Hablamos Juntos/SEGD
Universal Symbols in Health Care
Signs That Work

Phase 2
Symbol Design Curriculum Report

Lisa Fontaine
Oscar Fernandez
Kathryn McCormick
David Middleton

SIGNS THAT WORK

Phase 2:
Symbol Design Curriculum Report

Lisa Fontaine
Oscar Fernández
Kathryn McCormick
David Middleton

In Association with Hablamos Juntos
An Initiative of the Robert Woods Johnson Foundation

University-Led Symbols Research

University of Cincinnati

Oscar Fernández, professor

Winter Quarter 2009

Kristen Bartlett
Beau Broering
Gage Burke
Jennie Chen
Michael Colarik
Sarah Dunn
Molly Finn
Julie Gadzinski
Cristen Hayes
Doug Hovekamp
Renee Kinkopf
Kara Koch
Sarah Kutney
Brian Labus
Matt Lewis
Linda Lucas
Marnie Meylor
G. Mauricio Mejía
Jesse Reed
Jason Walley

Research Planning + Testing

G. Mauricio Mejía
Maren Carpenter Fearing
Ian Monk

Spring Quarter 2009

Matthew Geitsting
Linda Lucas
Kinyanjui Migwe
Amanda Brown
Brian Labus
Mark Murphy
Benjamin Schutte

Summer Quarter 2009

Emily Boland
Ian Donohue
Paige Farwick
Christopher Garman
Mai Hoang
Stephanie Hoffman
Molly Johnson
Matt Johnson
Kim Louis
Ashley Ma
Josh Marvin
Jesse Mckinney
Andrew Murray
Evan Passero
Jesse Reed
Joseph Sikorski
Jameson Tyler

Iowa State University

Lisa Fontaine, professor and Research Director

Jesse Blanner
Jiyoung Choi
Devon Estes
Clifford Gentry
Beverly Krumm
Xiaoxi Li
Mariam Melkumyan
Ed Outhouse
Becky Popelka
Emmanuel Saka
Kimberly Topp

Research Planning + Testing

Brytton Bjorngaard
Clifford Gentry
Mary Swank
Kristen Lewis
Nanhee Kim

California Polytechnic State University

Katie McCormick, professor

Tierney Cunningham
Jaclyn DeMartini
John Dixon
Scott Ender
Helen Feldman
Sara Hamling
Dante Iniguez
Keiko Komada
Douglas Meyer
Rachell Newburn
Xander Pollock
Justin Rodriguez
Andrew Santos-Johnson
Melissa Titus
Quyen Trie
Mai-Chi Vu
Adam Wirdak

Kent State University

David Middleton, professor

Bob Keleman
Wes Jones
Natalie Pauken
Lee Zelenak
Kayne Toukonen
Emir Bukva
Kaitlyn Ord
Matt Ferrier
Diane Sperko
Mark Daniels

Symbols Testing Consultant

Wendy T. Olmstead, Imagine That!

Symbols Design Integration

Mies Hora, Universal Symbols

Technical Expert Panel

Ben Goodman

Steven Stamper

Kate Keating

Wayne McCutcheon

Jack Biesek

Craig Berger, Society for Environmental Graphic Design

Yolanda Partida, Hablamos Juntos

Grant Support

Robert Wood Johnson Foundation funded all major project components

SEGD Education Foundation Supported Symbols Research

Innovator Healthcare Facilities

Women and Infants Hospital, Providence Rhode Island

International Community Health Services, Seattle Washington

Children's Mercy Hospital, Kansas City Missouri

Grady Memorial Hospital, Atlanta Georgia

INTRODUCTION

Hablamos Juntos: Improving Patient-Provider Communication for Latinos is a national program funded by the Robert Wood Johnson Foundation to develop practical solutions to language barriers to health care.

Hablamos Juntos' Signs That Work (STW) is an ongoing partnership with the Society for Environmental and Graphic Design (SEGD) aimed at promoting widespread adoption of graphic symbols in health facilities serving diverse Public Users, with special interest in low literacy and limited English proficiency (LEP) populations. The project produced the Universal Health Care Symbol (UHCS) set and found that graphic symbols are an effective alternative to costly multilingual signs.[1] With continued funding, STW's main objectives were to:

1. Grow the collection of UHCS by developing sustainable national capacity for ongoing graphic symbol design and evaluation through a consortium of design schools.
2. Support evidence-based design and implementation of symbol-based wayfinding systems and signage in four innovator health facilities.
3. Document innovator facilities experience in real time and produce best practice tools to help other early adopters of UHCS.

A consortium of four United States university design programs formed in 2008 using a Call for Participation (CFP). The immediate objective of the CFP was to promote academic programs to work together in a highly-focused effort to develop sustainable national capacity for ongoing graphic symbol design and evaluation. In essence building the foundational knowledge base for the role symbols can play as a communication tool in health care. Using curricular prototype development and testing, 22 new medical symbols were developed, followed by user testing with linguistically diverse public users with special emphasize on LEP populations.

[1] Available from www.hablamosjuntos.org

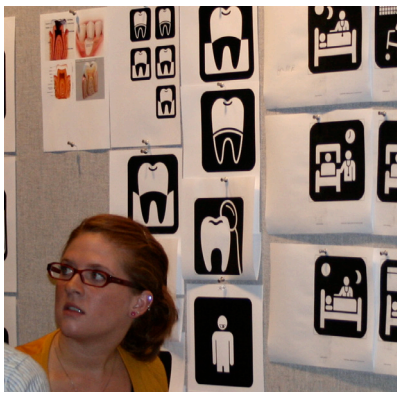
While the consortium of university design schools explored the design of visual and conceptual elements that are universally understood across cultures, and those that are culturally specific, resulting in new symbol design and analysis methods, in parallel, the project worked with four innovator health facilities, selected through a Request for Application (RFA) to develop award-winning signage programs using graphic symbols with the help of a team of leading national experts in symbols and wayfinding. The project also served to advance understanding of how symbols can be effectively used in healthcare wayfinding. The work of the innovator sites and the set of best practice tools developed through the project are reported in *Testing Universal Symbols to Support Implementation in Healthcare Facilities Signage.*[2]

The project focuses on cross-cultural communication, in response to growing numbers of foreign born residents and a growing list of federal and state standards that require health delivery organizations to respond to the language needs of their patients.

The U.S. Census 2000 Survey estimates that over 44 million Americans over the age of 5 speak a language other than English at home, and that language is Spanish for 62% of those 44 million. The U.S. Census Bureau projects that by 2010 Hispanics will account for more than 48 million or 15 percent of the total U.S. population.[3]

Attention to federal and state laws, which require health facilities to have signage available in the language of their patients, has increased with the growth of this population, but these mandates offer no new clear guidelines for accomplishing this task. This presents challenges for designers, since there are limits to how many languages can effectively be included in a wayfinding system. The incorporation of symbols for navigation of healthcare environments seems an obvious solution as a means to best serve LEP populations.

Symbol design, especially symbol systems, is a challenging process, even when the audience shares a common culture and experiences, because the decoding of simple graphic elements is dependent on clear, unambiguous visual references. How do cultural differences affect an audience's interpretation of a visual message?



Λ

During this project, students gained valuable experience in critically analyzing their symbol studies and to effectively articulate design concepts and strategies.

[2] Available from www.hablamosjuntos.org

[3] According to American fact Finder United States Census Bureau, by Hispanic population and projections.

Symbol systems have tremendous potential for cross-cultural communication, as is evident in airports, Olympic venues, and other places with diverse user groups (Steiner + Haas). However, their extreme simplicity also risks the possibility of miscommunication. As cross-cultural communication grows and overlaps, symbols must become universal. Yet the serious evaluation of symbols through evidence-based methods[x] remains minimal. This lack can be partly attributed to held misperceptions, time commitments and graphic design's late acceptance of user-centered design methods. Among segments of the professional and academic design communities (unlike industrial design), there persists the perception that by conducting evidence-based testing it will lead to detrimental compromises and inferior designs (aesthetics). User testing is often viewed as low priority item are often not scheduled, much less included in proposals, due to deadline pressures.

The other reason is the graphic design profession's late arrival into user-centered design. Industrial design, by comparison, has for over 40 years integrated user-centered testing into their working processes. With the arrival of the internet, and the absolute need for good intuitive interaction by the user, graphic design could no longer ignore user feedback. These misperceptions and prejudices will continue but over time evidence-based testing will gain greater acceptance.

Changing these existing misperceptions will require active efforts in raising user-centered awareness within the profession and integrating user-centered design philosophy into design curriculums, not merely at the advanced levels (where it can be seen as an afterthought) but at the introductory levels. The curricular effort of this university consortium, then, provides a model for those educators looking for new methods for teaching evidence-based design.

Go to STW website for a copy of the RFA used to select four innovator health facilities to design and implement symbol-based signage at www.hablamosjuntos.org. Design work informed by data and decisions based on the best information available from research and project evaluations.

This symbols system (posters and print ready art) is available at no cost from Hablamos Juntos and SEGD websites. (http://www.hablamosjuntos.org/signage/default.index.asp)

SIGNS THAT WORK, PHASE 1: DESIGN OF THE FIRST 28 SYMBOLS

This symbol design initiative builds on earlier collaboration between the Society for Environmental Graphic Design (SEGD) and Hablamos Juntos (We Speak Together), a center for language policy and practice in health care. Hablamos Juntos is funded by the Robert Wood Johnson Foundation, and administered by the UCSF Fresno Center for Medical Education & Research. The goal of Hablamos Juntos is to develop practical solutions for language barriers to health care in the U.S. One specific objective is to develop easier ways for diverse public users, including populations unable to read and those with LEP, to navigate their way through U.S. health care facilities.

The idea to develop a symbol set for Healthcare facilities came from Yolanda Partida, the national program director for Hablamos Juntos. In the 1970s and again in 2000, Partida visited Mexico City and saw how Lance Wyman's cultural icons had prevailed over nearly 30 years, growing with the subway system (Yew 99). Inspired, Partida wondered whether well-designed universal symbols could be used in US healthcare environments to reach people with limited English proficiency.

Like many other urban transit systems, the subway system in Mexico City uses cultural icons to identify destinations. Symbols have been used there for more than 30 years, making the city's subway system accessible to tourists and those unable to read(webesteem).

Partida was determined to explore possible application of this idea to hospitals, where universal symbols were rarely used. In 2003, Hablamos Juntos began to explore the use of symbols in health care signage. Hablamos Juntos approached the Society for Environmental Graphic Design (SEGD), which created a working group to explore, design and test the first phase of the project. In phase 1, which took place in 2004 and 2005, a group of experienced designers from SEGD designed and tested 28 symbols for the most commonly used hospital referents.

Because of its public familiarity, the U.S. Department of Transportation symbols became the stylistic basis for the design of Hablamos Juntos' new Universal Healthcare Symbol set. The symbols went through clinical comprehensibility tests using a system developed by Harm Zwaga and adopted by the International Organization of Standards (ISO). Each referent and its definition was placed in the center of a five or six spoke "wheel" with a symbol in each spoke. Subjects at four healthcare facilities were then were asked their opinion as to what percentage of the general population would understand each of the presented symbols.

With the leadership of design researcher Wendy Olmstead, 300 participants from four language groups (English, Spanish, Indo-European and Asian) provided input on the candidate symbols.

For further information on phase 1, visit *www.hablamosjuntos.org*.

The first set of 28 healthcare symbols from phase 1.

V

SIGNS THAT WORK, PHASE 2: CURRICULAR DEVELOPMENT

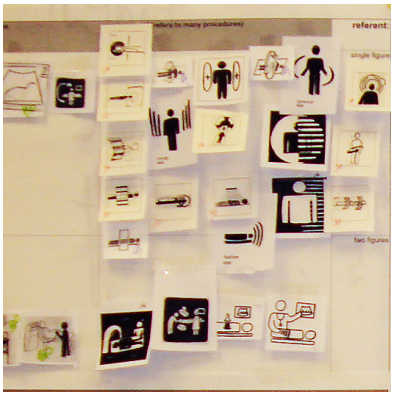
The early work of Phase 1 showed that symbols have much potential as a solution for communication across languages and poor literacy. Although an important early contribution, the collection of 28 initial symbols needed to be expanded, and symbol research for health environments needed to be advanced. A more comprehensive set of symbols was needed to ensure adoption by healthcare facilities.

For these reasons, four Design schools across the U.S. became engaged in a highly focused effort to develop curricular methods for ongoing graphic symbol design and evaluation, and in doing so, to create new symbols for 18 referents to add to the symbol set; for one referent (imaging), approaches for multi-use symbols and specific symbols were proposed.

There were many project goals for the design schools in Phase 2, each satisfying a different stakeholder. These include:

- *for students:* developing fundamental design skills for cross-cultural or universal symbols
- *for educators:* creating curricular methods that can be replicated by other design educators
- *for LEP users:* having a set of symbols that read clearly across different cultural groups
- *for SEGD:* advancing EGD research and education
  for Hablamos Juntos: providing a symbol set that would be adopted by healthcare institutions

The consortium of schools all had wayfinding within their graphic design curricula, and each had experience in user-centered design and design research. A multi-university national consortium of this nature had never been conducted before. With participants in 3 states across a span of 2400 miles and 4 time zones, constant communication was imperative. Hablamos Juntos, SEGD, and the schools met by phone conference on a bi-weekly basis to establish project goals, discuss scheduling logistics, divide responsibilities, and share pedagogy. In addition, academic calendars and differences in course offerings had to be aligned.



