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# Human Centering Design Across Dimensions

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Boundaries

Previous studies have proposed a framework suggesting that there are ambiguous definitions of human factors, and valid reasons for its perceived absence in certain design professions (Hanington, 2003). It has been particularly noted by some authors that there is a scarcity of human-centered research in the graphic design profession (Strickler, 1999). Human factors are well established in the history of industrial design, and more recently, interaction design (Weed, 1996). However, human centered design remains elusive in communication and graphic design practice, particularly with respect to primary user research, generative methods, and testing. At a pedagogical level, we are no less guilty of failing to instill in our students sensitivity to human variables and research consistently across design disciplines. Human factors, research and ergonomics courses are typical at the core of industrial and interaction design programs, but are less evident in graphic and communication design. Coinciding with a significant curriculum and program review in one institution, new initiatives have begun to correct this imbalance, acknowledging the need to address human needs through an appropriate emphasis on research and testing across design dimensions. The school is well recognized for an emphasis on human centered research and design, yet the course structure, and therefore the knowledge basis, was applied unevenly across the curriculum, particularly in course requirements that differed by program.

Fundamentally this uneven application is flawed. A fair assumption of design activity is that we are creating artifacts for human use, whether in response to need, demand, or desire, or in forecasting to improve the human condition through positive interactions or experiences. Even in design driven by monetary motivation alone, we can still assert that we must fulfill a human need or desire, such that emerging artifacts are consumed in some fashion. The underlying human criteria for design activity should know no dimensional boundaries. The creation of printed material to convey information, digital interfaces for devices or web-based interactions, and three-dimensional products and environments, all share a foundation of human use. There is no reason, then, why any design discipline should be disadvantaged in the sensitivity to human factors, and therefore in the exposure to the necessary tools for responsible design activity.

Course

Program reviews in the school have served to inspire changes to course offerings, and in turn certain course changes have inspired a further examination of the school curriculum. In particular, there is a new questioning of existing boundaries between design disciplines as currently structured in the program, and by extension, an attempt to understand how these boundaries are perceived and are changing in practice. Discussions have considered the core competencies necessary for designers regardless of professional discipline, in both skills and knowledge, and how expertise is recognized in practice. Fundamental to this core is a human centered focus in design.

One of the most obvious places for intervention in the education of students is at the foundation level, as they are first introduced to their intended design professions. As undergraduates in this school complete a general foundation year of design, this exposure to the professions occurs more specifically beginning in the sophomore year. An introductory course has served for many years as the basis of human factors education for industrial design undergraduates. In fact, several years ago the course was moved from the spring semester of the sophomore year, to the fall semester, to further emphasize the key importance of its content. Students were sensitized almost immediately in their industrial design education to the fact that they were first and foremost designing for human beings, and it was fundamental that they recognize things they needed to know about people to design for them responsibly. No such requirement existed for their corresponding communication (graphic) design classmates in the school.

This is not to say that faculty and students of communication design, like their industry counterparts, do not have their own means of addressing human criteria in their work. However, as detailed in the framework for understanding human factors, there is a difference between employing an over-all human centered design philosophy in process, actively researching and testing with users through direct interaction, consulting literature or standards to ensure design meets human criteria, addressing human issues, and assessing design outcomes (Hanington, 2003, see Figure 1). Communication designers may consult literature or standards, or at the very least are cognizant of human criteria at an intuitive level, to ensure such aspects as readability, legibility, and therefore usability, are addressed in their work. However, the comprehensive understanding of human factors in communication design is typically less than compared to industrial design, particularly with respect to methods of direct interaction user research and testing.

