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AUDIENCE/ONLINE INFORMATION INTERACTIONS

NEW RESEARCH IN LEARNING PREFERENCES

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Abstract

This investigation proposes the need for a paradigmatic shift in the production of formal and behavioral online information to accommodate the differing learning preferences of its audiences. Developments in the presentation of information itself and the management of its complexity have not progressed at the same rate as the technology that produces it. Psychologist David Kolb (1974) found that the combinations created by an individual's perception and processing techniques form a unique learning style, which becomes the most preferred and comfortable way to process information for that individual. This project poses the question: In what ways can the redesign of online information presentations, formal and behavioral, support the different learning preferences of complex audiences? As a response I share my work-in-progress research into audience/online information interactions. This research emphasizes the need to acknowledge that information must be flexible and customized to enhance meaningful experience for different learners.

Introduction

This research project proposes that there is potential to turn the web, which is currently an information acquisition tool, into a cognitive tool that encourages meaningful learning for its users. It recommends a shift in the production of formal and behavioral characteristics of online information in order to accommodate the differing learning preferences of its audiences. It seeks to exploit the affordances of online interfaces by suggesting that the web not only promotes easy surface learning but also deep learning, revising search engines away from acquisition to meaning-making.

This paper poses the question: How can learning theories inform designers of online experiences as they provide search engine users with conditions for meaningful learning that turn the latter from online collectors to deep learners?

In order to investigate ways in which learning theories can inform meaningful user/information interactions, this paper will discuss learning in terms of technology, information, usability, design and learning styles. The investigation will explicate the current state of online information and delineate the problem. It will then offer an analysis of the existing taxonomy of research into user/information interactions, an existing taxonomy of technology that attempts to promote deep online learning, define variables and terms used in the research and share visual examples of learners sketching their desired interactions with information. Finally, it will provide visual suggestions of ways in which learning style theories could inform the design of conditions for meaningful online user/information experiences.

Project statement

Leung (2009) wrote, "Part of the service offered by experience designers is the process of making information meaningful for the user, but it is more difficult to ensure that users will turn such information to knowledge" (Leung, 2009, 17).

One of the misconceptions associated with access to information (online or offline) is that access to information equals access to knowledge. It does not. Wurman (2001) quotes Shedroff who described the continuum from data to wisdom in *Information Anxiety 2*. Data can be obvious or subtle. Data does not teach. Data is only data until it is designed, presented and organized for an audience when it then becomes information. Information, in turn, is different from knowledge.

Access to information does not make one knowledgeable. “What most differentiates knowledge from information is the complexity of the experience used to communicate it… By necessity, knowledge can only be gained by experiencing the same set of data in different ways and therefore seeing it from different perspectives” (Shedroff, 2001, 28).

Wisdom, according to Shedroff is the ultimate level of understanding that allows us to find patterns and meta-patterns that we can use in unexpected ways (29). Similarly Leung (2009) associated online information with surface learning and knowledge with deep learning. She speaks of short-term memory and long-term memory in relationship to surface learning and deep learning respectively. Deep learning involves a serious approach to learning in which students aim toward understanding. Surface learning is described as a superficial approach to learning in which learners are aiming to reproduce material in a test or exam rather than actually understand it.

While search engines provide instant results ranging from simple answers to more elaborate articles, users usually go to search engines to access instant answers to their questions—data and/or information—rather than to spend time reading elaborate answers or making sense of it—knowledge and/or wisdom. Krug (2006) wrote that search engines and interfaces are and should be designed for scanning, not reading (22). This investigation believes that in addition to accommodating for human cognitive limitations by promoting scanning among other behaviors, there is a potential for search engines to act as cognitive tools for deep learning. In *Cognitive Tools for Learning*, David Jonassen explained that

> …cognitive tools are not designed to reduce information processing, but rather to provide an environment and vehicle that often requires learners to think harder about the subject matter domain being studied while generating thoughts that would be difficult without the tool. They are cognitive reflection and amplification tools that help learners construct their own realities (Jonassen, 1992, 1).

Current state of online search engines

With scholarship in mind, the search engine was originally invented in support of scientific research activities. In 1990, Archie, short for ‘archives,’ was the first search engine to be created. In 1980, Tim Berners-Lee’s concept of hypertext’s main purpose was the sharing and updating of information among researchers. Today’s search engines still maintain the same goal of allowing users to access and share information. Technological advancements have made this process much faster and accessible to a larger demographic from many more access points—computers, television, game stations and cellular telephones.

