscience, EEG

INTRODUCTION

If we think about the act of reading, it seems as though it is nearly effortless; cast your eyes over a passage of text and information is somehow absorbed with little thought or consideration to the processes involved. If you are a typographer you may consider or examine what visual circumstances have contributed to the ease of reading: a clean open typeface, the relationship between the letter, word, and line spacing, margin space, line length, etc. Since reading is such an integral part of our culture and education, it can be argued that the primary concern of any typographer should be to produce texts that are as legible as possible in order to facilitate easy and accurate letter and word identification, reading, and comprehension. Although letterforms are also objects of beauty and expression, it is the decoding of texts that is the primary function of typography for reading. This means type or typographic design that interferes with this process is unsuccessful regardless of the aesthetic qualities of the letters or their composition (Beier, 2012).

Legibility research has seen contributions from both typography and psychology, but historically there has been relatively little evidence of collaboration (Beier & Dyson, 2013; Dyson, 2013). This may be due to differing objectives with a typographer's primary concern focused on the 'what' and a psychologist's with the 'how' of reading (Dyson, 2013). Since both the 'what' and the 'how' are essential to our understanding of reading processes, multidisciplinary teams may be better placed to improve our knowledge about what affects the legibility of texts. In a collaboration of typographic and cognitive neuroscience researchers, we used a novel approach to legibility research and explored the discriminative processing[1] of letters across a range of typefaces. Understanding how the brain responds to typographic stimuli may enable the development of a more thorough understanding of what features of letters are essential for accurate identification and what variations of form improve legibility. The potential impact of this research may also contribute to the ability of typographic designers to produce more legible typefaces and texts, which can then influence how easily readers are able to access content, whether they are fluent readers, developing readers, or those who experience any range of reading difficulties, including dyslexia. In the broader context of design for reading, when this knowledge is considered in combination with the theory of working memory as a limited capacity system (Baddeley, 1992, 2002), texts that are developed with the aim of reducing the cognitive load required for basic tasks like letter identification may enable more of this limited capacity system to be designated for performing higher-order tasks related to comprehension and assimilation. Thus, it is argued that with the application of neuroscience methodologies, typographic designers will be able to develop a better understanding of the variables contributing to legibility, enabling them to produce more legible typefaces and texts. Even with the exploratory nature of this study we have been able to demonstrate that typeface can influence how the brain processes letter information.

1 Discriminative or preconscious brain activity refers to the time before an individual is consciously aware of what they are looking at. This is typically between 0 and 300 milliseconds from stimulus onset.

LETTER RECOGNITION IN THE BRAIN

Cognitive neuroscience is a branch of psychology[2] that focuses on the brain structures and functions and how they relate to behaviour and mental processes (e.g. memories, language, reasoning, decision making, learning, and our ability to recognise and identify objects and people). This is a science that is based on inferences made about how the brain works by using technology such as Electroencephalography (EEG), which records the brain's neuronal activity during specific cognitive tasks, like letter recognition, through an electrical measurement taken at the scalp (Gage & Baars, 2013).

EEG measures electrical impulses generated by the brain with increased task specific activity showing more electrical activation (Gage & Baars, 2013). Although behavioural methodologies are able to tell us about how readers respond to specific reading materials, fluent readers are typically quite efficient with the task, and it can be difficult to design test scenarios that are sensitive enough to show differences in performance based on typographic variation. EEG is able to provide data on brain activity from the moment a visual stimulus is presented (i.e. to the millisecond), including that window of time before a participant is consciously aware of it. With this ability to track activity in the brain to the millisecond, it becomes increasingly easy to infer how specific typographic variables influence letter processing and legibility.

A typical test scenario is shown in Figure 1. Participants are required to wear a cap with sensors that monitor electrical activity at the scalp. Distractions must be limited as much as possible to isolate the brain's response to the tested variables. As a result participants are typically required to sit in a small empty room. This may not resemble a realistic reading scenario, but is necessary to this sort of data collection. Knowledge gained here can be used in combination with that collected by other means to develop a clear picture of reading and readers more generally.

FIGURE 1

Demonstration of an EEG testing scenario. Participants wear a version of the electrode cap shown above for the duration of the task. The electrodes map to regions of the brain and record neural electrical impulses generated during the task.

Our knowledge about how typographic variation influences letter recognition in the brain is relatively limited, but Rey, et al. (2009) have identified an ERP component[3]

2 The psychology of the brain is different from the biology of the brain, which refers more specifically to neuroscientific studies that explore the physical structure, neurological pathways, and where in the brain specific content is processed.