| | Design Philosophy | Research Methods | Standards & Data | Human Issues | Design Outcomes |
|---|---|---|---|---|---|
| **Examples** | Human-Centered Design<br>User-Centered Approach | User Research<br>Product Testing<br>(User testing, Usability studies) | Anthropometric Data<br>Graphic Standards<br>ADA Legislation | Physical Fit, Safety, Comfort<br>Information Processing<br>Emotional Response | Products<br>Interfaces<br>Environments |
| **Descriptors** | Primary design driver | Direct interactions | Established from research | Ergonomics<br>Usability<br>Emotive<br>Human Factors | Ergonomic<br>User-friendly<br>Delightful, fun<br>Culturally appropriate |

**Figure 1**. Framework for Understanding Human Factors (Hanington, 2003)

Change

To begin addressing this disparity at the educational level, in the fall of 2004, it was proposed that the introductory human factors course change to a requirement for all sophomore students, in both industrial and communication design. Initially, the course would be offered in a similar fashion, delivered as a combined format of lectures, discussion, and short projects. The existing course followed a sequence of physical human content, encompassing safety, fit, and comfort associated with ergonomic design and anthropometry; information processing, addressing issues of sensation, perception, and cognition pertinent to usability; and experiential aspects of human-product interactions, focusing on personal, social, cultural and emotional factors. Projects were a combination of short in-class exercises, team and individual projects. For example, spaces were evaluated and redesigned on the basis of anthropometric data collected from literature and the classroom population. A "desk tour" required students to interview and document how people organize information in the workplace, and respond with design concepts appropriate to organizational styles. For more traditional human factors testing, students observed people using interfaces to guide redesign proposals.

As the course had been designed for industrial design students, the first challenge of teaching the material to a more diverse audience was to find broader points of connection. While professors believe that design examples are used merely as vehicles to illustrate fundamental issues, students are inclined to categorize specific content by disciplinary boundaries. For instance, students perceive mobile technology devices to be the territory of industrial or interaction design, disregarding the input of graphic design to layout, typography, and icon development inherent in product design. Likewise, the design of instructions is perceived to be part of the graphic or communication design landscape, rather than an integral feature of the product as developed by industrial or interaction design. These perceptions presented barriers to overcome, and certainly the first round of the course met with some resistance from communication design students. Many only barely tolerated the perceived emphasis on industrial design, confirmed in their minds through three-dimensional product examples and exercises in subject areas such as ergonomics and anthropometry.

Resistance was met with explicit efforts to draw connections across design disciplines, including examples from various areas and product types, and by infusing the lectures with guest appearances from communication design faculty. This was appreciated, but not enough to compensate for the perception that this was still, fundamentally, an "ID" course. Interestingly, when students working in small teams were given the option of any "product with a significant user interface" to investigate for a final project in testing and redesign, most chose traditional "device" products such as car stereos and alarm clocks, or digital, web, or kiosk interfaces, despite a clear instruction that they could use print products, maps, schedules, signage, way finding, or other examples of information design. Perhaps it was the use of the word, "product".

The lesson was learned, and it was time to change the course to respond to this new audience. The inspired need for course alteration coincided with reflection by the instructor on the over-all content and format, after teaching it in similar fashion for several years. A reassessment was needed to command the interests of a new breed of designers, and to maintain the focused attention of 45-50 students, for two sessions of three-hour duration each week. Previous enrollment for industrial design students ranged from 20-25, and the pressure of increased student numbers was believed to be a critical factor in the modest reception evident in the first run of the new course.

Principles

The course was restructured for the following year, fall 2005. Primary content was built around a set of design principles, conveniently supplied by the text, *Universal Principles of Design: 100 Ways to Enhance Usability, Increase Appeal, Make Better Design Decisions, and Teach through Design* (Lidwell, Holden & Butler, 2003). One hundred principles are listed in the text, presented in two-page spreads, alphabetically ordered but optionally listed in five categories of perception, learning, usability, appeal, and design decision-making.