While there have been major developments in the information vehicle—screen, touch screens, cell phones, e-readers, electronic paper—not much has been done to the structure and design of information in the new information vehicle. Most of the changes made to the way information looks and behaves have been insignificant. While the web did provide for different affordances such as hyper-linking, book marking, fast copying and pasting and scrolling versus page turning, text online predominantly looks like the printed page.

Even so search engines have increasingly become the wellspring for data and information as well as the venue for many types of transactions. It is the place one goes to find out how to cook a turkey, to get directions to a destination or to purchase one's favorite song. In any situation, users gravitate towards search engines to find answers and explanations, to learn why, how, what, who and when. These answers and explanations manifest themselves in different forms—from images to videos, from casual forum conversation to scholarly articles.

Most importantly, today's search engines focus on usability, making access to information easy, seamless and instant. Usability and user experience are wrongly yet usually considered interchangeable. However, as Albert and Tullis (2008) wrote, usability is generally thought of as the "ability of the user to use the [search engine] to carry out a task successfully, whereas user experience takes a broader view, looking at the individual's entire interaction with the [search engine], as well as the thoughts, feelings and perceptions that result from that interaction" (Albert and Tullis, 2008, 4).

Jakob Nielsen (2009) wrote that designing for the web is designing for brainpower limitations. He notes that many usability guidelines are dictated by cognitive limitations of the human brain, which is not optimized for the abstract thinking and data memorization that websites often demand.

Usability guidelines such as these provide designers of online experiences the rules and/or principles they need to follow to provide conditions for better navigation which in turn contributes to a better experience; an experience that is uninterrupted; one that allows for seamless navigation and acquisition of information; one that makes sure users don't have to think to access information they need.

While this project values usability guidelines, it is more concerned with providing meaningful user/information experiences that consider the entire system. It emphasizes the need for the complexities—different learning preferences—of the learners to be taken into consideration for better user-experience directed toward meaningful and substantive learning.

In his article *Is Google Making Us Stupid?: What the Internet is doing to your brains,* Nicholas Carr (2008) explains the cognitive differences between accessing information from books and online portals.

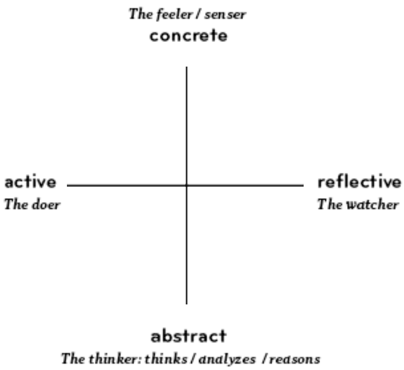
> The kind of deep reading that a sequence of printed pages promotes is valuable not just for the knowledge we acquire from the author's words but for the intellectual vibrations those words set off within our own minds. In the quiet spaces opened up by the sustained, undistracted reading of a book, or by any other act of contemplation, for that matter, we make our own associations, draw our own inferences and analogies, foster our own ideas. Deep reading, as Maryanne Wolf argues, is indistinguishable from deep thinking (Carr, 2008).

While the Internet is making information accessible, it might not be providing the conditions needed for users to turn words into knowledge, draw inferences and analogies and foster ideas. There could be a shift from search engines offering an environment that diminishes information processing to provide an environment and vehicle that encourages learners to think harder about the information being studied. A failure to promote this shift could result in a series of search engines that (maybe not intentionally) dumb down the next generation of learners by making them less autonomous and "not think."

Predictions showcased in a study, titled *Information Behaviour of the Researcher of the Future* (2008), commissioned by the British Library and the Joint Information Systems Committee (JISC) provided an intricate analysis of how the specialist researchers of the future—the Google generation/those born after 1993—are predicted to access and interact with online information in five to ten years. Educational concerns were raised regarding whether "having 'facts at their fingertips' and surfeit of information is at the expense of creative and independent thinking?" (British Library and JISC, 2008). The study further states that

> a one-size-fits all policy towards library or system design is not going to be effective: there is as much (albeit, largely unacknowledged) diversity in today's scholarly population as is likely to exist between today's scholars and tomorrow's. Without a detailed handle on these issues, it becomes impossible to target services effectively (British Library and JISC, 2008, 30).