3 Event-related potential (ERP) is an average measure of EEG activity collected over multiple participant trials. Once averaged this data tends to reveal very regular patterns, which can then be used to determine whether the recorded brain activity is a response to specific stimuli (Gage & Baars, 2013).

that depicts letter-processing in time, illustrated in Figure 2. They have shown low-level processing related to feature analysis, which consists of a basic response to the fact that something has appeared in the visual field and that it is an object recognised as an exemplar of a known category (e.g. 'a letter'), takes place at 100–200ms after stimulus onset. Between 120 and 180ms higher-level processing, likely related to feature detection and essential to letter and object recognition commences. At this point, the letter representation is high-level case-specific (a letter f). At around 220ms abstract case-independent letter identity representations are activated that transcend specific visual representation (the letter f), and after 300ms participants show behaviour responses indicating the object is recognised and its meaning processed sufficiently to consciously respond to a task related activity (Rey, et al., 2009). With this framework for letter recognition in the brain, we can determine how typeface influences neural recruitment, referring to how many neurons are need to complete a task during discriminative processing, and had not been done before our study, first reported in Keage, Coussens, Kohler, Thiessen, and Churches (2014).

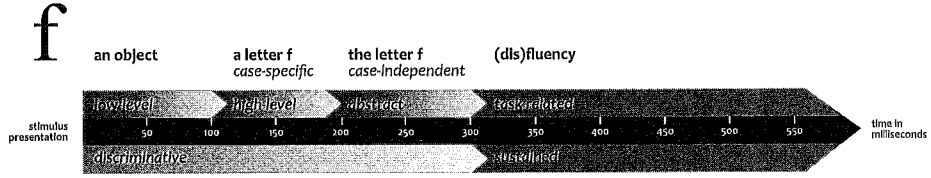

FIGURE 2

Object recognition in the brain over time (in milliseconds). High-level processing involves the use of letter attributes that are specific to the letter variation (e.g. upper or lowercase and variant forms); whereas, abstract processing is related to more general identification of the letter unit (e.g. all forms of the letter f). Discriminative processing is related to object/letter identification and sustained activity to its use and maintenance in the working memory. It is during sustained/task related activity that the fluency effect can be measured.

The use of EEG is seen as particularly valuable to legibility research, and specifically here since we are interested in letter identification, because it is able to show instantaneous data related to neural recruitment; however, it is limited by the fact that it can only provide data related to what regions of the brain are active rather than pinpointing the specific neural clusters. On the other hand, technology related to functional magnetic resonance imaging (fMRI) can help clarify which specific neural clusters are active by observing blood flow but is limited in that it has a lag time of approximately six seconds (Gage & Baars, 2013). However, for sustained cognitive tasks, fMRI may be a profitable data collection method as demonstrated in Nishimura, et al. (2007). This study shows the value of fMRI, and the less invasive functional near-infrared imaging (fNIR) variation, during a task where participants were asked to read a pair of sentences and determine whether the combined statement was plausible. The test stimuli were presented in a range of typefaces that differed in level of visual degradation from high legibility (no degradation) to low legibility (extensive degradation). The results showed that more neural recruitment was necessary to decipher the degraded typefaces suggesting the brain must work harder to identify words as shown in the visual processing areas of the brain

but that the region associated with language processing (Broca's area) was not affected by typeface legibility.

LETTER RECOGNITION

Recent interest in legibility has seen exploration in a range of areas, including perceptual, cognitive, and, in this paper, psychophysiological processes, that influence the way we decipher and interpret texts. In a review of literature, Dyson (2013) brings to attention the differences in disciplinary approaches but aims to highlight, as we do here, that both typographers and psychologists share goals and points to a mutually beneficial approach of collaboration as a means to further our understanding of typography, typeface design, and design for reading. It is, however, pertinent to mention that there also appears to be a gap between the knowledge generated through research and its application in typographic practice. This may be because legibility studies are typically guided by the interests of those undertaking the work and who are motivated by the issues that are relevant in their area of expertise (e.g. psychology or engineering) and because these interests do not typically extend to visual features and variations of letterforms relevant to typeface design (Beier & Dyson, 2013). Unfortunately, this can also include limited consideration of the experiential knowledge of the typographic practitioner and the practicalities of the profession resulting too often in the reluctance of practitioners to take up the knowledge generated by these studies. For example, Pelli, Burns, Farell, and Moore-Page (2006) were able to suggest that there is an early feature detection stage in letter identification where readers draw on multiple features to aid with accurate identification, using a system of template-matching. A simple and logical conclusion may then be, if fonts are developed that can accentuate these essential features the legibility of texts may be improved. However, the type variations tested do not represent realistic letterforms, having been developed based on the arrangement of pixels on a 3x4 or 4x4 grid, making the interpretation of the results difficult to translate to how texts and typefaces are actually designed and used. Due to this impractical comparison, these data are too vague to inform design, which has also been suggested by Dyson (2013). Knowledge generated with the use of more familiar and conventional letterforms may be more useful to typographic practice because it may be able to provide more specific information about which features are most relied on and how differences are used by the reader in an effort to inform the overall typeface design.