While use of this text departs from traditional human factors curriculum, it serves well to establish a foundation of principles relevant to a wide range of design applications, without specific dimensional boundaries. Some principles of the text are established and familiar to particular design professions, such as form follows function and affordance in industrial design, and highlighting and the pictorial superiority effect in graphic design. However, many more are borrowed from other disciplines, or have more general applications across design dimensions, including classical conditioning, symmetry, iconic representation, and Ockham's razor. Ockham's razor, for example, asserts that given a set of possible solutions for any problem, the simpler should prevail, with variations on the principle adapted to philosophy, science, and theoretical explanations of natural phenomena. Applied to design, the principle is exemplified in the success of simple furniture forms, and Google's minimalist search page. Based on the broad scope of principles and applications, it was assumed that the textbook would have widespread appeal to the students, while maintaining a connection to the material intent of the course.

Action

The principles of the text inspired several activity-based exercises, with potential for developing a lab format more appropriate to the course than the previous version that relied heavily on lecture and discussion.

With the large class size, conducting lab activities would be a challenge, but was deemed more likely to maintain interest in the material, and to provide engaged learning preferred over lectures, particularly in the context of design.

The course was therefore structured as follows. In the beginning weeks, students worked in pairs and selected a principle from the text, to be presented to the class in the form of an activity and printed handout. To give enough lead-time on developing the labs, and to initiate the students in the content and format of the course, a combination of lectures and instructor-initiated labs were conducted during the first few weeks. The students were provided with a basic introduction to human centered design and the subcomponents of physical, cognitive, and emotive human factors. Instructor-provided lab exercises consisted of activities such as the construction of scale model cardboard chairs based on student body dimensions (physical ergonomics), geriatric sensitivity training, whereby the students are exposed to simulated conditions of age-related deficits in sensation, perception, and cognition relevant to design (information processing), and a show-and-tell project where examples of objects with personal meaning were shared by classmates (emotive factors).

The mid-section of the course was then allocated entirely to the student-conducted labs, with two labs running consecutively during each three-hour class, twice weekly. To ensure attention and to gauge effective communication of the principles, all students were required to write a one-page reflection on the week's activities. Principles covered by the lab activities were diverse, creative, and engaging. The following are examples of three labs from a total of 23 conducted, selected to illustrate the broad nature of the activities.

*Gutenberg Diagram*

A lab on the Gutenberg diagram (Figure 2) provided compelling evidence of how a reader's eyes follow a natural "gravity", from the upper left corner of the page (primary optical area), to the lower right (terminal area), when reading homogenous compositions. Fallow areas lie outside the dominant reading path and require visual emphasis for attention. To demonstrate how the principle has an impact on interest and ease of reading, students were instructed to read newspaper page spreads that follow and violate the Gutenberg diagram, while indicating their reading patterns using flashlights in a low-tech but effective version of eye tracking (Figure 3). This demonstration was supplemented with individual readings issued to the class on paper, followed by a quiz on information retained. Quiz results were compared between the Gutenberg and non-Gutenberg diagram page layouts. Although the results were ambiguous, the exercise served to stimulate discussion on interest, retention and comprehension as facilitated by effective page layout.

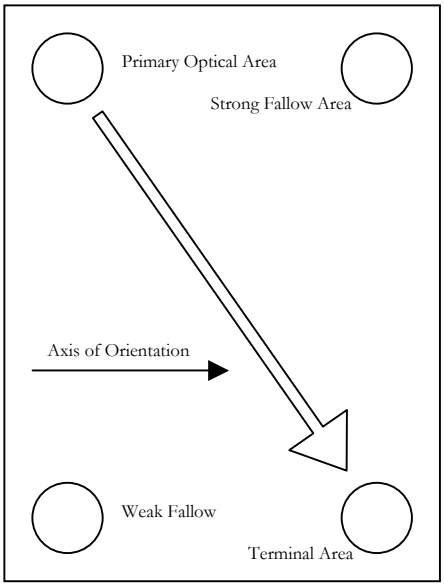


**Figure 2** . *The Gutenberg Diagram* (adapted from Lidwell et al., 2003)

**Figure 3** . *Exploring the Gutenberg Diagram*

*Common Fate*

Common Fate is a principle that suggests that the mind will group objects according to similar movement, luminance in unison, and as figures against static ground. The lab to demonstrate this principle provided engaging examples from film, air traffic control interfaces, and sound applications. The exercise proceeded to give students access to an interactive Flash activity, whereby they could create rhythmic patterns

of on/off, pulse, or fade conditions of squares on a screen grid. Their display patterns were then projected from laptops to the class for demonstration and discussion.