Because it is unlikely that the Internet will stop nor should it stop providing information, and because the Internet is one of the main sources of information that



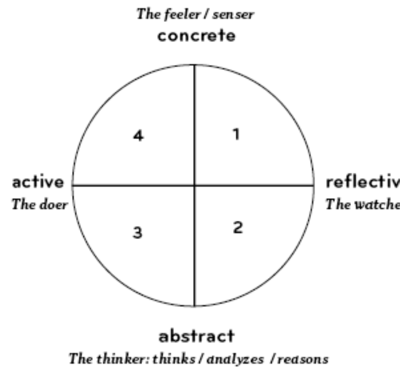


Figure 1: Concrete to abstract perception and active to reflective processing.
Figure 2: 4 quadrants showing 4 different learning styles

the "Google generation" will be relying on, it is important that the disseminators and designers of online information provide conditions for independent and critical thinking in our future learners.

Different learning styles

In the *4Mat System*, learning theorist Bernice McCarthy (1980) explained that all learners perceive and process information and experiences differently. While some understand information abstractly, entering content through theories and concepts, others absorb information concretely, using the senses and personal experiences (McCarthy, 1980, 25) (*see figure 1*).

In addition to perceiving differently, learners process information differently. Some process information reflectively by watching and thinking about things. Other learners process information through physical activity (*figure 1*). Psychologist David Kolb (1974) found that the combinations created by someone's own perception and processing techniques form their unique learning styles or their most comfortable way to learn (25). Kolb's learning style inventory in the *4Mat System* (*figure 2*) encourages teaching in all four styles to support students who move from quadrant to quadrant, excelling when they are in their most comfortable quadrant and developing learning techniques they might not be comfortable in when in the other quadrants (Kolb, 1974, 55).

By acknowledging the different learning styles, search engines/the web takes a step towards becoming a cognitive tool that allows learners to construct knowledge/meaning.

> A learning style 1 individual values personal meaning and makes judgments based on that kind of meaning. She/he functions through social interaction and wants to be involved in important issues as well as be cooperative and social. Learning style 1 favors discussion as a teaching mode, is impressed by authority, and models behavior on those aspects (McCarthy, 1980, p. 33).
>
> A learning style 2 subject likes to know what experts think. She/he learns from reality and by thinking through ideas. Style 2 prefers to perceive information abstractly and process it reflectively. A data collector and an analytic learner, a learning style 2 individual will re-evaluate facts thoroughly if confused. Schools are designed for this learner who functions by adapting to experts (McCarthy, 1980, p. 39).
>
> A learning style 3 person seeks usability. Style 3 sees information abstractly and processes it actively. Using factual data to build designed concepts, this learner type prefers hands-on experiences, enjoys solving problems, resents being given answers, restricts judgment to concrete things, has limited tolerance for "fuzzy" ideas and needs to know how assigned tasks will help in real life (McCarthy, 1980, 41).
>
> A learning style 4 learner needs to know what can be done. Style 4 individuals learn by trial-and-error, self-discovery and adapts to change. This learner sees information concretely and processes it actively. A learning style 4 person acts and tests experience, makes things happen and brings action to concepts (McCarthy, 1980, 43).

Currently neither online or offline information allows interactions for users that support all the different learning styles. Designers of online information and experiences should rethink ways that content can be customized and adapted to support not only users of learning style 1 but also learning styles 2, 3 or 4. Learning style theories and categories can inform designers of online experiences as they try to provide conditions for audiences and collectors of online information to become deep learners that can move from learning style quadrants comfortably. It is this paper's assumption that if information were presented in a way that is the learner's preferred way, more meaningful learning would happen.

Existing research into user/information interaction

Research into user/information interactions but more specifically information search processes (ISPs) has existed for a long time. Professor T.D. Wilson (1994) in his paper *Information Needs and Uses: Fifty Years of Progress?* explained, "Most 'user studies' have been about how people use systems, rather than about the users themselves and other aspects of their information-seeking behavior" (Wilson, 1994, 2). Wilson defined two sub categories of research into ISPs—system studies and user-studies—and provided a detailed taxonomy of research into each domain. While the majority of the research pertained to system studies, "the field broadened out from the study of library systems to the study of behavior and attitudes of information users in general" (Wilson, 1994, 3). Wilson gives the example of a study carried out in three London Boroughs where 506 people were interviewed regarding their reading habits and gender differences in information use were discovered; in Baltimore, U.S.A, 1973, research was carried out into the information needs of ordinary citizens; in the special libraries sector, Mote (1962) attempted to categorize the user as a way to better understand their information use; and Palmer (1991) investigated the relationship between personality, discipline, organizational structure and information behavior in the field of agricultural research (Wilson, 1994).