REFERENT SELECTION

The 19 symbols that were selected in addition to the 28 symbols from phase 1 was based on an in-depth review of the needs of the four innovator facilities selected to develop symbols based wayfinding programs. The process began with a review of the destination hierarchy of the four facilities dividing them into four basic levels:

- Building Identity
- Building Wings or Units
- Primary Destinations (Departments, Key Functions)
- Support Destinations (Restrooms, Administration, Cafeteria)
- Room Numbers and Addresses

The destinations were placed on a spreadsheet along with a survey of how the innovator facilities reviewed their destination approach. Destinations associated with the first 28 symbols were separated out, and 19 new destinations remained. In addition guidance was developed for the new symbols based on key issues associated with their use in the facility:

a) Referents needed to support four innovator facilities working to implement wayfinding systems with graphic symbols.

b) Referents that support multiple functions in a facility (e.g., Medical Support and Education; administrative functions; nutrition education; library and medical records).

c) Referents that are related to the same basic function but are used in broadly different ways. For example: Mental Health can serve as a clinic, an office, an inpatient facility or a testing location; Dental can be for preventative services, a clinic or a place for surgery; Ophthalmology can be a place for general exams, testing as well as surgery; Ear Nose and Throat can be a location for general examinations, testing or surgery.

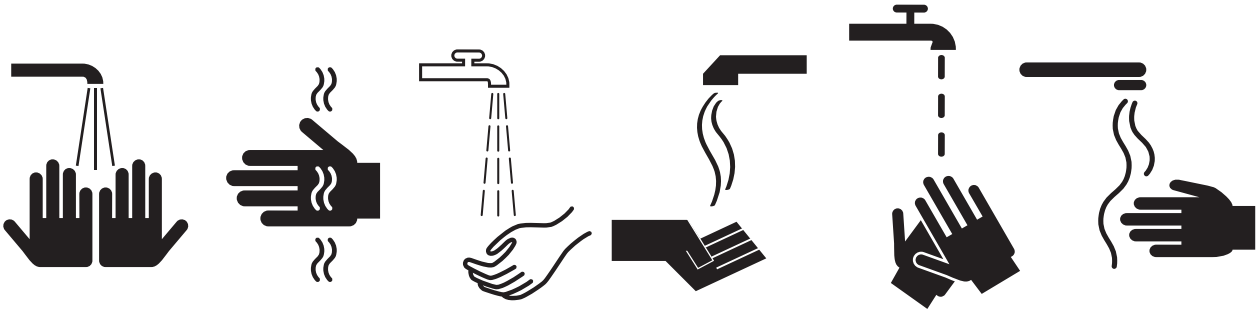
d) Referents that cover an umbrella of activities as opposed to one specific activity. For example, Health Services: Can one symbol cover the multiple health services in a clinic or hospital; Alternative Medicine/Complementary Medicine: Can one symbol cover all the services related to alternative or complementary medicine; Inpatient Unit: Can one symbol cover the range of activities involved in a residential hospital?

e) Overarching referents used as a destination in health care facilities in different ways (e.g. Imaging) to determine how best to approach symbol development when there are multiple subcategories of a root referent.

PRELIMINARY SYMBOL DESIGN ASSIGNMENTS

Before embarking on the design of the new symbol set, consortium members agreed that it was important to prepare the students for the type of form simplification necessary in pictographic visual language. While all of the students had experience with aspects of graphic illustration, they were not all accustomed to the restraints that would be placed on them stylistically, and in many cases were unaccustomed to prioritizing clarity above creativity.

Preliminary experiments in simplified form by Iowa State University students.



As a prelude to the project, the students conducted precedent studies, which included historic overviews, symbol taxonomy, symbol design explorations, and analysis of the existing UHCS symbol set. These included study of the ISO standards (ISO 7000), the AIGA symbols, and many other pictogram sets. Preparatory symbol design assignments were devised at each school to build toward the UHCS symbol set.

At **Iowa State University,** eleven students from five countries worked on preliminary assignments that allowed them to experiment with simplified depictions of human figures, body parts, and tasks. Learning objectives here included simplified form, application of design principles, clarity of message, and respect for the iterative process in design development and refinement.

At **California Polytechnic State University**, each developed a set of symbols representing the five human senses: seeing, hearing, smelling, touching and tasting. Learning objectives included the translation of conceptual ideas and messages into visual communication; the transformation of realistic shapes and patterns into simplified graphic form; the use of both negative and positive shapes to construct symbols; the creation of symbols that work individually as well as part of a series; and communication with diverse audiences.

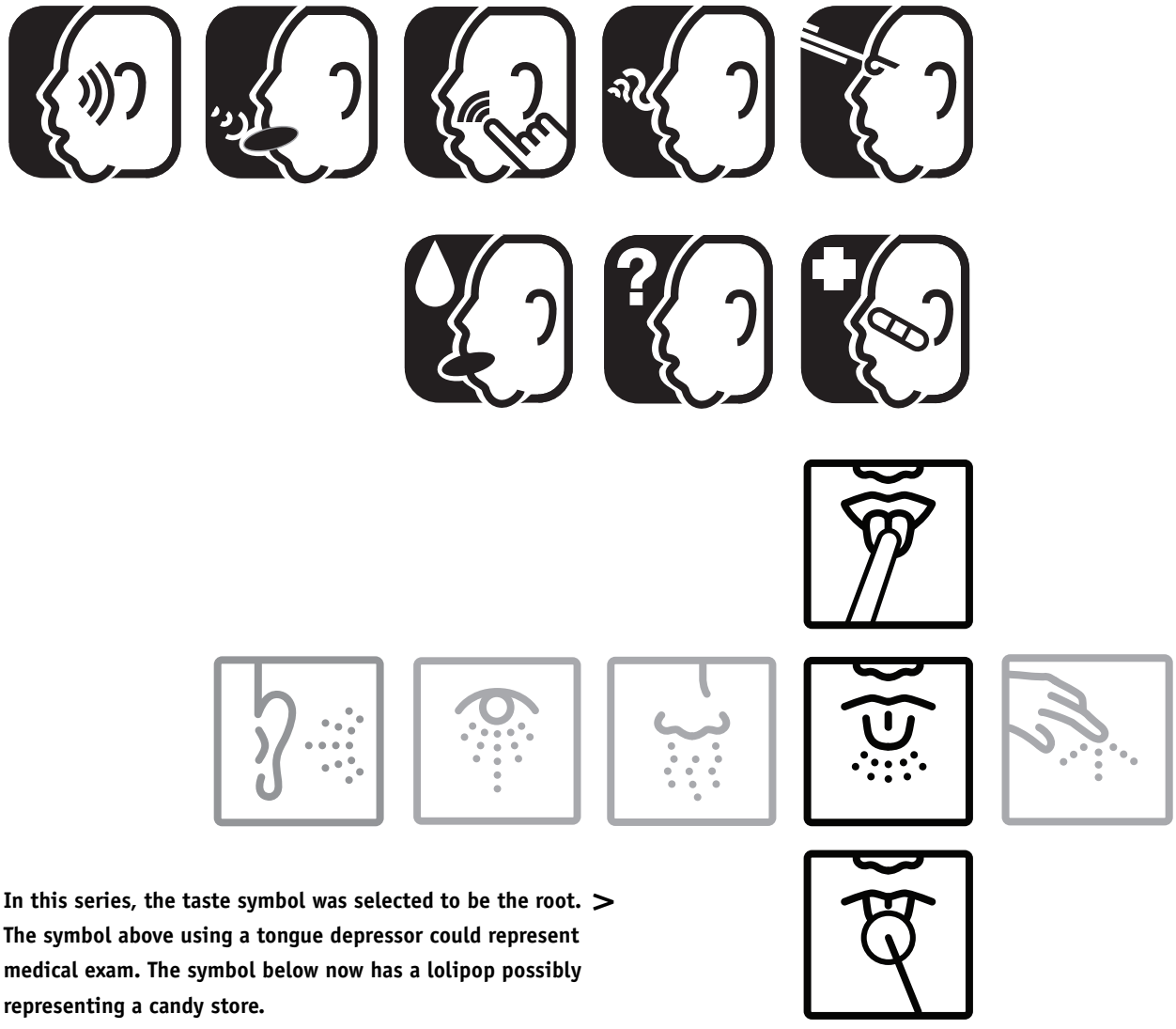
Symbol sets by Cal Poly students.

Students at the **University of Cincinnati's** School of Design also worked on the human senses assignment. The only difference was adding two extended challenges. First, students had to assign a context for their developing symbol set (e.g., a children's zoo, pediatric clinic, natural disaster site, etc.). This allowed the assignment to seem less abstract and more relevant. Students gained a clearer purpose by recognizing a tangible and vital need for their symbols.

In the second challenge, students were to select one of the symbols from their completed symbol set to serve as a "root" symbol.

This symbol family is intended as temporary signage in natural disaster areas anywhere in the world. Assuming relief/rescue teams would be likely language diverse, these symbols would serve as universal warnings.

V



In this series, the taste symbol was selected to be the root. > The symbol above using a tongue depressor could represent medical exam. The symbol below now has a lolipop possibly representing a candy store.

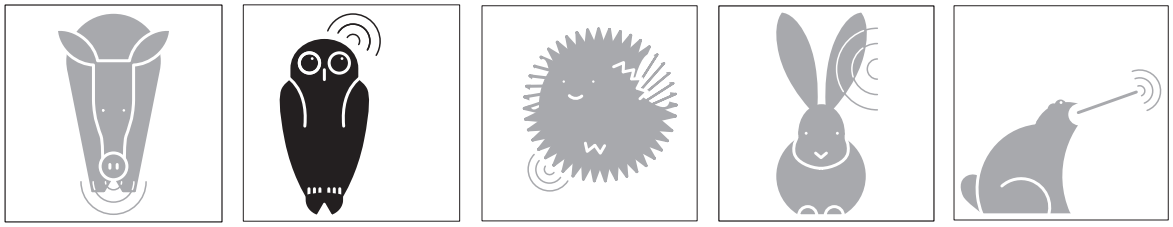
This latter exercise would build student experience for the eventual major project, in particular medical imaging. For hospitals, this represents a major area with subordinate testing areas (e.g., radiology, ultrasound, MRI, etc.). Hablamos Juntos would later ask for design exploration towards developing a root/determinant for Medical Imaging. Later, Medical Imaging was selected for special attention.

Students learned that symbols have to be clearly understood by others. They learned to overcome the misperception that this clarity brings compromise, or somehow lessens the design's quality. On the contrary, they were learning that it invites innovation and assures communicative effectiveness.

The learning objectives would introduce students to design principles for symbols, visual semantic theory, and to adopt working terminology (symbol taxonomy) during the iterative design process. During these preliminary projects, lectures provided historic overviews, and introduced research methods for analyzing and determining user comprehension.

∧

Intended for a kindergarten school nurse station and cafeteria. From top to bottom: touching, seeing, smelling, hearing, and tasting.



< **Students had the option of developing a metaphoric family of symbols for the five senses. Here the student chose animals whose inherent qualities support the five senses. The owl serves as the root.**

ANALYSIS OF THE EXISTING SYMBOL SET

At this point, the students were ready to move forward, but still needed to spend time understanding the parameters of the current symbol set. With this shared goal, each school developed its own methods for this analysis. This would allow for the sharing of each educator's unique methodologies rather than limit the group to one approach. The multiple methods would also allow for a more adaptable curricular model upon completion of the project.

original

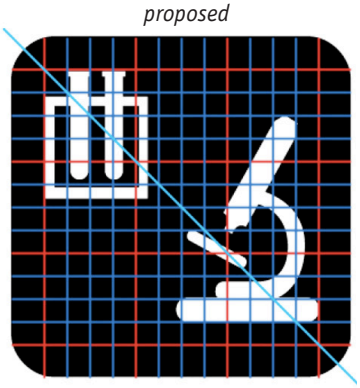
proposed

At **Iowa State University**, students categorized and analyzed the symbols according to issues such as point of view, pictographic style, the use of symbolic elements, the inclusion of contextual elements within the symbols and the existing grid structure and black to white ratio. While conducting this analysis, the students were asked to propose improvements to these existing symbols. While there was no plan to implement the proposed changes, the process allowed students to gain a deeper understanding of how each design decision was made.