*Flexibility Usability Tradeoff*

This lab introduced the students to the necessary balance between flexibility and usability in design, arguing that an inverse relationship exists. Once the class was introduced to the topic through examples such as the Swiss army knife, they were set in pairs to design interface concepts for small electronic devices. The resulting sketch concepts were then physically plotted on a wall-size graph, according to x and y axes of flexibility and usability, to stimulate discussion.

The students clearly saw the actual and potential relevance to broad areas of design in the range of principles exhibited. In an interesting turn of fate, some students deemed more of the principles to be communication design specific. This may have been in part due to the student selections of particular principles from among the 100 provided by the text. Regardless, the labs may be considered a success in having provided a more diverse set of examples than in previous versions of the course, and in discussions more inclusive of communication design students. The conversations facilitated by the labs were rich, and were, for the most part, undistinguished by any particular design boundaries.

Assessment

As might be expected, the lab format itself had its share of successes and failures. Primarily, students appreciated the hands-on nature of activities, and for the most part seemed to retain a significant amount of content. The better the labs were organized and conducted, the better information retention seemed to be, as witnessed by reflection essays, a short quiz, and classroom discussion. When queried on the difference between the quality of labs, students were quick to recognize that the more "respect" given to the topic and the materials by those conducting the labs, the more attention was maintained, and the more understanding was facilitated. For example, a lab on the principle of modularity, that included carefully hand-made cards with images and text instructions, was particularly well received and had the students attentively immersed in the exercise and subsequent discussion.

Of course, some labs were less productive, in part due to the constraints of classroom size and facilities for the number of students. A lab on scaling fallacy, whereby students were to demonstrate that a design of one scale would not necessarily work at another scale, was unconvincing when students were asked to produce paper vessels to hold water. As small groups left the room to try out their prototypes in nearby restrooms, the cohesion of the class fell apart, with only wet paper and random tales to tell as evidence of the principle working, or not. The control of chaos in the classroom is challenging enough for instructors, so a certain amount of forgiveness was necessary for students, given the daunting task of orchestrating complex activities with large numbers.

There were also instances where students misinterpreted the principle, and damage control was needed to prevent the incorrect presentation of material becoming solidified in the minds of the class. For

example, a lab on classical conditioning misidentified conditional and unconditional stimuli and responses, leading to confusion among the students. However, the ensuing discussion helped to engage the class and clarify the principle. In a lab on constraint, there was disagreement between the instructor and the students conducting the lab on the interpretation of the principle as demonstrated. While the activity provided a compelling exercise that required student volunteers to drink from various vessels based on personal form interpretation, it departed significantly from an illustration of the actual principle. The demonstration should have communicated how physical or psychological constraints in design limit the perceived or actual actions that can be performed on a system, product, or situation.

At the end of the lab section of the course, a quiz challenged the students to provide the names of the principles next to textbook definitions. A second round of the test was then allowed, that provided students with a list of the principles, to match to the definitions. The quiz yielded good results, however, in summary discussion, the students questioned the need for such recall. There was consensus that while the principles were important to design, the specific names attributed to them were less critical to remember. There was also discussion on a perceived difference between established terms such as "affordance", and "form follows function", and those believed to be developed by the particular textbook authors, such as "pictorial superiority effect" and "entry point."