More recently and closely related to this research paper, in *Web-based learning interaction and learning styles*, Sabry and Baldwin (2003), reinforced the significance of individual differences on learners' behavior. They acknowledge differences such as gender, system experience, cognitive styles but also state that "individual differences make designing Information Learning Systems (ILSs) a complicated task as it requires accommodating a wide range of characteristics (Galitz, 2002), and for these to be interactive, certain qualities and principles need to be related to different learners' needs" (Sabry and Baldwin, 2003, 2). They further explained that "much of the learning styles research has given little attention to influencing factors such as learner perception of different interaction types on the learning approach they take, and how this information can inform the design of effective ILSs" (Sabry and Baldwin, 200, 444).

In their research, Sabry and Baldwin used Felder and Soloman's learning style categorization—sequential and global learners—and concluded that

> an awareness of the pedagogical needs of different learning styles can result in more effective ILSs...a carefully balanced approach not only can help learners to respond more effectively to different learning situations, but also make the learning process more enjoyable and help in developing a more flexible and autonomous learner (Sabry and Baldwin, 2003, 10).

Furthermore, in their paper *The Learning Styles, Expectations and Needs of Online Students*, Mupinga, Nora and Yaw (2004) focused on determining the learning styles, expectations and needs of online industrial education college students. Their study explored how the individual characteristics can be incorporated in designing effective online instruction (185). They concluded, "No particular learning styles were found to be predominant among the online students; hence, the design of online learning activities should strive to accommodate multiple learning styles" (Mupinga, Nora and Yaw, 2004, 188).

The above highlighted existing research reinforces the value of acknowledging learning styles when designing conditions for online learning experiences. This paper shares the same conclusion. However, it approaches the problem and solution from an interface and experience design perspective and visualizes how educational theories can intersect with and inform design practice to create conditions for more meaningful learning experiences.

Existing taxonomy of technology—interfaces, plug-ins etc.

Search has been the focus for many search engines. With instant access to large amounts of information, search engines are finding popular ways to categorize information based on user search behaviors. This paper values effective search but does not place it at the heart of the research.

GOOGLE

Google (http://google.com) can be thought of as the most-used search engine. To make search more effective, Google has worked on enhancing different aspects of the search process. They have conducted spelling improvements, refined international results, advanced search options, provided search freshness and maps in search results, generated personalized suggestions and site links among other features. While Google has been focusing on the search process, its results feature and presentation has stayed mostly the same since its establishment. Currently

Google offers users the ability to filter search results based on the following criteria: everything, news, updates, videos, books, images, maps, shopping, blogs, discussions, size, type and color.

In addition to providing the search engine that we are familiar with, Google Docs, a Google product, allows users to create, share and collaborate on online documents, presentation and spreadsheets; Google Wave lets users communicate and collaborate in real-time and Google Scholar allows users to search scholarly literature across many disciplines and sources, including theses, books, abstracts and articles.

Google has produced so many products over the past years and while technology is a great tool for education, more time could be spent on making existing technology better by assuring that tools like Google Scholar becomes a space for further critical thinking versus a repository for information only. How can a search engine like Google Scholar not only provide information but create conditions for users to turn such information into knowledge?

NEWSMAP

While Google's result lists have not experienced a major facelift over the years, "Newsmap, an application (powered by Google) provides a tool to divide information into quickly recognizable bands which, when presented together, reveal underlying patterns in news reporting across cultures and within news segments in constant change around the globe" (http://marumushi.com/projects/newsmap accessed on June 15, 2010).

The visual relationships that are demonstrated through the use of color-coding and hierarchical categorization exemplify a new way to visualize information. While Newsmap is successful at instantly making complex information and patterns more visual, developments stop at the visualization stage. More effort could be placed on further guiding the viewers once they have been exposed to the visual grid of news. Information only becomes concrete when it turns into knowledge. In addition to making complex information visually concrete, how can meaning making be supported online? How else can information be visualized for learners with different learning styles?