original *proposed*

original

proposed

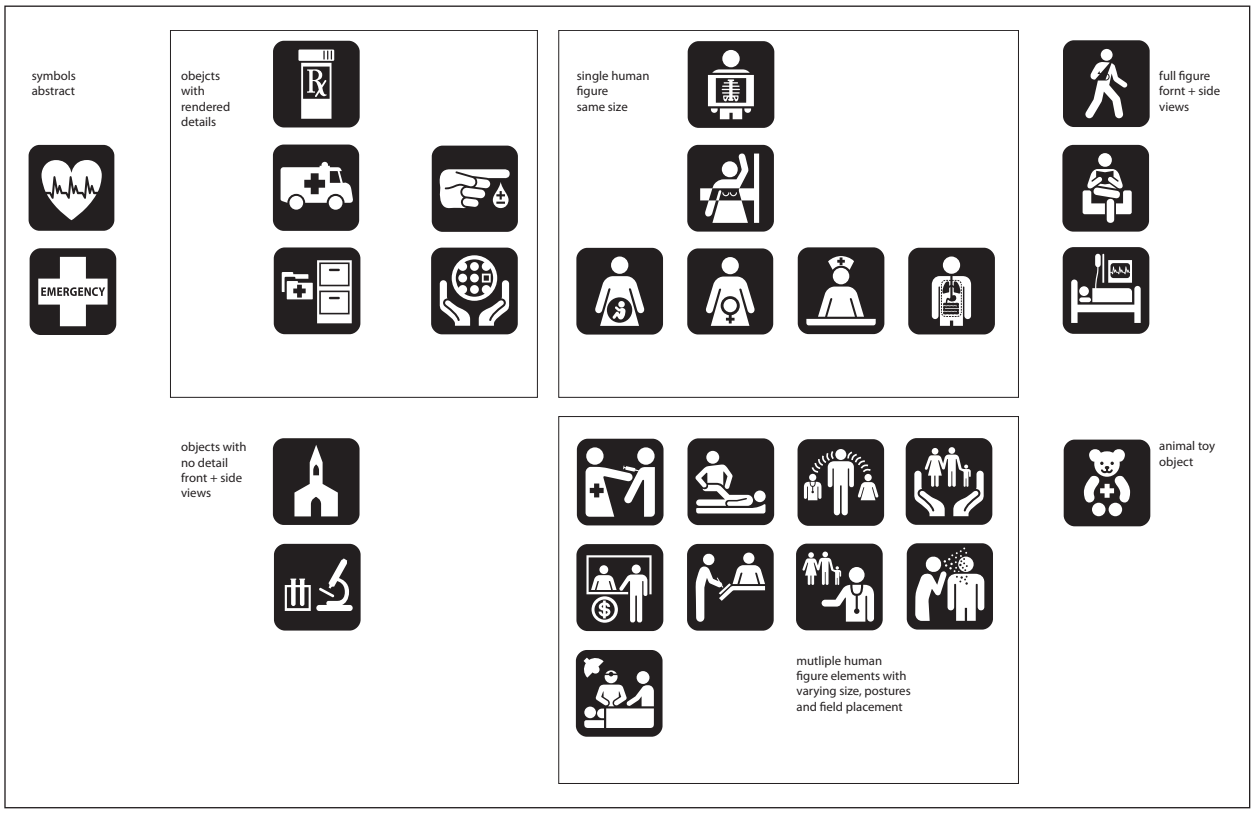


original

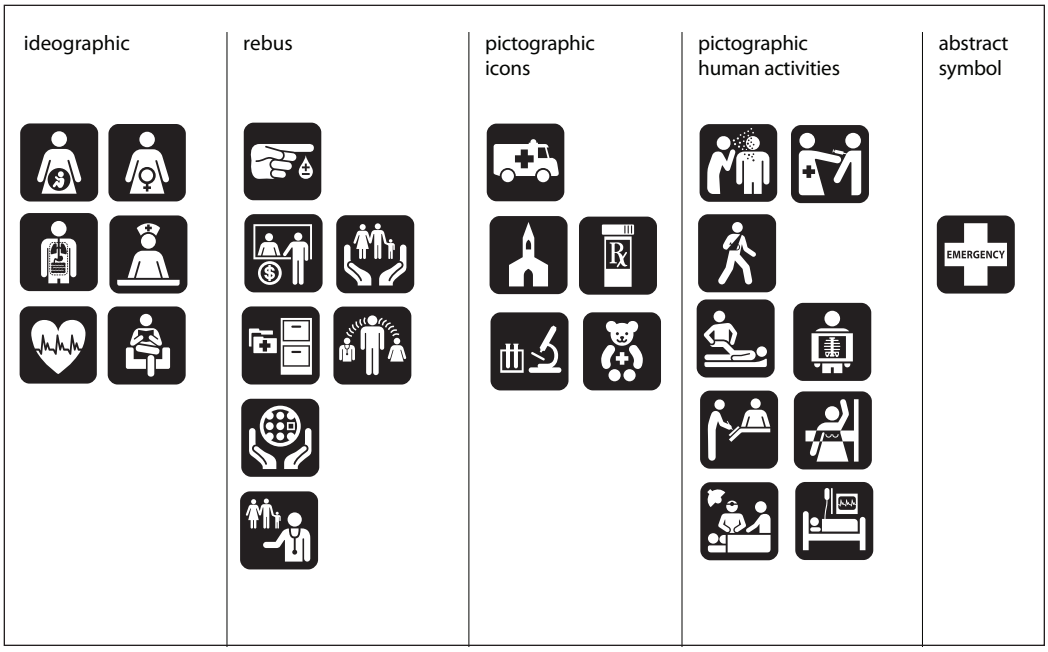
proposed

Students compared the original version to their proposed revisions to determine whether or not the revision actually improved the design.

University of Cincinnati student teams analyzed the existing UHCS symbol set by first organizing them based on similarities such as representational types (abstract to literal), human form treatments (single/group, postures, scale/views, and inference), non-human symbols, and symbol design strategies (metaphor, rebus, pictogram). By this organization, students were able to take note of the inconsistencies and potentials for creating stronger visual syntax within the UHCS symbol set. Just like verbal syntax, certain graphical rules (syntax) needs to be established.



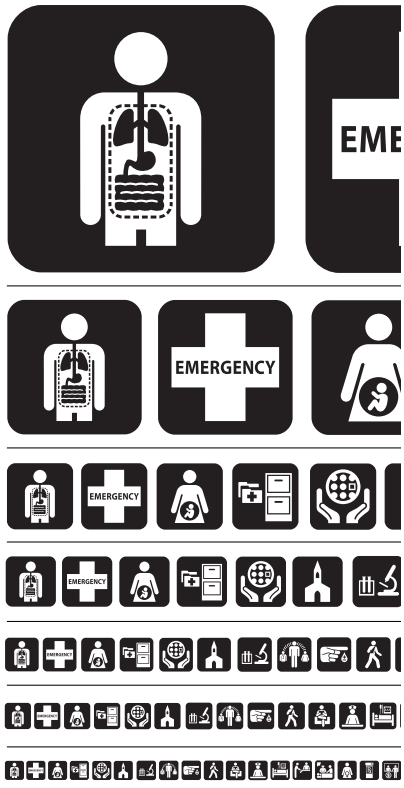
∧ In this analysis, one student team organized the UHCS symbols based on image content differences, similarities, and found annomalies.



One UC student team organized the UHCS symbol set by the design strategies/devices (metaphor, rebus, pictogram, abstract (to be learned). Through this organization, students were able to identify which strategies rely on a user's past experience and knowledge (cognitive maps), which have to be learned over time and which design strategy should be employed for these referents. Ideographic symbols are similar to rebus, where compounds of two or more signs are merged into the design; Ideographic are not separated like a rebus.

To evaluate legibility, symbols were tested at different sizes, consistent with or following the current industry standard for displaying symbols/icons digitally on computer screens.

^ This student team organized the UHCS symbols based on symbol types: ideographic, rebus, pictographic and abstract.



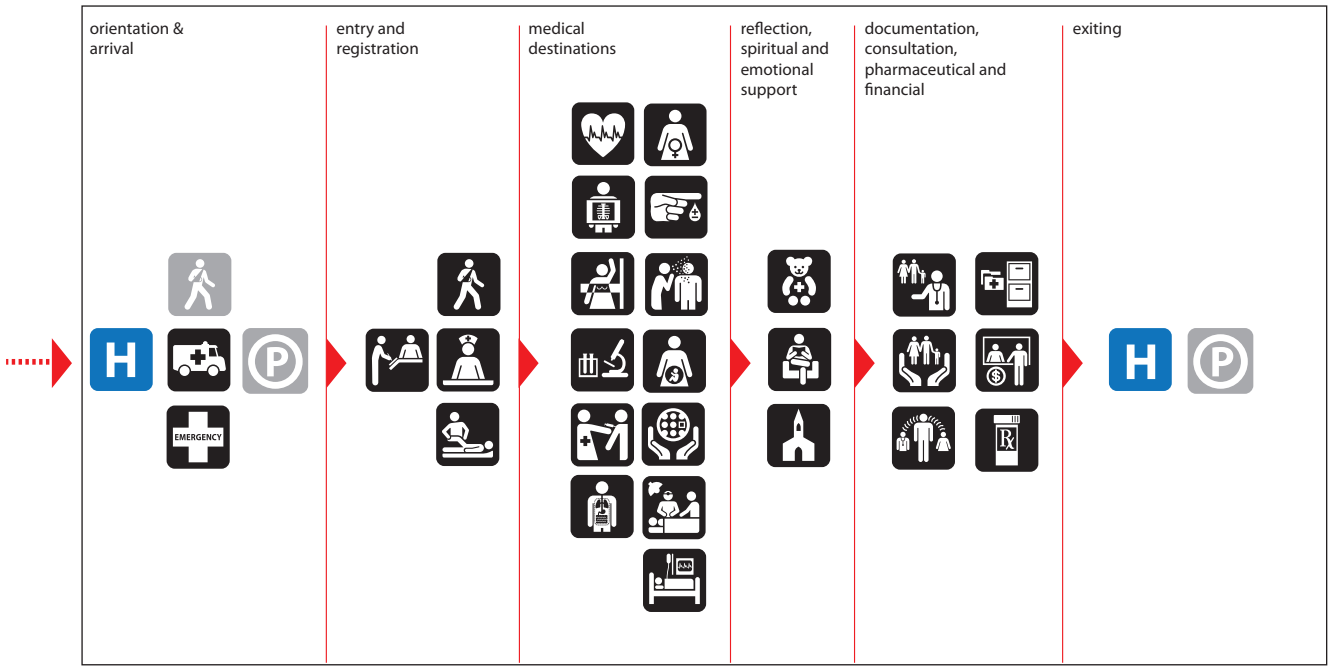
>

Recognizing that theses symbols will not only be displayed in physical environments, but on computer screens too, one student team examined the UHCS symbol set against the industry standards for displaying icons. The row marked with a dot is at 64 pixels squared (.85 inches). ***This chart segment is scaled down here.***

Because audiences today rely and access information online and not just from physical sources (e.g., signage, brochures, oral, etc.), the need to begin testing the UHCS symbols for digital legibility in displays either on computer screens or hand-held devices must be conducted at some point. Because the public user's journey may begin online, their hospital facility orientation and recognizing the symbol for their desired destination starts there as well.

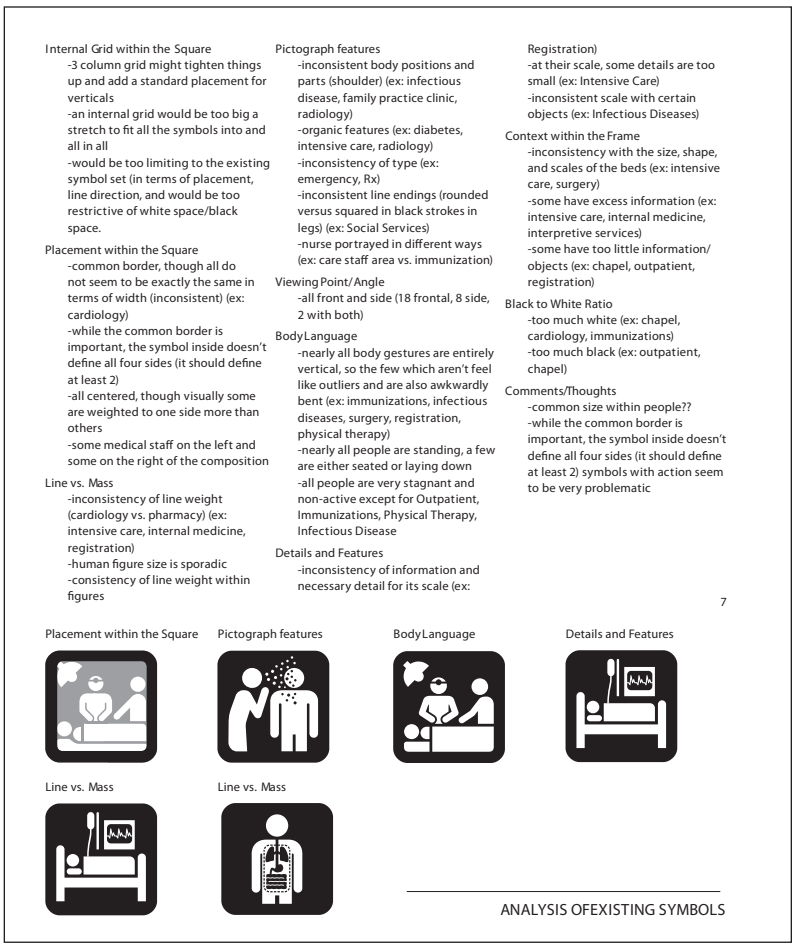
As the UHCS symbol systems continue to grow, attention should also be placed on eventual implementation and for developing guidelines. Doing so would assure acceptance and ultimate effectiveness of the UHCS symbol set. Shown below is a diagram developed by graduate students representing a possible scheme for symbol facility placement based on the public user's probable hospital journey, whether patient or visitor.

A team of graduate students wanted to investigate possible guidelines that would be provided to hospital administrators. This chart would provide the UHCS symbol set with an implementation scheme based on a public user's sequential contact points.



At **California Polytechnic State University,** students worked in teams to analyze the existing 28 symbols. They were asked to consider the test data from phase 1, along with their own analysis, which included many of the same considerations used at Iowa State, including: internal grid, placement within the square, line vs. mass, pictograph features, viewing point/angle, body language, human facial features, context within the frame, and black/white ratio.

The four student teams each approached the assignment and process in somewhat different ways, although there was some overlap in their findings. Team 1, for example, broke the 28 symbols into categories (with some symbols in multiple categories), and looked for visual standards based on such things as line weight vs. mass, placement, and pictograph features.



Internal Grid within the Square
- -3 column grid might tighten things up and add a standard placement for verticals
- -an internal grid would be too big a stretch to fit all the symbols into and all in all
- -would be too limiting to the existing symbol set (in terms of placement, line direction, and would be too restrictive of white space/black space.