Several studies have examined issues concerning letter identification and determined that readers rely more heavily on certain features of a letter over others and that more salient features are accessed before less distinctive ones during the identification process (Beier & Larson, 2010; Fiset, et al., 2009). Since specific features are used not only to identify letters in isolation (Finkbeiner & Coltheart, 2009; Grainger, Rey, & Dufau, 2008; Pelli, et al., 2006; Rey, Dufau, Massol, & Grainger, 2009) but also in context, i.e. words (Sanocki & Dyson, 2012), understanding whether

it is more or less difficult for the brain to process letter and word information across a range of type classes will improve our understanding of what makes letters more or less legible. It makes sense to conclude that if each letter is identified by specific unique features, then typefaces that somehow accentuate those features would make this process easier. In an attempt to isolate the parts of letters that are more useful in identification, Beier and Larson (2010) developed several variations from a single typeface skeleton (or template). These variant forms of the same letter were then tested for letter recognition under short exposure times. Beier and Larson found letter width to be an influential factor in identification since wide variations were recognised more accurately compared to the narrow and ascending and descending features are also influential. Double-storey characters were shown to be more legible than their single-storey counterparts, but Beier and Larson were unable to conclude whether letter openings were essential distinguishing features in identification; i.e. letterforms with wider openings did not increase their legibility compared to those with narrow openings. This is an interesting observation since wide letter openings have traditionally been considered a feature that improves legibility (a summary of early research can be found in Beier, 2012).

Although it is clear that each letter within the alphabetic system must be unique to ensure accurate identification, reading efficiency is supported by similarities across the set of letters (Beier, 2012; Sanocki, 1988; Sanocki & Dyson, 2012; Walker, 2008). A typeface designer, therefore, aims to develop fonts that consist of a series of letters that have unique distinguishing shapes but that also have a certain level of continuity between letterforms. By sharing certain visual features, a rhythm and flow across the letter set is developed that contributes to the overall look and feel, or 'personality', of a typeface (Cheng, 2005). For this reason, the forms within a single font will be developed based on considerations such as the proportions of both the vertical and horizontal measurements of a letter, the relationship between stroke width and variation and counter space across the entire alphabet, as well as the use of similar and shared shapes (Beier, 2012). All of these contribute to an overall sense of unity, which aids reading efficiency. This effect is apparent in studies that show reading times improve because a reader's visual processing system is able to 'tune' itself to the particular consistent visual features of a font design and uses this information for identification (Sanocki, 1988; Sanocki & Dyson, 2012; Walker, 2008).

In summary, typefaces that balance distinct and related visual features are likely to be more legible because they may do more to facilitate accurate letter identification, as well as capitalising on the consistency needed for font tuning; however, we are still only able to say with moderate certainty which features are essential since only several specific features have been isolated in research, such as vertical and horizontal strokes, width, or ascending and descending features (Beier & Larson, 2010; Fiset, et al., 2009; Fiset, et al., 2008; Grainger, et al., 2008; Pelli, et al., 2006; Sanocki & Dyson, 2012). It is proposed that the application of neuroscience methodologies is likely to provide the evidence we need to address this gap and inform the design of more legible typefaces and texts.

READER EXPECTATION AND COGNITIVE PERFORMANCE

Although the ability to identify letterforms and efficiently read texts is essential to the design of written content, reading is also influenced by preference and expectation. The overall appearance of documents – which includes visual attributes related to layout as well as typeface – can influence the reader's impression of the content, and this may extend to the perception of the elements such as difficulty, importance, seriousness, or trustworthiness of the content (Gonzales Crisp, 2012; Moys, 2014; Schriver, 1997). For example, in an examination of typeface, Song and Schwarz (2008, 2010) demonstrated that their participants thought tasks were harder (i.e. requiring more skill) or took longer to complete when set in a more visually complex typeface compared to one that was conventionally easier to read. In addition, participants were less willing to undertake described tasks that were set with a harder to read typeface. Conversely, content that was easy to read was thought to be more familiar or less risky, more trustworthy or truthful, and described a task that would be easier to complete. Interestingly, participants did not consciously link the typography to their impression of the text.