VIEWZI

In contrast to Google whose focus has been on better search, Viewzi (http://www.viewzi.com/) takes the visualization offered by Newsmap a step further. Viewzi's interest lies in providing a better way to view search results. At Viewzi, the visual demonstration of search results change based on the intent of the search. Viewzi provides users with different viewing preferences. Two of the most unconventional viewing modes offered by Viewzi are the Power Grid view and the Timeline view. The Power Grid displays information in a grid structure. The grid allows users to view image thumbnails or text. The Timeline uses results gathered from Google and arranges them chronologically on a timeline that can be scaled and manipulated. Viewzi's motto is to focus on one aspect of search—how people experience information.

While Viewzi's effort to better visualize the result list is commendable and a well-needed shift in the search results landscape, how people experience information does not solely rely on the way information is visualized. The act of experiencing a good meal relies not only on the way the food looks, but also what it tastes like and the feeling one is left with after the meal (and the overall service). The same principles apply to information. Experience with information is meaningful if information is turned to knowledge—if the user gains meaning from the information after he views it. Conditions need to be set up for the user's processing preferences as well as viewing preferences so they can act upon the information being viewed. Information experience is about the search, the results and the knowledge generated from the results generated by the search.

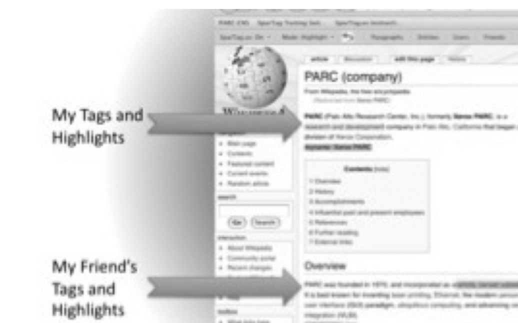
COGNITIVE TOOLS/PLUG-INS

To enhance learning online, the Palo Alto Research Center (PARC), which focuses on interdisciplinary approaches to the development of innovative technology, makes prototype web-based services available for download by users. Annotation is an important part of any learning process. It is a strategy used by many learners to visually categorize content and bookmark pieces of information as a cognitive strategy. In an attempt to allow users to "easily and directly tag keywords, highlight snippets, collect tags/snippets in a personal notebook, and share notebook information while browsing web content," PARC created SparTag.us, a "social annotation system for paragraph-level tagging, highlighting, collecting, and sharing web content" (http://spartag.us/)(*see table 1*).

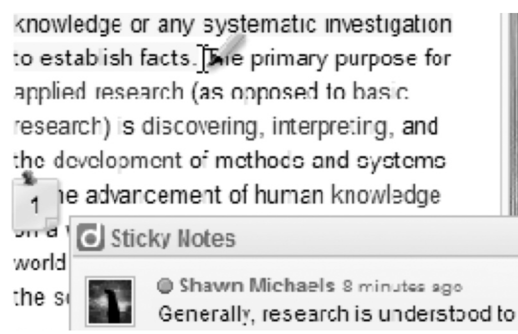
Firefox also offers annotating plug-ins that allow users to highlight content and take notes as they look at information. Reframe It (https://addons.mozilla.org/en-US/firefox/addon/5677/) is a commenting tool that lets people connect and share their thoughts online. These thoughts/annotations are juxtaposed with content anywhere on the web, without the permission of the site owner (*see table 1*). Diigo (https://addons.mozilla.org/en-US/firefox/addon/2792/) is an online

REFRAME IT
http://reframeit.com

SPARTAG.US
http://spartag.us



DIIGO
http://diigo.com



HIGHLIGHT
http://dev.reedmace.net

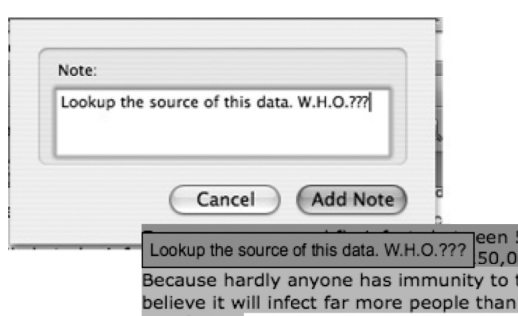


Table 1 : Online Sources (access date 6/14/2010)

highlighter and sticky notes plug-in that allows users to highlight as well as add sticky notes to any webpage. Diigo also allows users to save their bookmarks, connect and exchange with other users that have bookmarked the same content. Users of Diigo can also easily publish their bookmarks and annotations to blogs (*see table 1*). Highlights (https://addons.mozilla.org/en-US/firefox/addon/12676/) is a multi-color highlighting tool that lets users highlight text on web pages with a right-click. Highlights are saved and reloaded when the page is revisited (*see table 1*).