Placement within the Square
- -common border, though all do not seem to be exactly the same in terms of width (inconsistent) (ex: cardiology)
- -while the common border is important, the symbol inside doesn't define all four sides (it should define at least 2)
- -all centered, though visually some are weighted to one side more than others
- -some medical staff on the left and some on the right of the composition

Line vs. Mass
- -inconsistency of line weight (cardiology vs. pharmacy) (ex: intensive care, internal medicine, registration)
- -human figure size is sporadic
- -consistency of line weight within figures

Pictograph features
- -inconsistent body positions and parts (shoulder) (ex: infectious disease, family practice clinic, radiology)
- -organic features (ex: diabetes, intensive care, radiology)
- -inconsistency of type (ex: emergency, Rx)
- -inconsistent line endings (rounded versus squared in black strokes in legs) (ex: Social Services)
- -nurse portrayed in different ways (ex: care staff area vs. immunization)

Viewing Point/Angle
- -all front and side (18 frontal, 8 side, 2 with both)

Body Language
- -nearly all body gestures are entirely vertical, so the few which aren't feel like outliers and are also awkwardly bent (ex: immunizations, infectious diseases, surgery, registration, physical therapy)
- -nearly all people are standing, a few are either seated or laying down
- -all people are very stagnant and non-active except for Outpatient, Immunizations, Physical Therapy, Infectious Disease

Details and Features
- -inconsistency of information and necessary detail for its scale (ex: Registration)
- -at their scale, some details are too small (ex: Intensive Care)
- -inconsistent scale with certain objects (ex: Infectious Diseases)

Context within the Frame
- -inconsistency with the size, shape, and scales of the beds (ex: intensive care, surgery)
- -some have excess information (ex: intensive care, internal medicine, interpretive services)
- -some have too little information/ objects (ex: chapel, outpatient, registration)

Black to White Ratio
- -too much white (ex: chapel, cardiology, immunizations)
- -too much black (ex: outpatient, chapel)

Comments/Thoughts
- -common size within people??
- -while the common border is important, the symbol inside doesn't define all four sides (it should define at least 2) symbols with action seem to be very problematic

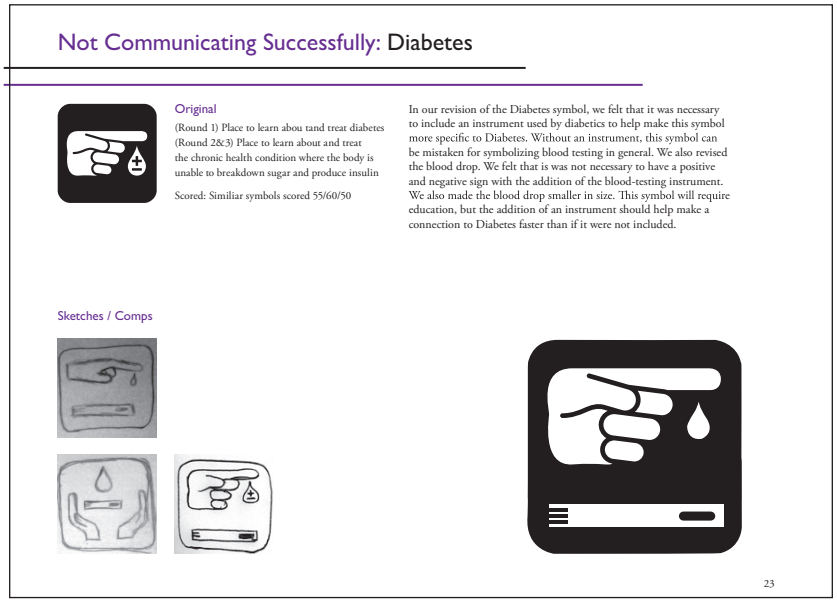
7

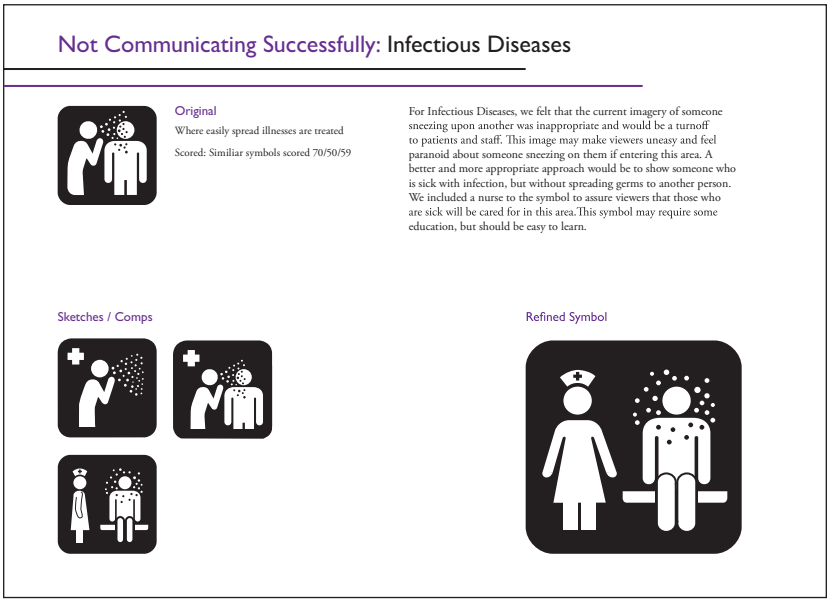
ANALYSIS OFEXISTING SYMBOLS

<

Excerpt from group one's analysis.

Some teams analyzed why the group of 'successful' symbols were effective with reasons such as simplicity and symmetry, visual uniform characteristics, and unity through abstract references. They then analyzed the test data and identified 11 symbols that didn't pass and/or were below the approval rate of 87 for re-design. Finally, they made minor changes to some of the remaining 17 symbols.





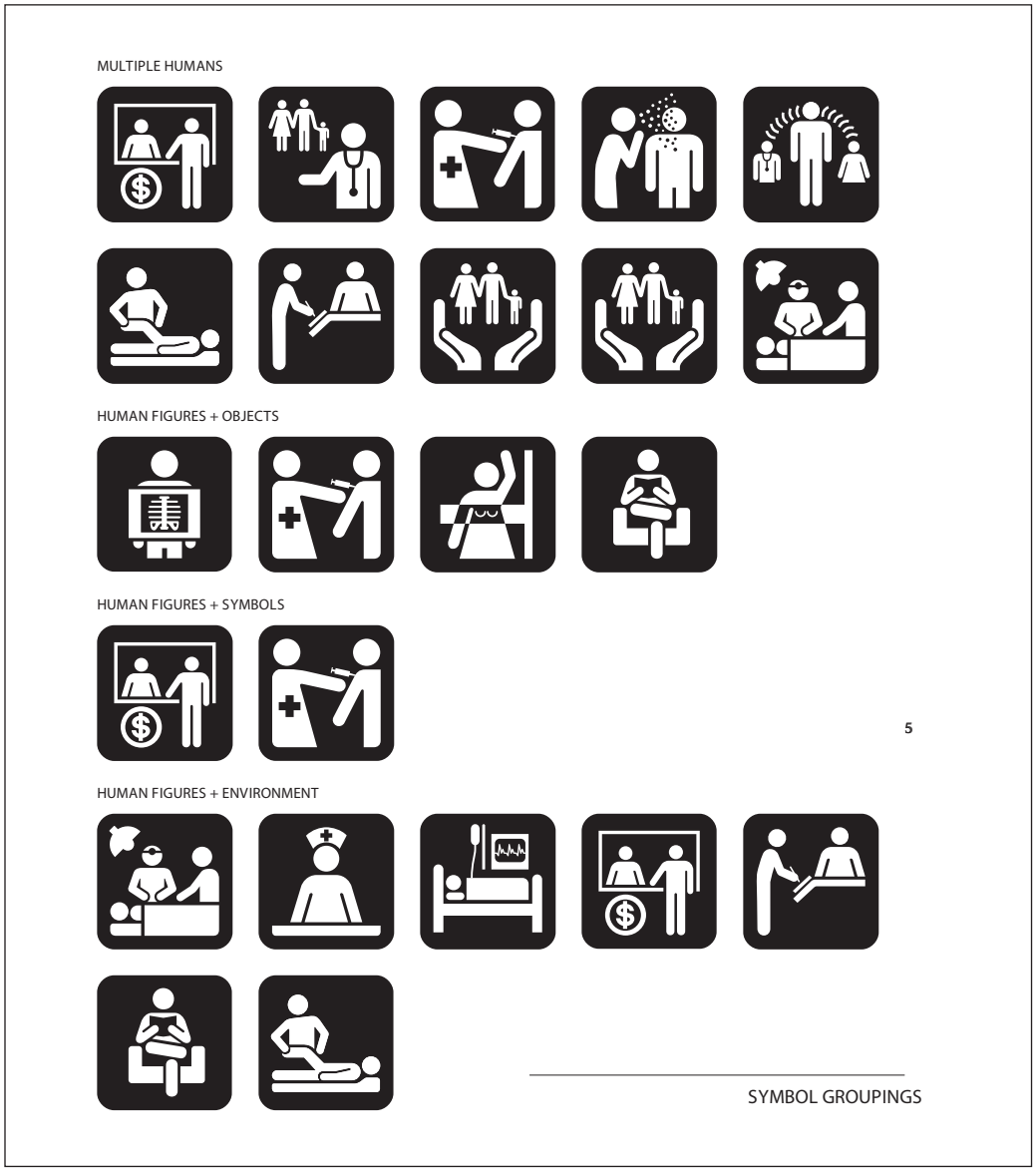
Excerpts from group three's analysis.

<

Other evaluation strategies used were to group the symbols (for example, human figures only, human figures + objects, etc.) and to compare pictographic symbols vs. ideographic symbols.

Excerpt from group one's analysis.

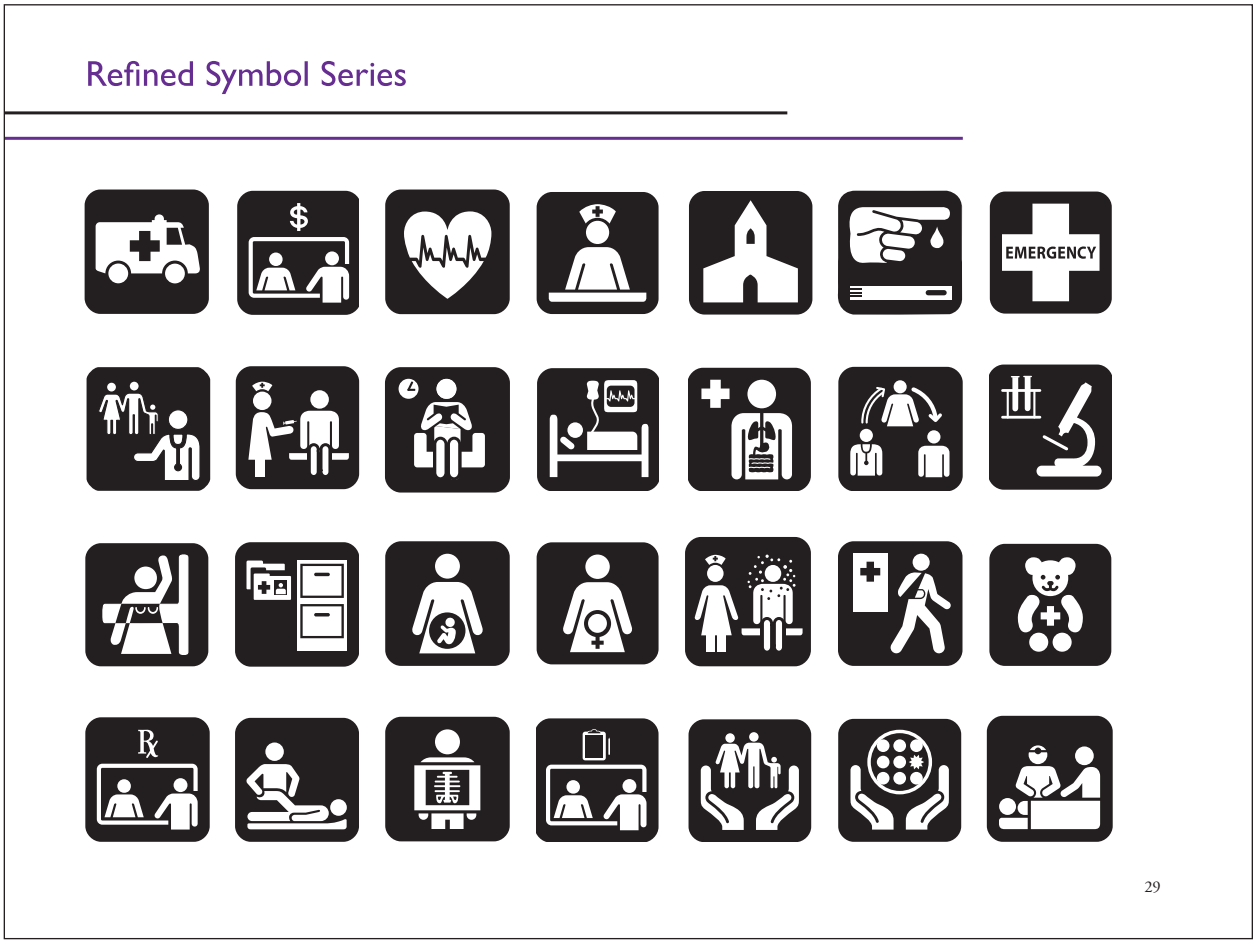
V



In the end, each of the four groups proposed a refined symbol set.

Excerpt from group three's analysis.

V



The study at **Kent State University** took place a year earlier than the other three schools, but proceeded in much the same manner. Students initially studied the symbol design work of designers such as studio Dumbar, Otl Aicher, Lance Wyman, Henry Dreyfuss and many others, to achieve an some general understanding of the recent history of the design of graphic symbols. Students first went through an analysis of the orginal 28 symbol set, and looked carefully at the test results, seeing which symbols finished highest and tried to determine what they had in common. With less successful symbols, often those with more a complex story to tell, students explored the possible problems in communication.

Preliminary studies of new symbols for the Oncology referent.

V

The students at Kent State University studied the formal characteristics in much the same way as Iowa State University and California Polytechnic State University, including the use of internal grid, line vs. mass, scale of elements, consistency of form, etc. Those symbols that either did not make the adoption threshold, or were untested symbols base on a combination of elements from higher test symbols of the same referent were studied and redesigned for further testing.