Since reading is an important part of our culture and a primary source of information transfer, it is essential to develop a more thorough body of knowledge around this subject. Data collected through neuroscientific methods are far more sensitive and less subjective compared to those seen in behaviour studies, and this may allow us to show definitive differences in performance based on typographic presentation (i.e. how hard the brain is working in response to variations in typographic presentations). However, it is important to understand that reading environments change, scenarios vary, and goals shift. Although data collected by observing brain functions can inform our understanding about reading in a way that we have not been able to achieve before, it is important to understand that this is only one piece of the puzzle and that the most thorough understanding will likely only come through a combination of both neurological and behavioural methodologies. The study discussed here is limited in its scope to single letter identification across broad type categories and does not examine the recognition of letters in context (e.g. words), which may produce varying results. Nonetheless, this study demonstrates the value of neuroscience methodologies and the potential of the data they generate, with the use of technology such as EEG, to our developing body of knowledge about legibility.

THE INFLUENCE OF TYPOGRAPHIC INFORMATION ON BRAIN ACTIVITY[4]

The application of neuroscientific techniques can provide a measurement sensitive enough to provide a picture of how hard the brain is working to process a range of typographic information that varies from easy to difficult to read. Working as a multidisciplinary team of typographic and cognitive neuroscientific researchers, we examined the effect of typographic information on brain activity within a 600ms window of first seeing a letter stimulus. We looked at a range of typefaces representing broad categories of classification that have traditionally been considered more or less legible in order to determine whether differences in processing were apparent. We hypothesised that more neural recruitment would be measured, i.e. the brain will work harder, at low-level processing or stimuli categorisation (>100ms) and abstraction (220–300ms) to identify letterforms that are displayed in typefaces with low legibility compared to those with high legibility. Finally, since processes after 300ms should not be affected by visual form because they are related to sustained activity rather than to identification, we hypothesised there would be no differences in recruitment at this stage.

We worked with 26 fluent readers (university undergraduates) that were all right-handed[5] and had normal or corrected-to-normal vision. Each participant identified letters across 4 different typefaces that were grouped according to whether they had characteristics considered to be more or less legible: 2 typefaces made up the high legibility[6] group and 2 the low legibility group. These characteristics were identified by conventional standards[7,8]. Since this was an exploratory study, we were concerned primarily with determining whether differences in processing occur across broad type categories with very different visual features traditionally considered to contribute to legibility. We examined representations from the basic typeface classifications serif, sans serif, blackletter, and script. For the purposes of this study, text typefaces, a serif and a sans serif, represent the high legibility category. The low legibility typefaces were selected from more decorative or display options, a blackletter and a script. This is not to say that all serif or sans serif typefaces are highly legible or that all examples of script and blackletter have low legibility; however, these categories do tend to sit on either side of the spectrum as a result of their visual features and intended use, whether it is for text or display. Future work using our methodology can start to narrow down the criteria and examine what specific features within each category influence letter recognition in the brain.

high legibility variations

Arial Times New Roman

low legibility variations

Lucida Blackletter Edwardian Script

FIGURE 3
The tested typefaces. Lower case letters that were either x-height with straight and curved strokes and of standard width (a / c / e / o) or cap-height with a single vertical stroke and of narrow width (f / i / l / t) were typeset with an x-height of 90px in each of the four typefaces shown. Each letter was presented individually onscreen with a viewing distance of 60cm. The participants were placed in groups based on test stimuli. Group 1 saw only the x-height characters and Group 2 saw only the cap-height characters. Each participant saw stimuli set in each of the four typefaces.

The specific typefaces selected were Arial and Times New Roman representing the high legibility variations and Lucida Blackletter and Edwardian Script the low legibility options. For reference, examples are shown in Figure 3. In order to ensure that this study could be easily replicated and to improve the accessibility of the results, we selected typefaces for testing from those within the Microsoft suite. This also ensures that a visual reference of the typefaces can be easily found, reducing the abstract nature of the material for individuals without typographic backgrounds.