As a final point, the students enjoyed the labs and felt they were an appropriate means of learning, but felt that there could have been more summary discussion and examples to bring several principles together interspersed every few sessions, facilitated by the instructor. A presentation for this purpose was conducted by the instructor at the end of the labs, but by then some of the discrete elements inherent in 23 different principles was lost. However, a final project was also yet to be completed by the students, intended to further cement the principles of design.

Testing

The final project was designed to ensure an aspect of broad application of the principles in context. In parallel with the labs, students were assigned to work in teams of three throughout the semester on a traditional human factors project, involving testing with users, redesign and retesting. This was almost identical to a project issued in previous versions of the course, but now the language in the instructions was broadened from the choice of "product", to the selection of "a product, visual communication or information system", with a significant user interface for testing and redesign. The intent of this project was to contextualize the principles in design applications, and to expose the students to a typical process of human factors protocol and redesign that involved direct interaction user research and testing.

Similar to the labs, students appreciated the freedom to explore broad opportunities in design, corresponding to their own particular interests negotiated in small teams. The more inclusive instructions also resulted in a more diverse set of design "product" investigations than in previous versions of the course. For example, projects included traditional products such as microwaves, digital interfaces such as ATMs and websites, systems such as identification cards, parking, and transit, and a printed signage map for building

navigation. In conjunction with the broadened instructions, the increased range of examples may be attributed to the diversity of applications provided in the foundation of lab principles. This final project served well to solidify the application of principles, and familiarize the students with a typical human factors research and design process across disciplines.

Reflection

Having conducted the class as a trial run, and recognizing it as a significant departure from several years of previous content and format, it is natural to reflect on the experience from the perspective of students and instructor, in the context of wider curricular discussions and in preparation for continued delivery of the course.

At the curricular level, the course is indicative of faculty conversations centered on the notion of blurring boundaries, foreseeing the need to be more flexible in course offerings throughout the program, catering to student needs. Whether current distinctions between industrial and communication design are maintained, or whether additional programs such as interaction design are integrated into the undergraduate curriculum, a stronger foundation of core competencies, including exposure to fundamental principles, followed by elective topic offerings in design studies, is suggested.

From the student perspective, there was a clear desire to spend more time in course-work conducted together, rather than divided by industrial and communication design as structured by many current studio and course requirements. Even when polled on the option of reducing class size to ease the chaos, most students preferred the larger numbers if the alternative was to divide the students, by discipline or otherwise. Suggestions to improve the course were targeted more at increasing the available space, or to have a room more amenable to lab activities rather than continuing to use an ordinary classroom (Figure 4).

**Figure 4** . *Lab activities in the classroom*

The successful broadening of content to be more inclusive of design disciplines, particularly communication design, will be a key feature retained in future iterations of the course. In fact, these disciplinary boundaries will continue to be challenged, corresponding to the motivations of students and the wider examination of the curriculum in design. A survey of incoming students in the class revealed very few

who foresee themselves with the traditional job titles of "industrial" or "graphic" designer. In response to questions on their anticipated career roles, answers included design director, creative director, art director, experience designer, and freelance image consultant, working in such areas as research and development, product development, furniture, fashion, photography, web and motion graphics, and at least two responses merely of, "designer", one coupled with the quote, "I would hope that I wouldn't have to limit myself to a specific field." It is critical that we recognize the changing face of design, as inspired by emerging young designers, and reflected in practice.

The use of a principles-based approach to the course fits this model of the emerging designer very well. Understanding a principle beyond its theoretical definition, presented through demonstration, experienced in activity, and applied in design, is a thorough and compelling method for counteracting the limited perceptions that frequently stem from single product examples, lectures and readings. Furthermore, activities designed by students, for students, provide a good experience, presented in a framework of generation-relevant interests and language. The first run of this course was a good experience for the instructor as well. Future iterations will bring further challenges, yet with these challenges come refreshing ideas. The true test of the merits of the new approach will be witnessed as the students advance through subsequent years of their program, and into their careers beyond. Evidence of success will come in the form of principled and creative human centered design, across dimensions.

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