For each of these referents, the highest scoring symbols were augmented by new designs, and edited to five symbols for each referent to retest in through the same process as the previous tests.

The Kent students found that the majority of symbols adapted for use by the Hablamos project maintain the simplicity and black/white balance achieved by the AIGA's symbol set, while many others have varying degrees of complexity that make them difficult to read from a distance. The Kent State students approached the redesign of the symbols by striving for the visual simplicity established by the AIGA set.

SYMBOL DESIGN PROCESS

With the preliminary assignments accomplished, students were ready to begin ideation for the new symbols. A challenge for any symbol designer is to achieve simplicity of form yet clarity and richness of concept. This challenge is heightened with the demand for universality in communication across multiple cultures. Symbol systems have tremendous potential for cross-cultural communication, but their extreme simplicity also risks the possibility of misunderstanding.

For many of the students, cross-cultural clarity was a new criterion in their design work. This might seem surprising, given the multicultural world we live in, but not when you consider how many design criteria points presented to them with each new assignment. The students have been exposed to basic communication theory, which does consider the audience, and some of the students have studied semiotic theory, which examines the relationship between the signifier and the signified (Meggs 51). These fundamental theories prepared them to explore the cross-cultural nuances of each symbol's message.

One fortuitous learning experience in this project was the fact that the students gained tolerance and empathy for others of diverse cultures and languages. While learning to design for cross-cultural communication, the students were reminded that design is about the user's needs, not the designer's preferences. Emphathizing with user's who face communication challenges provided students with an example of this fundamental value.

CHALLENGES DURING THE SYMBOL DESIGN PROCESS

Many challenges arose while the students worked on symbol concepts for each referent. While each referent presented unique issues, some challenges were common to many of them. For example:

How does the new symbol fit into the existing symbol set? Is it close enough in style and approach to feel like it works within the system? How close can a new design be to the existing symbols without being too close?

Some referents support multiple functions in a facility (e.g., Medical Support and Education). How specific should symbols be in communicating a destination? For example, Can one symbol serve for all financial issues in a facility, or will it require multiple symbols? This question can be applied to other referents, such as administration, library, health education, nutrition, etc. How does a symbol achieve simplicity while at the same time alluding to an umbrella of activities?

Another challenge relating to specificity was the fact that each healthcare facility may have a different structure and/or set of services for each referent. For example, one might have a Kidney Center that includes dialysis, while another might not. Some medical departments might perform surgeries in their area of specialization, while others do not. How should these differences be accommodated in the symbol design?

Should the symbols emphasize health or illness? This question was presented to the schools by Hablamos Juntos, which expressed a concern about a possible negative message that could result from a series of illness depictions. The designers were convinced that the symbols could not show a “lack of illness” since the mere absence of something communicates nothing. Instead, they considered the possibility of showing the healing process of a disease rather than the illness itself as a response to this concern.

Another issue that was discussed in the development of all referent symbols was the knowledge level of the patient users of the wayfinding system. True, a patient visiting a particular medical department likely knows much more than the average person about the illness or disorder in question. In a wayfinding system, however, these symbols would be most helpful to first-time visitors to the department. In that case, how much do they already know about their condition? Perhaps in subsequent visits they will be very knowledgeable, but it is their first visit to the department when the symbol performs its most important signifying role.

SYMBOL DESIGN CHALLENGES: ADMINISTRATION

Administration was defined as offices for management and business services. While we had a general idea of what that meant for a health care facility, it was necessary to do some research on the kinds of 'offices' those were and the responsibilities that administrators hold. Compared to many of the other referents, this was somewhat unique because it was not specifically linked with a medical condition or a type of health care. Early on, we examined and discussed the relationship between administration and the symbols for medical records that was designed in Phase One. It seemed that we would need to relate administration to medical records, while simultaneously differentiating these offices.

Our research led us to question whether it was necessary to introduce a new figure to the set that was not a doctor, nurse or patient. How could we most accurately describe administrators and/or what they do? Many discussions revolved around whether or not the figure should be male or female, as well as how to differentiate that figure from a patient. We also questioned whether we needed a figure at all, which led us to explorations of the 'tools' that administrators use as well as the kinds of places these offices are found within a health care facility. Once we had conceptual directions, we faced challenges to relate the new symbol to the existing set formally. For example, if we used a figure, should he or she be behind a desk (as with Billing), should the file folders be the exact same size and in the same location as Medical Records, etc.

SYMBOL DESIGN CHALLENGES: ALTERNATIVE/COMPLEMENTARY

Alternative and Complementary Care centers offer a multitude of services, ranging from acupuncture to herbal medicine and massage. These services will vary widely from one healthcare facility to another. This presents a challenge for symbol design, since the objects depicted in the symbol may refer to services not offered at each destination. The question, then, is whether or not the symbol needs only to refer to the topic enough to allow recognition, or if it will confuse the patient to show services that are not included locally.

Another consideration here is that alternative medicine refers to those services used instead of traditional medicine, while complementary medicine refers to those used in tandem with traditional medicine. For the symbol to represent both of these, it must avoid any references to the rejection of traditional medicine.

Other challenges included the questionable recognizability of the mortar/pestle image, which many students thought might represent an ancient approach to medicine. While this element is fairly well known in the U.S., does it convey the message to non-English speakers? Other visuals used included leaves to represent herbal medicines, but this image has so many other meanings (ecology, gardening, etc) that its use could be confusing. Also, herbal medicine is not offered at all centers; would the leaf be a clear enough message if it merely represents a natural approach and not specifically an herbalist? Another challenge here would be how to show acupuncture, a process that involves very thin needles. How can this be depicted in a symbol set that requires thick, strong lines?

SYMBOL DESIGN CHALLENGES: ANESTHESIA

This referent assignment was challenging from the beginning. It was well understood what happens to the patient, but the key question was: why a sign? In what situation would a patient be instructed to go to anesthesia? Not ever finding a good reason, nonetheless students assigned this referent pursued the localized numbing of the body.

SYMBOL DESIGN CHALLENGES: DENTAL

One of the first challenges related to creating a symbol for Dental was that most of us didn't immediately associate dental care with a hospital or health care facility. Although it was defined as a place to get care for gums and teeth, should this symbol represent or include oral surgery? Would this symbol be used for a more advanced or extended type of dental care?

After initial research, we immediately came up with the idea of using an icon of a tooth for the symbol. Could we depict a tooth somehow so that it indicated a need for care? The idea of a tooth seemed the most clear and direct, but how would it relate to the rest of the symbol set? From the previous twenty-eight symbols, we identified the Chapel, Pharmacy, heart (Cardiology) and bear (Pediatrics) as symbols that communicated in a similar way, but there were not formal characteristics in those symbols that would relate. There were questions of how organic the form of the tooth could be while still relating to the set.

We also had discussions about whether using dental instruments or showing dental procedures could be effective. The challenges with these directions were that we suspected an association of pain or negative connotations with some dental practices. Would showing a doctor and/or a patient emphasize the care aspect? Should we incorporate the hands from the Social Services symbol to emphasize care?

SYMBOL DESIGN CHALLENGES: DERMATOLOGY

Discussions on this referent, dermatology, revolved around whether or not the symbol candidate should convey cosmetic enhancement or medical treatment. The tactile (touching) aspect for conveying the meaning was important. The skin is highly sensitive. We confirm skin abnormalities not only by sight but by touching. Therefore, students felt inclusion of the human hand was necessary. During initial studies, students found use of graphic textures (irregular arranged dots, different sizes, line patterns, etc.) against clean surfaces on figure/face worked best.

SYMBOL DESIGN CHALLENGES: EAR, NOSE AND THROAT

This referent proved most significant in helping enhance and graphically expand the UHCS symbol set. In Phase I, no referent called for any close-up views of the human figure or a face. This immediately directed students to explore facial views, front and side, and degree of detail (e.g., ears, eyes, nose, nostrils, etc.). From these efforts, it introduced another graphic tool to the overall symbol system and to solve for other referents.

SYMBOL DESIGN CHALLENGES: GENETICS

For the Genetics symbol we were immediately drawn to depicting a strand because it is an already established and fairly recognizable symbol itself. This led us to formal challenges of drawing a strand so that it was clearly identifiable while also using the same graphic language as the rest of the symbols. How much could it be simplified and still read? Was it more recognizable in a vertical or horizontal orientation? How could such a narrow and linear symbol fit in with the others?

We also questioned how to incorporate learning about hereditary traits as they relate to health and health conditions. How could we make the strand medical? We explored adding the cross, but had difficulty relating the two separate symbols. In other symbols, the

cross is housed within another object, but it was impossible to put it inside of the strand. Should we introduce the hands again to depict a care aspect associated with hereditary traits? Would a figure or multiple figures help to extend meaning beyond just hereditary traits and into relating them to health and health conditions?

SYMBOL DESIGN CHALLENGES: HEALTH SERVICES

Health Services, defined as services to improve general physical and mental well being, was very challenging to understand because it seemed to include everything within a health care facility. Our initial reaction was that all of the other symbols fell under the category of Health Services, so how could we be that broad and encompassing while still making the symbol unique and descriptive? We questioned whether pulling from other symbols— like using the cross, the stethoscope, and the pharmaceutical bottle, for example— would help the symbol fit into the overall set. However, these symbols were already representing other facilities and services and that could potentially be very confusing. We also explored using a doctor, nurse, and/or patient. Again, how could we depict them so that the symbol was broad and encompassing enough, and not confused with any other symbols? Finally, we explored symbols other than the cross that represent medicine in a general way. The caduceus, for example, could do that, but how could we combine it with, or incorporate it into another symbol that represented 'services?'

SYMBOL DESIGN CHALLENGES: HEALTH EDUCATION

In the context of a healthcare facility, any reference to education will be clearly related to health education. What are the most recognizable visuals to depict education? If a teacher is shown, should that person be male or female, doctor or nurse? Should students be shown as well? Is the health education experience done in classroom situations or as one-on-one?

Another consideration is the possible use of the apple as a known symbol for education. While the American students were convinced

about this image, the international students had no familiarity with this as a sign for education. Even the American students did not realize that Apple Computer was named to make reference to their role in education. Since we had no Hispanic students or any from the Indo-European groups, it was decided that the apple could be included in at least some proposals, so that the testing would help determine its familiarity in those groups.

SYMBOL DESIGN CHALLENGES: INPATIENT

Our first challenge with the Inpatient symbol design was to understand the differences between Inpatient and Outpatient services and care. It seemed almost immediately apparent that we should use a patient in a bed for the Inpatient symbol, but we would need to clearly differentiate it from Intensive Care and Surgery. Should the patient be sitting up or lying down? Should the patient have visitors or be supervised by a doctor and/or nurse? How could we depict 'overnight?' Many explorations were done showing additional and more permanent elements of a patient room, like a curtain or clock, for example, as well as experimentation with multiple beds/patients.

SYMBOL DESIGN CHALLENGES: KIDNEY

The most prominent service offered in a kidney center is dialysis, a process that filters the blood of people with malfunctioning kidneys. This process is very visible, with tubes going in and out, but could be intimidating if shown literally. Some students focused on the attributes of purification, recycling, and filtration as a way to depict the dialysis process without showing the actual relationship of patient and machine. Others were concerned about using dialysis as a representation of a department that offers so many other services; they felt it must be limited to depictions of the kidney and avoid featuring one procedure over all others. In anecdotal testing, it was discovered that some people don't know the difference between kidneys and liver.

SYMBOL DESIGN CHALLENGES: MEDICAL LIBRARY

The first question students had was whether or not to relate to or actually use the existing library symbol, and somehow make it 'medical.' Explorations were done adding a cross or caduceus to the library symbol in an effort to expand or relate its meaning and communication. Discussion also emerged around the idea of simply showing books— both open and closed, individual as well as stacks or rows of books, etc.— and how to make them specific to medical. One challenge with the book concept was how to relate that form to the other symbols. Was a figure necessary to formally integrate this symbol into the set? If a figure were used, how would it relate to other symbols that use a figure (front vs. side view, half or three quarters figure, etc.)? Could the Medical Library symbol draw from the Waiting Area symbol in which a figure reading is used?

SYMBOL DESIGN CHALLENGES: MENTAL HEALTH

Initially, the challenge with the Mental Health symbol was to research and understand the wide variety of services that fall under this medical specialization. Ranging from study and care of the actual brain as it relates to mental and behavioral health to therapy for relationship problems, the definition of the referent seemed broad and diverse. In addition, the services will likely vary from one healthcare facility to another, which like the Alternative/ Complementary Care symbol, means that the objects in the symbol may refer to services not offered at each destination. There was also a lot of consideration about distinguishing Mental Health from the Neurology symbol, and not creating confusion between the two.

There were many general discussions about ways to depict the symbol in a 'healthy' or positive light vs. indicating that a patient was mentally unhealthy or disturbed. Metaphors for health and happiness were challenged for their universal understanding. Ultimately, this was probably the most challenging symbol for the students to design.

SYMBOL DESIGN CHALLENGES: NEUROLOGY

Fortunately, students assigned the referents, neurology and ear/nose/throat, were able to simultaneously develop head views to convey both meanings. In discussions, it was often debated whether too much emphasis was being given to the brain when conveying neurology. Certain students included studies of the whole figure and the nervous system. Yet, the majority in class felt the brain is the "hardrive" and must be prominent.

SYMBOL DESIGN CHALLENGES: NUTRITION

An icon of an apple came up in early discussions and ideation about the Nutrition symbol. Although some felt that it was a very recognizable symbol for healthy eating, others questioned whether or not representing only one food group was accurate enough in representing a complete diet. There was even discussion about whether or not an apple had too much connotation to the corporate computer company. Many sketches and studies were done experimenting with multiple food groups and simplified imagery of different kinds of food that would be understandable. One challenge here was to keep the symbol simple enough. Many variations were ruled out for simply having too many elements in them to read instantly. There was also a lot of discussion about the symbol of the food pyramid. Is that an image that is universally recognized and understood? If so, what other element(s) need to go with it to make it relate to food and not appear to be a triangle or a pyramid that could be associated with math? Studies were done with a plate and utensils to communicate 'eating' and 'diets,' although some felt that those images related too much to the well-known restaurant/dining symbol.