While this paper is not critiquing the effectiveness of each individual annotating device that exists, it does promote the development and integration of more tools that promote learning/critical thinking and information processing as well.

Research question

In *Three Types of Interactions*, published in the *American Journal of Distance Education*, Michael G. Moore (1989) describes the three types of interactions crucial in distance education. He lists them as: learner and content interaction; learner and instructor interaction; and learner and learner interaction. In this research project, I addressed interactions between learners and information and learners and interface.

Different learners construct meaning differently because they have different learning styles. Learners should have an interface that will allow them to turn information into knowledge. By taking learning styles and learning preferences into consideration when redesigning the behavior of search engines, one may be able to construct conditions that will allow learners, no matter what their learning preference, to not only access information but also process information in ways that will meaningfully inform.

In order to support deep online learning—the questioning of content, the construction of meaning when exposed to online information—search engines need to present information in ways that encourage learners to construct their own meaning—literally construct their meaning by manipulating online content. Users become learners when they are given control over the content. Users surf the web and collect information. Learners process information and create knowledge. The potential for deep online learning happens when users are given control of online content and when users step away from being the passive audience/viewers and instead become the learners and co-creators of content.

Then, how can the redesign—formal and behavioral—of online information support the different learning preferences of learners in ways that allow them to turn from collectors of information to processors of information and creators of knowledge? In order to answer this question, this project poses the following sub-questions:

1. In what ways can learners become co-creators of their online experiences?
2. In what ways can the design of interactive tools allow each learner to customize their experiences based on their learning preferences?

Research methodology

USERS AS CO-CREATORS OF EXPERIENCES

Trends and changes in culture require that designers move away from making assumptions about what users want. Designers need not impose experiences based on their assumptions about users and instead set up conditions for meaningful user-experience. Designers can encourage meaningful user experience by including learners at the grass-roots level of the design process, therefore turning learners into co-creators of their own individual experiences.

In this project, three methods were used to involve learners at the grass-roots level of the design process: *Process Similarity Analogies*, *Sketching for Interaction* and *Visualization*. Process similarity analogies are analogies about how objects, situations or actions are similar to one another. In this activity, participants brainstormed and listed processes that resembled the act of researching. The objective of the *Process Analogies* activity was to get participants/learners to express their feelings and thoughts about the research process using other processes that are meaningful and familiar to them.

The second activity—*Sketching for Interaction*—asked learners to participate in the design of their own remote control device with the following question in mind: "If you could use your remote control and do anything you wanted to do with the text, images or videos online, what would that be?" The intent of *Sketching for Interaction* was developed to observe and identify what features/functions learners value when researching, what their explicit needs are and how they might envision and prefer information behaving online.

The last method used—*Visualization*—involved applying knowledge about learning style theories with the results from the analogies and sketching exercises in order to visually suggest ways in which formal and behavioral characteristics of online information could be redesigned to meet the different learning preferences and allow collectors to become meaning-makers.

ACTIVITY ONE:
PROCESS SIMILARITY ANALOGIES AND LATENT NEEDS

The results of this preliminary study made up of nine communication design undergraduate participants at the University of North Texas showed that the analogies produced by the students related their own set of interests and experiences, thus reinforcing the ideas that some learning is personal. While some students made lists, others used techniques such as word map and matrices. User Tim for example whose preferences are linguistic carefully crafted his words and took time articulating his thoughts on paper, stopping a few times to reflect on the vocabulary he was utilizing. These analogies expressed some of the latent needs of the learners (*see figures 3 and 4*).

In Figure 3, could Jenna's reference to the patience needed to teach a child be hinting at the patience needed when faced with bad web usability and the struggles attached to bad navigation? In Figure 4, could Nora's desire to have web browsers be her version of an Indiana Jones express her latent desires for effortless yet deep and exploratory access to information?

ACTIVITY TWO:
SKETCHING FOR INTERACTIONS

Alan South (2004), in *Abstract Truth* talked about the different outcomes between empathic research and market research. While empathic research "uncovers latent user needs, 'market research' is only able to address explicit user need" (South, 2004, 119). He writes that empathic research "is not about doing a statistically significant survey. Carrying out a few observations around the edge of a user group is effective; it is particularly critical to observe users in the environment and context in which they will be using the product or service that is being developed" (South, 2004, 119).