All participants completed a one-back task[9] in which they were shown one letter at a time sequentially once every 1.5 seconds, on average. They were instructed to press a response button with one index finger when they saw the same letter twice in a row regardless of which typeface it was presented in and another button with the opposite index finger if the letters were not the same, again, regardless of typeface. Each participant completed the task in 2 blocks of approximately 8 minutes in length. Each block contained 240 stimuli of either x-height (o, a, e, c) or capital height (f, i, l, t) characters. The order in which participants saw the letters was pseudo-randomised so that high and low legibility letters were mixed, but each block of stimuli contained only x-height or capital height character sets. This was to minimise inter-letter visual variation (Grainger, et al., 2008). Figure 4 shows a representation of a stimulus train for a one-back

4 A summary of the study procedure is presented here for the purposes of this discussion. For full details refer to Keage, et al. (2014).

5 The fact that they were all right-handed means that the primary language processing component was more strongly located in the left-hemisphere of the brain and enabled us to compare data across hemispheres.

6 Features such as unique and distinctive shapes, large x-height, letter width, open counters, and even stroke treatment are traditionally considered to improve legibility of letters; whereas, those such as extensive shape repetition and minimal letter distinction, closed counters, narrow width, small x-height, flourishes, and highly variable stroke treatment are thought to contribute to low legibility. It should be mentioned that although generous letter openings have traditionally been considered to aid legibility, Beier and Larson's (2010) study did not find this to be an influential feature in identification. More work or study replication is needed to verify these results.

7 Baines and Haslam (2005) raise the important point that what is considered within the spectrum of legibility is largely dependent on what is considered to be 'normal' and what readers, as a collective group, are familiar with, making our idea of what is legible largely based on convention. This perception has changed over history and is likely to continue to shift, particularly with the digital age. This makes the inclusion of typographers and typographic researchers, with their practical experience and expertise working with texts, on teams investigating legibility a necessity for improving our knowledge of the practical application of that work.

8 Discussions about the legibility of individual letters are limited, which may be due to the fact that it is more informative to discuss legibility of form as it pertains to its context of use: how a system of letters works in words, sentences, passages, etc. A letter in isolation may perform very differently compared to when it appears in a word. A typographic designer, therefore, must consider both individual and global features of letters simultaneously (Beier, 2012). Beier (2012) provides a discussion of early studies, such as those conducted by Tinker (Tinker, 1963, 1965), that were able to isolate specific parts, such as ascending and descending features or taller x-heights as being helpful to recognition. Early researchers were also able to identify groups of forms that are frequently misread due to similarities in form, like the letters h and b or e and c. From this work typographers were able to draw conclusions and establish a set of principles for what features aid with legibility.

9 A one-back task is a common paradigm to cognitive neuropsychology experiments in which measurements of the neural activity involved during activation of the working memory are taken. It consists of showing participants a continuous sequence of stimuli and asking them to respond (e.g. press a button) when matching images appear. This behavioural response is not linked to the neurological data collected, providing an uncorrupted response.

FIGURE 4
Example of a stimulus train for a one-back task.

task with target letters highlighted in green. The brain activity of each participant was measured using EEG. Behavioural data related to response and error rate were also recorded, although this did not form part of our main analysis.

RESULTS[10] AND DISCUSSION

We were primarily interested in preconscious or discriminative processing: 0–300ms from stimulus onset. Shown in the diagram in Figure 2, we collected object recognition data on low-level (an object), high-level case-specific (a letter f), and abstract case-independent (the letter f) processing. We also analysed the data collected during sustained task related activity after 300ms, at which time integration and maintenance in the working memory becomes apparent (Madec, Rey, Dufau, Klein, & Grainger, 2012).

In summary, the results showed (Keage, et al., 2014):

1 _ Significantly ($p<0.001$) more neural activity when participants were shown test stimuli in low compared to high legibility typefaces during low-level processing (0–100ms).

2 _ Significant ($p<0.001$) differences during abstraction (220–300ms) indicating a larger effect for the low legibility typefaces compared to the high legibility.

3 _ A trend ($p=0.05$) for low legibility typefaces requiring more effort for integration into the working memory (indicated by differences measured during sustained activity after 350ms).

4 _ Neural recruitment during sustained late activity that was larger for the low compared to high legibility typefaces.

5 _ No significant differences ($p>0.05$) in time or accuracy of the participant's behavioural response between the high and low legibility typeface variations.