Finally, there were questions as to whether or not a figure should be included: a doctor to make it relate to health care and fit in with the other symbols? A patient so that it was not only about food, but included the human aspect?

SYMBOL DESIGN CHALLENGES: OPHTHALMOLOGY

While our first ideas were to simply use an icon of an eye for Ophthalmology, there were challenges as to how to draw it with enough detail to read as an eye, and also be simple enough to work with the symbol set. In addition, many discussions arose about the actual shape of the eye and any cultural implications that might be inferred.

Another challenge was that at this point in the process, there were not any symbols that cropped the head only or symbols with facial features. Should we introduce that idea with this symbol or stick to the language of the existing symbols from Phase One? Were there ways to show eye care with a figure without showing facial features? What were universally understood practices associated with eye care? We had a preliminary design review with all of the students and outside reviewers, including Jack Biesek, who worked on the symbols of Phase One, and there was a lot of discussion about using a symbol of eyeglasses for Ophthalmology. On one hand, it communicated instantly and was very recognizable in terms of symbol design, but was it accurate enough in communicating a place to get eye care?

SYMBOL DESIGN CHALLENGES: PATHOLOGY

Early discussion for the Pathology symbol revolved around the use of the microscope and/or test tubes and the symbol for Laboratory. What was the relationship between the two symbols? If Pathology is a place where the conditions and processes of a disease are evaluated, how is a laboratory different? How is it the same? We did a lot of experimentation based on whether the two symbols should be closely related or clearly distinct.

There was also a lot of discussion about the relationship of the Pathology symbol to the Oncology symbol. With the symbol of cells already established, could we build off of that so that it would relate, but distinguish it from being treatment that is specific to cancer. Many felt that it was important that a figure should be included to emphasize the evaluation process. Should the figure be a doctor?

What equipment would the figure most often use (microscope, test tubes, file folders, etc.) in their evaluation?

SYMBOL DESIGN CHALLENGES: RESPIRATORY

Many of the challenges for the Kidney symbol were also present for the design of the Respiratory symbol, and in some ways, we thought that we should either determine one before the other, or make sure that they both took the same approach in communication and formal depiction. For example, if a drawing of the kidneys with a cross were used for the Kidney symbol, then it would make sense for Respiratory to be a drawing of lungs with a cross. Likewise, if a figure were used in one symbol, the other should follow the same strategy.

Another challenge was that Respiratory was defined as a place to get services for lung or breathing problems. If the solution simply had an icon of lungs, would that clearly communicate breathing problems as well? What were some of the ways to depict breathing or problems with breathing? Like many of the other symbols, students were faced with the dilemma of how to show treatment and portray a healthy scenario or solution versus a negative image that communicated illness.

SYMBOL DESIGN CHALLENGES: IMAGING

As has been discussed elsewhere, Imaging is a complex referent, with many distinct subtopics underneath the larger umbrella. In fact, this referent was seen as so challenging that the schools were asked to consider both universal and specific approaches. Instead of designing for one "imaging" referent, the students explored the subtopics of Ultrasound, MRI – PET, Cath Lab, in addition to the main referent (mammography and radiology already exist in the phase 1 symbol set). This presented a series of communication challenges. For example, how much does the patient know about the procedures, or the machinery used? What part of the body should be shown in the symbol, in cases such as Ultrasound or MRI where the procedure is done on many areas? Should the symbols show the machinery, the

process, or the resulting image? Does this depend on the specific referent or should their be a consistent approach?

One challenge for designing a universal Imaging symbol was in deciding which procedure to feature. The imaging services are so varied, it would be difficult to determine which one could stand for all. One thing they all share is the need to look inside the body to learn things that cannot be seen otherwise; could this 'looking in' be a conceptual attribute that would help create a universal message?

Other challenges were unique to the specific imaging categories:

ULTRASOUND

The ultrasound test has a very recognizable image shape, which is helpful for clear communication. One concern was whether or not to use a fetus in the image. The ultrasound process is used to examine all parts of the body, not just to look at a fetus, so perhaps some will feel excluded by a symbol that seems to be focused on pregnancy. Still, the prevalence of the ultrasound fetus image is the reason so many people know what the technique is in the first place. So is it better to make use of this familiarity, even if the patient knows they are having an ultrasound on their neck or chest? Are we concerned only with the patient's ability to understand the symbol, or do we need to consider whether it offends or excludes them?

MRI-PET

These machines look alike and there would be no advantage to trying to show a difference. The machines can be very intimidating, and if one hasn't yet been inside one, they may not know that it rotates around the body during the test. Yet rotation is one of the most visible attributes of these procedures. How can rotation be depicted? Another concern was that the view from the front of the machine (which is the most distinct view showing the circular machine) is the most confusing view for showing a person. The person would be best depicted from the side, while the side view of the machine denies its circular shape.

Should the patient be depicted inside the tube, or just outside on the table? If inside, how is it known where they are? How much context is needed to indicate they are inside a tube? Other concerns had to do with whether to show the concept of penetration/infiltration, and if so, how to do that in a non-threatening way.

People are sensitive to the notion of radioactivity, and even though MRI doesn't involve radiation, it still involves the mysterious process of something penetrating through, and might therefore be considered by some as invasive.

How should an invisible process like magnetic resonance be depicted? Would patients visualize this as waves, as radiating lines, or some other shape? Which is the most frightening, and which is the most accurate?

CATH LAB

One question here is the patient's familiarity with the procedure and associated machinery. The machine is quite unique, which is good for symbol clarity, but it's not known how informed the patient is before they undergo the procedure. Also, the machine is quite large; will the size of the machine be frightening? Should the symbol show a caregiver alongside the patient, so that it doesn't seem like one is sent into the machine alone? Although the healthcare sites had requested this referent, students questioned whether or not a patient would really navigate their way to the Cath Lab on their own. It seemed to some that this was a procedure that one would be wheeled into on a stretcher, rather than walking to the Lab.

SYMBOL DESIGN CHALLENGES: ROOT SYMBOL & DETERMINANT DESIGN STRATEGY

The root symbol/determinant approach for diagnostic imaging referent, which began as a simple request for the consortium schools to investigate other symbol approaches, proved promising. Student teams at the University of Cincinnati developed several studies with each demonstrating the visual mechanism, a constant graphic root with a different and replaceable determinant able to change the symbol's meaning. This approach is nothing new. In fact, it goes back thousands of years. Hieroglyphics used by ancient Egyptians often employed root/determinants to help comprehend their rather complex writing system. Today, different languages apply determinants to cue the reader to the proper pronunciation (e.g., accents and umlauts). Likewise, in graphic symbols, determinants provide a meaning cue based off the constant root. This approach provides benefits not only in effective comprehension, but in helping to differentiate not only procedural destinations but medical departments. It is like establishing a symbol nomenclature which can then provide the user better facility orientation.

SYMBOL DESIGN: IOWA STATE UNIVERSITY

First, the referent topics themselves had to be researched through in-depth conceptual analysis. Students developed a list of conceptual attributes for each referent: what are the broad ideas associated with it? How does it differ from other medical topics? Why do people need it or want it? This focus on attributes helped the students to focus less on what the medical topic looks like, and more on why it's needed. For example, attributes that were identified for Kidney Center included purification, recycling, and circulation. When the topic was difficult or impossible to visualize, these attributes became extremely helpful. For example, attributes for Mental Health include such concepts as metamorphosis, struggle, and conflict resolution; these invisible processes cannot be depicted iconically.

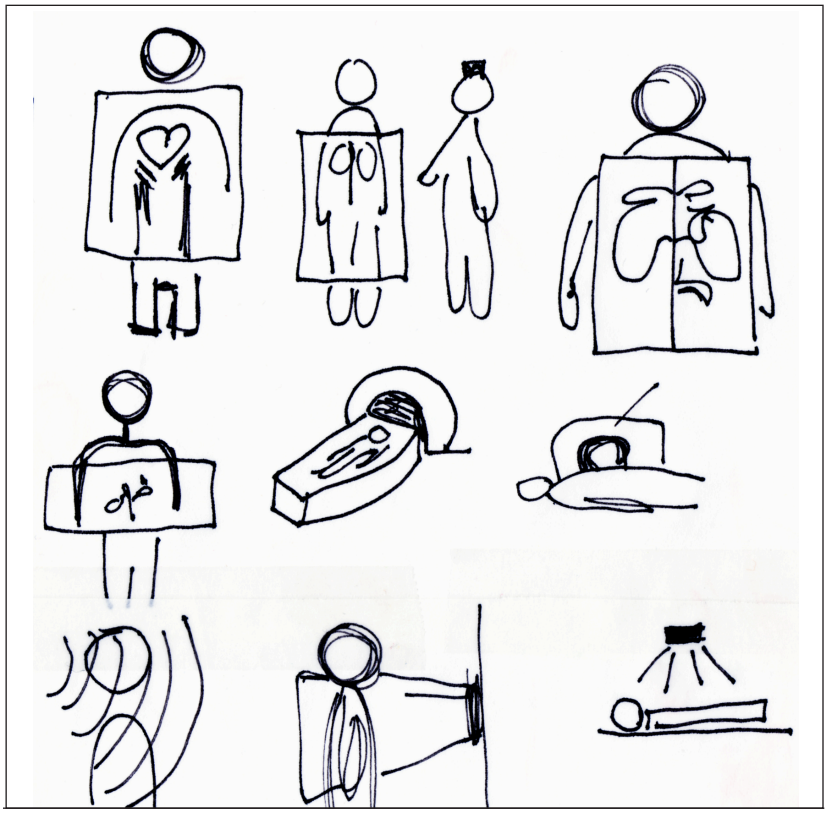
How, then, to show invisible processes in the language of pictograms? Can they be expressed metaphorically?

CONCEPTUAL ATTRIBUTES: MENTAL HEALTH

metamorphosis
balance
overcome adversity
journey
balanced - unbalanced
process
support
acceptance
struggle
rejuvenation
transformation
healing
partnership
helping
centering
conflict resolution
hope
inner peace
self-actualization
stillness
emergence
unraveling
consultation
enlightenment
wellness
clarity
peacefulness
openness

Early sketches for Mental Health; Iowa State University.

<



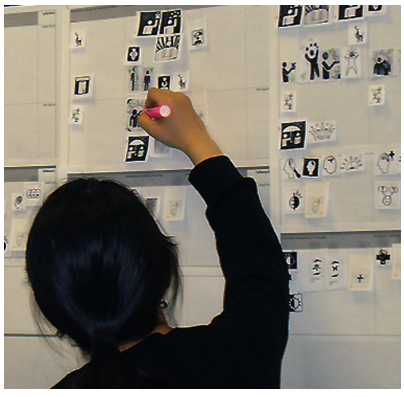
Students not involved with the project were asked to create very quick sketches of each referent. This offered insight into what people actually know about the human body and about medical procedures.

<

International students from Ghana, Romania, Korea, China, India and Taiwan offered input on the clarity of certain symbolic elements that the American students assumed were universal. Some American symbolic elements had no meaning to international students (apple to represent education, light bulb to represent ideas) while others were hotly debated (butterfly to represent metamorphosis, yin yang to represent Chinese medicine).

V

As clarity and accuracy were refined, a matrix was developed to evaluate the similarities and differences in approach for each referent. Were we emphasizing healing or illness? Were we showing medical procedures, and if so, were we very specific to one procedure or more universal? Were we using metaphors and symbolic references? How often did we use human figures? Heads only? No figures at all?



Once the symbol sketches had reached a stage of conceptual refinement, the attributes list was again employed; this time the attributes were positioned on a matrix along with a student's best contenders for each medical referent.

IMAGING	Radiate	Rotate	Examine	Enclose	Tube	Energy
	✓			✓	✓	
			✓			
			✓		✓	✓
	✓					✓
				✓		✓

These in-progress matrices help to made it clear how well each of these symbol contenders is communicating the intended messages, and which ones lack depth or express fewer attributes.

<

In viewing some of the final symbol candidates for Imaging, one can see how the conceptual attributes are carried through.