It is, therefore, apparent that typefaces with low legibility capture more attention and are more difficult for the brain to abstract and maintain within working memory than those with high legibility suggesting that the visual complexity may reduce legibility at the most basic processes of reading (Keage, et al., 2014). This is a result that is in line with those presented in Nishimura, et al. (2007) using fMRI/fNIR technology. However, in opposition, we also observed a larger effect of typeface at low-level processing in the language dominant left hemisphere compared to the right, implying that more effort is required for the brain to process basic tasks related to

10 Again, the study results are summarised here as they pertain to the discussion and focus of this paper. For full details of the ERP results refer to Keage, et al. (2014).

letter identification when harder to read typefaces are used. This suggests the need for more investigation since increasing the cognitive load needed to perform basic tasks may imply there is reduced cognitive capacity for higher-order functions that take place later and are related to abstraction and sustained activity, as well as the assimilation of knowledge (Baddeley, 1992, 2002). Nishimura, et al. suggest their study is limited by the fact that their task was not a natural reading scenario and may have been too short to produce more conclusive results.

IMPLICATIONS FOR THE DESIGN OF TYPEFACES AND TEXTS

The ability to easily ascertain essential distinguishing features is important for accurate letter identification where these features are first identified and then used to determine the complete letterform (Grainger, et al., 2008; Pelli, et al., 2006). This implies that the easier these unique or distinguishing features are to access, the less cognitively demanding letter recognition will be. Our data also shows that typeface can influence this process since the brain must work harder to abstract letter units when less legible typefaces are used. We have not yet examined which features are essential to identification and can only suggest that clarity of form and reduced visual complexity influences identification. Future research aims to explore this in more detail, as well as build on the knowledge developed by behavioural studies such as Beier and Larson (2010) and Fiset, et al. (2008) who have investigated distinguishing features of letters as a means to improve our understanding here.

It is also important to consider that the observed increase in effort needed to maintain letter information presented in typefaces with low legibility may be influenced by the familiarity and common use of our high legibility variations: Arial and Times New Roman. Although all our test stimuli were selected for their wide availability, Arial and Times New Roman are among the most commonly used fonts, and our participants were bound to be more familiar and have substantially more experience reading these compared to our low legibility choices: Edwardian Script and Lucida Blackletter. However, this effect may be counteracted once a reader has tuned to the unfamiliar font (Sanocki, 1988; Sanocki & Dyson, 2012; Walker, 2008), which is commonly believed to take only a few seconds (Beier & Larson, 2013). Further investigation that explores the effect of font tuning is needed before more specific conclusions can be drawn about its influence on how the brain processes typographic information.

Our study has shown that differences in letter identification that are influenced by typeface do occur at the most basic levels of object recognition. These results may be expected based on the broad range of visual stimuli that we tested, and individuals with typographic expertise may view this study as reinforcing what we know through experience. We see this as part of this study's value. We have been able to confirm knowledge that has previously been limited because of its subjectivity and thus estab-

lished the value of neuroscientific methodologies to legibility research. We can now, with future work, build on this knowledge and begin to examine a narrower range of differences to determine exactly what the tolerance for good legibility is and what elements are contributing factors, as well as potentially isolate specific features that are essential for accurate letter identification. Future work will also explore whether typeface has an influence on word recognition and examine both letter and word recognition in developing readers (i.e. children), both those learning at a typical rate and those who experience difficulties, like dyslexia or low vision. This approach can inform typeface design generally but also improve our knowledge of how to generate texts, and, with more exploration, how interacting variables such as space, size, line length, and typeface impact legibility and accessibility.

CONCLUSION

This study has shown the value of neuroscience to legibility research and to typographic practice. We have been able to produce systematic data that would not otherwise be known by examining how the brain processes typographic information; this approach will likely prove invaluable to furthering our understanding of reading and reading processes. Despite a growing body of knowledge around how individuals interact with texts, the influence of typeface on how the brain deciphers and processes visual information during reading is relatively limited. This study has shown that the brain works harder to identify letterforms when they are presented in harder to read typefaces compared to those that have characteristics that are traditionally considered to be more legible. Although the typeface categories we examined for this initial stage of research were very broad, it is easy to see the value that the implementation of cognitive neuropsychology methodologies can have for legibility research and the potential to improve our understanding of how readers interact with texts more generally. Cognitive neuroscience methods are typically unrepresentative of actual reading scenarios because they must take place in a laboratory and any distractions limited as much as possible. However, if this approach is used in combination with behavioural methodologies, we are sure to develop a rich understanding of reading, reading processes, and readers. Since the ability to decipher written language is such an essential part of our modern world, making that process and its content as accessible as possible, whether an individual is a typical or impaired reader, should be a primary concern.

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reflecting back–ahead

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