V

rotate

radiate + enclose

energy + penetrate

enclose

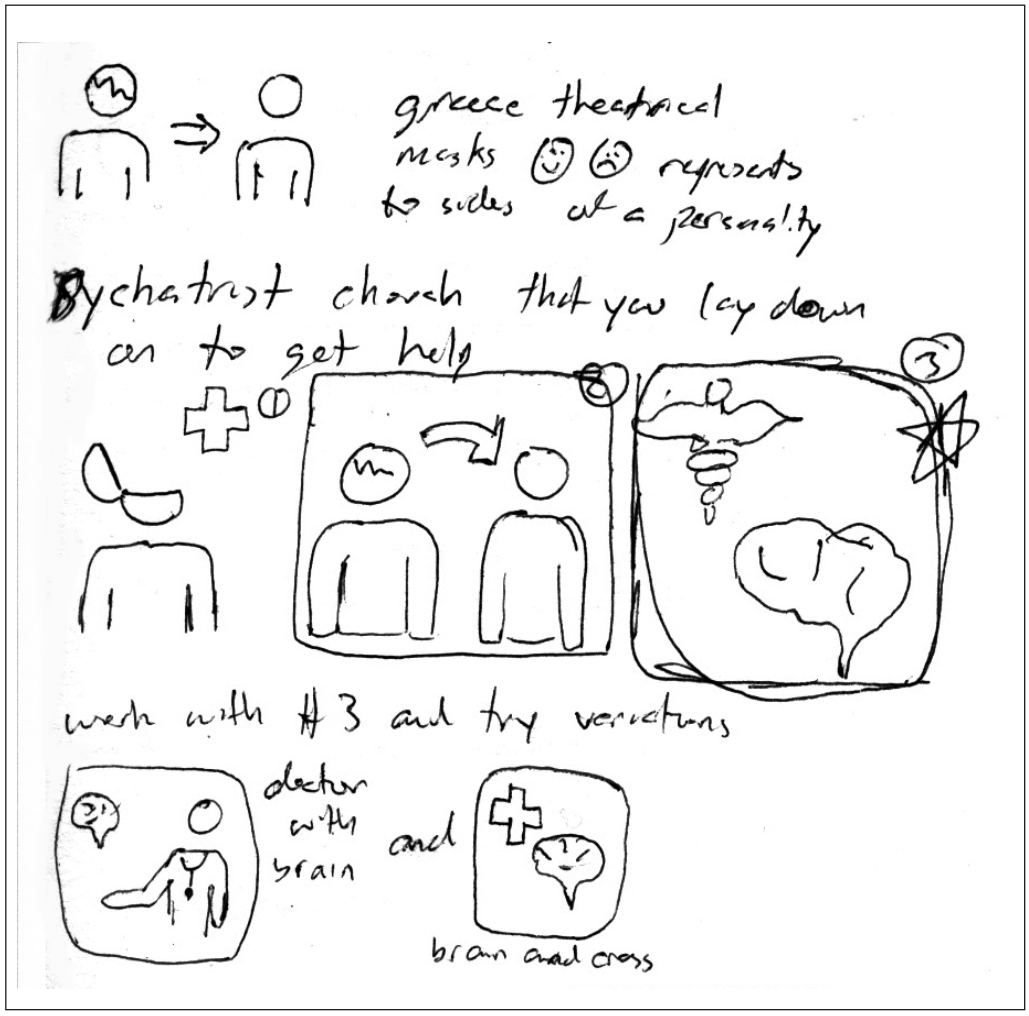
radiate + enclose

focus + enclose

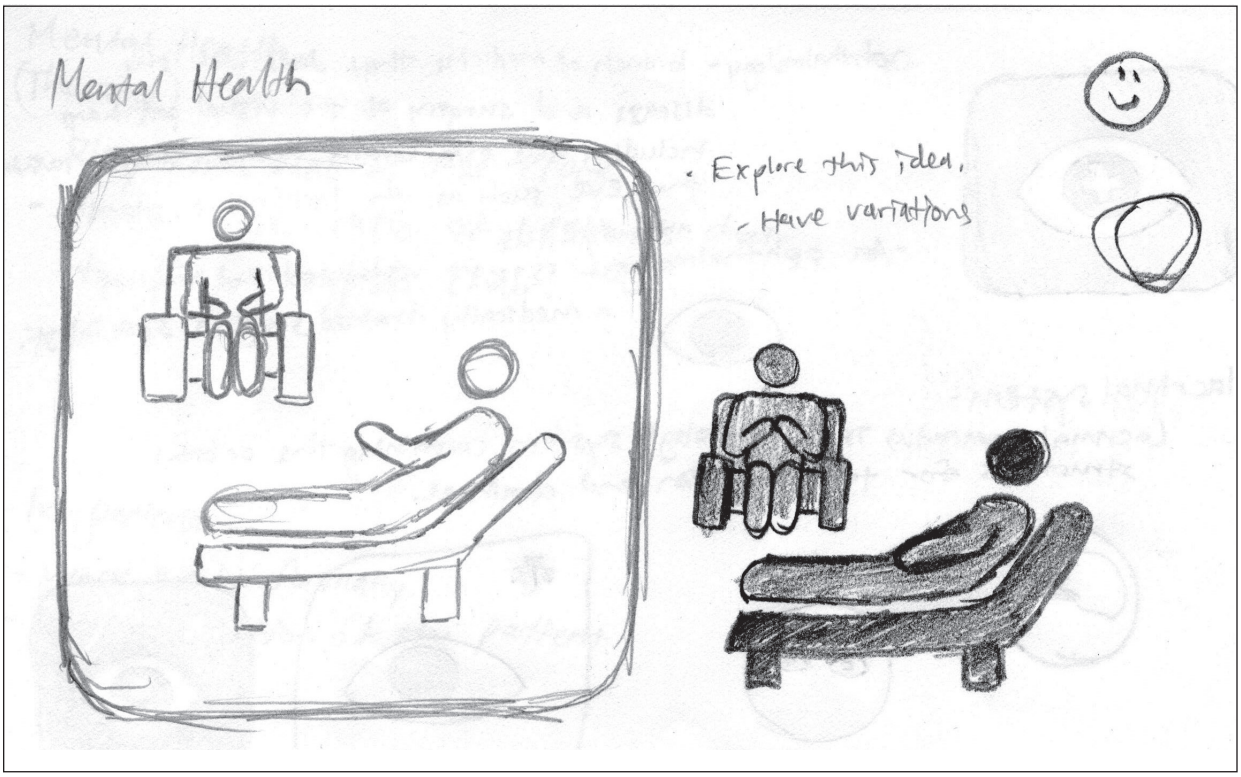
Shown below is a collection of symbols developed by the students of Iowa State University.

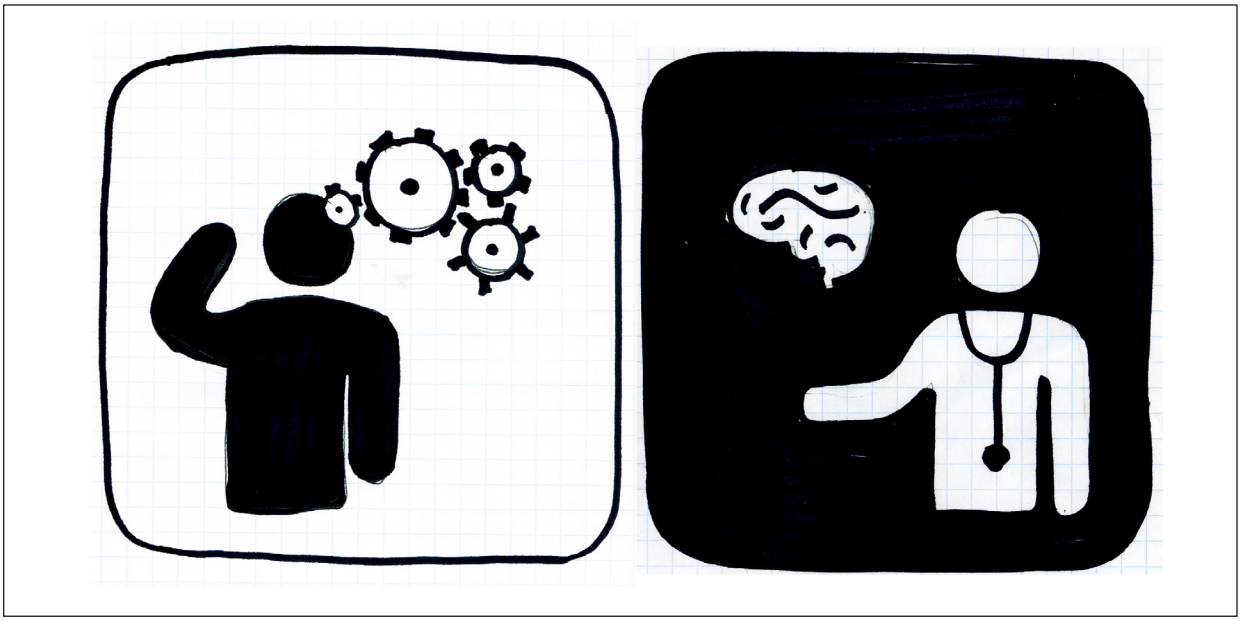
SYMBOL DESIGN: CALIFORNIA POLYTECHNIC STATE UNIVERSITY

At Cal Poly, research began in teams, with students extending beyond the given referent definitions to thoroughly understand the medical services for which they were designing symbols. Students then did quick, loose sketches, trying to consider what would come to mind for a broad audience of non-designers. They considered multiple meanings and interpretations based on cultural differences, and looked for commonalities that cross cultures.

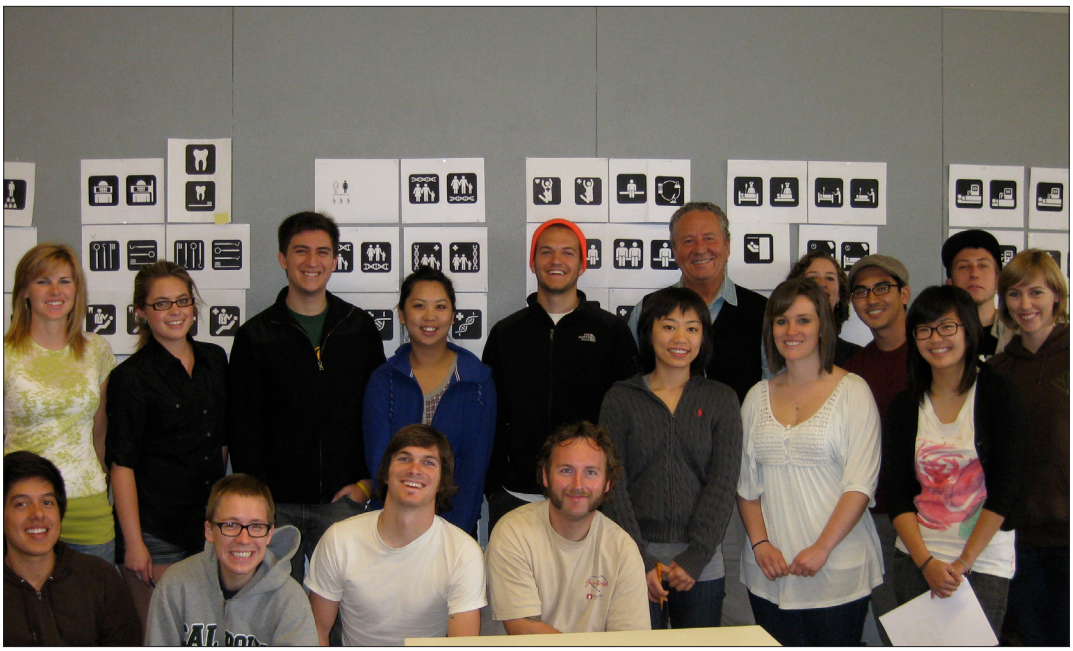


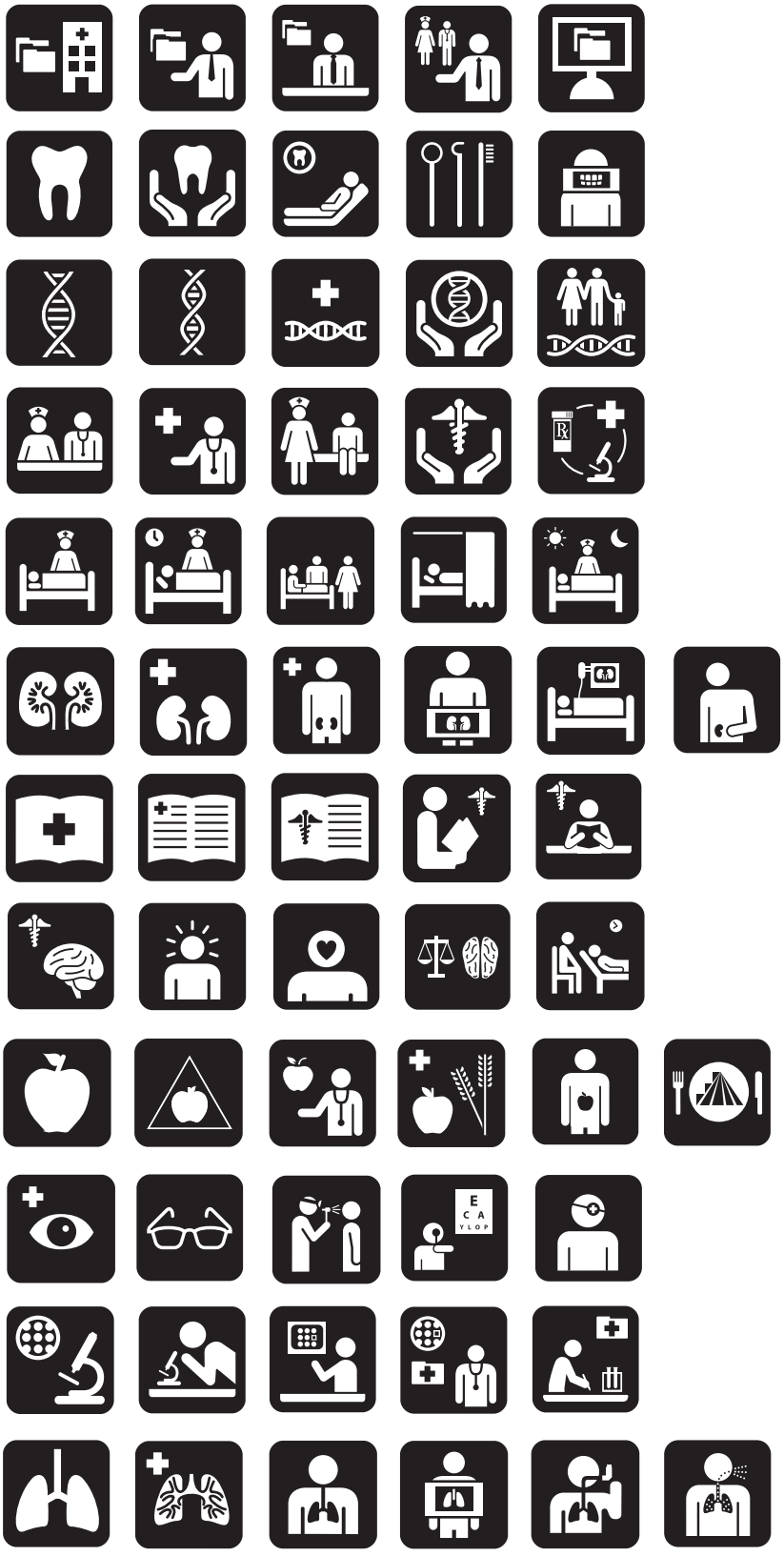
They concentrated on both the symbol candidate's abiity to communicate to an audience (correct interpretation: semantics), and on the formal nature of the graphic (syntactic).





In group discussion students pinned up all of the ideas; Jack Biesek, a designer from Phase I of the project, visited the critique to help identify the next steps. Students then developed variations for each symbol, considering the symbol's meaning and communication, as well as how it related to the overall set.





Shown here is a collection of symbols developed by the students of California Polytechnic State University.

SYMBOL DESIGN: UNIVERSITY OF CINCINNATI

When investigations began for the referent, ear/nose/throat, it quickly became apparent the existing UHCS symbols' visual vocabulary (the human figure and head) had limitations. The geometrically constructed shapes of circles, rectangles and lines, did not provide adequate visual information or supportive context. Needed were close-up views for the head. Precedence already exists in the UHCS symbol set; the diabetes symbol shows a close-up view of a hand. Yet, simply increasing the human head's white circle makes the symbol too abstract and "cartoon like", losing credibility.

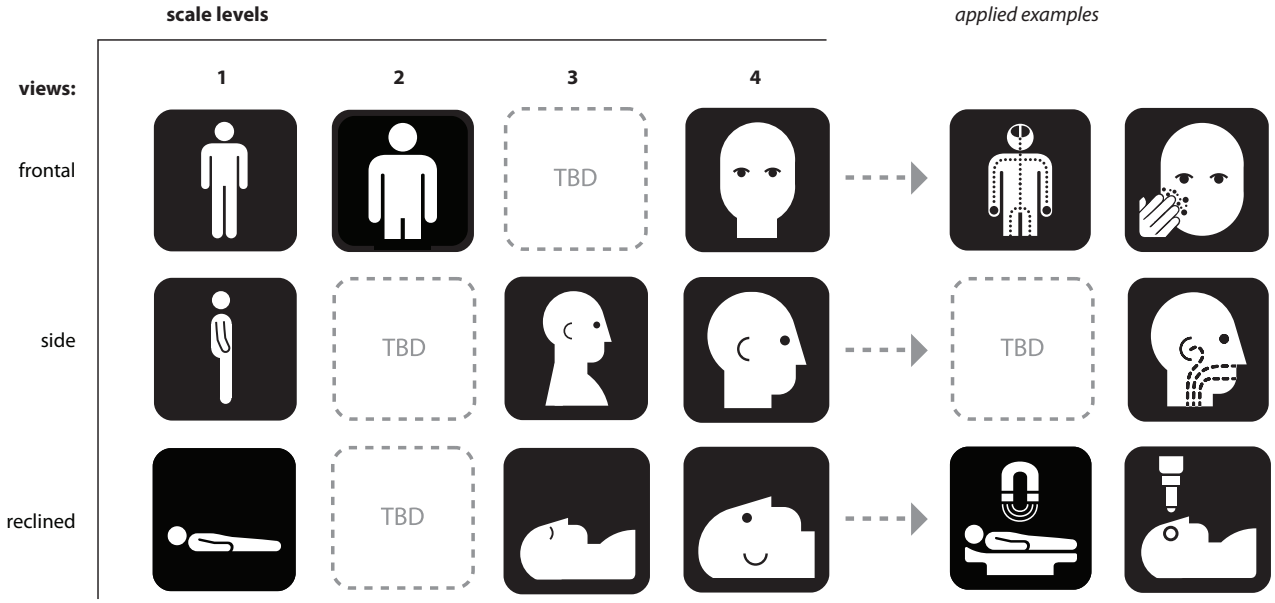
Λ

Students assigned the ENT referent, immediately recognized the graphic limitations of the UHCS human figure. Phase I did not encounter any referents with close-up facial/head. Attempting to derive symbols from the geometric figure proved unsuccessful.

Student teams began to explore new views of the human figure, especially of the head and head/shoulders. These studies and results would lead to student recommendations to adopt standardized views of the human figure and head. Below is a student team's proposal strategy. It calls for a matrix of three established views of the human figure: frontal, side and reclined and four scaled distance views: 1 being the farthest while 4 is the closest. Developed in one school term, this recommended view matrix, seen as having much potential, would be adopted by students in the following school term. The matrix and examples developed from its basis are shown.

Right two vertical rows below show examples of students' application of the standardized views concept to their symbol solutions. TBD = To be determined.

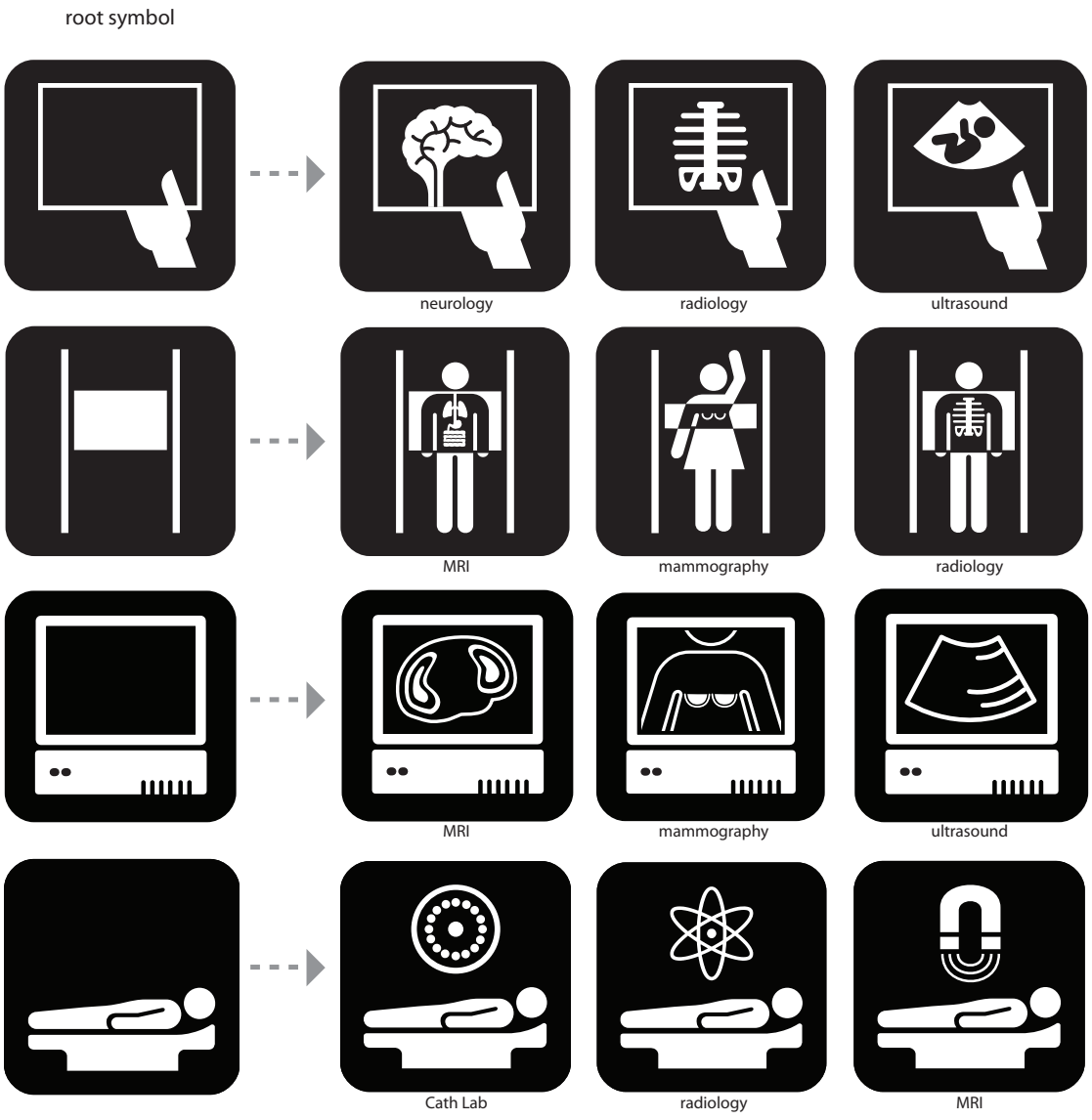
V



From the preparatory assignment, the human senses symbols and root/determinant concept, student teams now applied that experience towards the development symbols for the referent/s for diagnostic imaging and its imaging and its subordinate imaging capabilities. In several proposed directions, all utilized the same method of an established non-changing graphic root and the insertion of a graphic determinant to assign the proper imaging sub-referent. Below is one proposal showing the root as being a hand holding a piece of rectangular shaped frame (piece of film, sheet of paper or computer screen) and inside the determinant, radiology, ultrasound and MRI scanning.

Four student teams developed and proposed their design strategies for the imaging root symbol.

V



Shown below is a collection of symbols developed by the University of Cincinnati students from March to August 2009.

SYMBOL DESIGN: KENT STATE UNIVERSITY

Similar to the other three schools that followed, the Kent State students selected new referents for redesign to extend the existing symbol set, although only five of the referents chosen were the same as those designed by the other three schools. The design of these symbols followed the same consistent process used in developing new symbols for test of the original 28 symbol set. This included referent research, conceptual design studies, group discussion and finished symbol designs.

Shown below is a collection of symbols developed by the Kent State University students.

FINAL SYMBOLS SELECTED FOR FURTHER TESTING

Shown below is a collection of final symbol candidates by students from all four schools that were carried forward for testing.

This symbol design initiative provided an unparalleled educational opportunity to advance not only research and design of graphic symbols, but also to improve understanding of how these symbols can assist communication between language diverse public users and health care providers in the U.S. Although the multi-university approach was at times a logistical challenge, the opportunity to share pedagogy was invaluable. The educators learned methods for introducing students to new user-centered design processes and testing methodologies. Students developed an appreciation for research and working within the restrictions of an existing symbol set, and increased their cross-cultural awareness. Hablamos Juntos and SEGD achieved their intended outcomes, and will support and disseminate the education consortium's methods and deliverables.

BIBLIOGRAPHY

Abdullah, Rayan. *Pictograms, Icons and Signs*. Thames & Hudson; 2006

Ackerman, Marion, and Rathgeber, Pirkko. *Pictograms: The Loneliness of Signs*. National Book Network. 2007.

Asa Berger, Arthur. *Signs in Contemporary Culture: an Introduction to Semiotics*. Sheffield Publishing, Salem, Wisconsin. 1999.

Caplin, Steve. *Icon Design: Graphic Icons in Computer interface Design*. Watson Gutpill, New York. 2001.

Cowgill, Jamie, et al. *Symbol Usage in Health Care Settings for People with Limited English Proficiency*. Hablamos Juntos. 2005.

Crow, David. *Visible Signs*. AVA Publishing. Lausanne, Switzerland. 2003.

Dreyfuss, H., 1984. *Symbol Sourcebook: An Authoritative Guide to International Symbols*. Van Nostrand, Reinhold, New York.

Frutiger, Adrian. *Signs & Symbols: Their Design & Meaning*. Van Nostrand Reinhold, New York. 1989.

Evamy, Michael. *World Without Words*. Watson Guptill Publications. 2003.

Hall, Sean. *This Means This, This Means That: a User's Guide to Semiotics*. Lawrence King Books. London. 2007.

Hirsch, E.D. *Cultural Literacy*. Vintage Books, New York. 1988.

Holmes, Nigel. *Wordless Diagrams*. Bloomsbury Publishing. New York. 2005.

Hora, Mies. *Official Signs & Icons 2*. Ultimate Symbol Inc. 2005.

ISO 9186-1:2007. *Part 1: Methods for Testing Comprehensibility*. International Organization for Standardization; 2007.

ISO 9186-2:2008. *Part 2: Methods for Testing Perceptual Qualities*. International Organization for Standardization; 2007.

Jones, S., 1978. *Symbolic representation of abstract concepts*. Ergonomics 21 4, pp. 573–577.

Macnab, Maggie. *Decoding Design: Understanding and Using Symbols in Visual Communication*. How Books, Cincinnati, OH. 2008.

Meggs, Philip. *Type and Image: The Language of Graphic Design*. John Wiley and Sons, Hoboken, NJ. 1989.

Mollerup, Per. *Wayshowing: A Guide to Environmental Signage Principles & Practices*. Lars Müeller Publishers, Baden, Germany. 2005.

Morgan, John, and Welton, Peter. *See What I Mean: an Introduction to Visual Communication*. Edward Arnold Publishers. 1986.

Pavio, A., Rogers, T.B. and Smythe, P.C., 1968. Why are pictures easier to recall than words? Psychonomic Science 11 4, pp. 137–138.

Pierce, Todd. *International Pictograms Standard*. Watson Guptill Publications. 1997.

Standing, L., Conezio, J. and Haber, N., 1970. Perception and memory of pictures: single trial learning of 2500 visual stimuli. Psychonomic Science 19, pp. 73–74.

Steiner, Henry, and Haas Ken, *Cross-Cultural Design: Communicating in the Global Marketplace,* Thames & Hudson. 1995.

Vukelich, M. and Whitaker, L.A., 1993. The effects of context on the comprehension of graphic symbols. In Proc. Human Factors Ergonomics Soc. 37th Annual Meeting, pp. 511–515.

Yew, Wei. *The Olympic Image: The First 100 Years*. Books Nippan. 1997.

Harm J. G. Zwaga, Theo Boersema and Henriette C. M. Hoonhout, editors. *Visual Information for Everyday Use: Design and Research Perspectives*. London: Taylor & Francis, 1999.