Using empathic research to include users in the design process, students quickly sketched a remote control device to control different online media such as text, image and video with which they would normally interact when researching online. Participants were asked to answer the following question as they sketched their remote controls: "If you could use your remote control and do anything you wanted with text, images or videos online, what would that be?" Participants designed their remotes with the context being research. They were also encouraged to think of what tools they found useful when researching in the analog world.
As they designed their remote control devices, participants assigned values/verbs to each button. Each value represented the behavior they wanted to assign to the information to which they were being exposed.

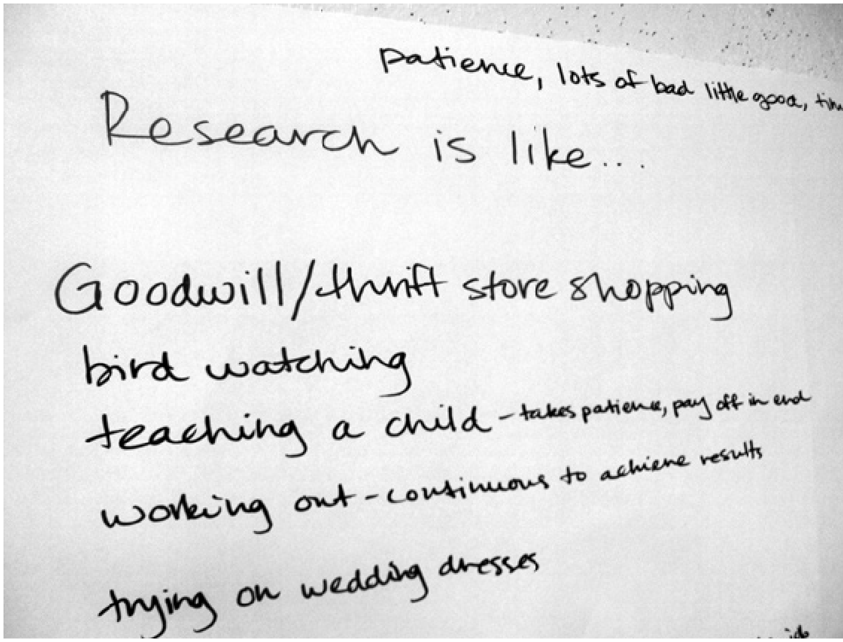


Figure 3: Participant Jenna's analogies: Research is like...

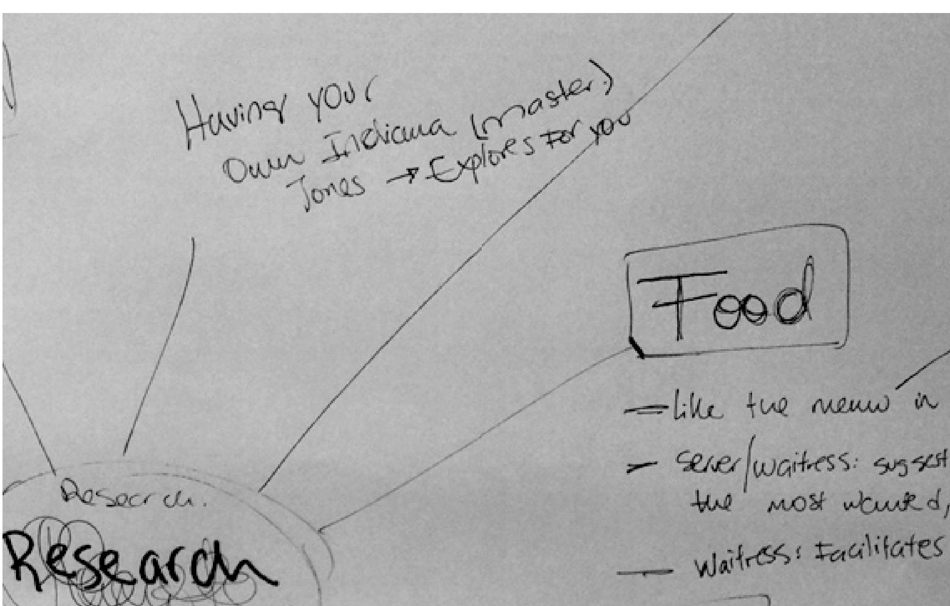


Figure 4: Participant Nora's analogies: Research is like...

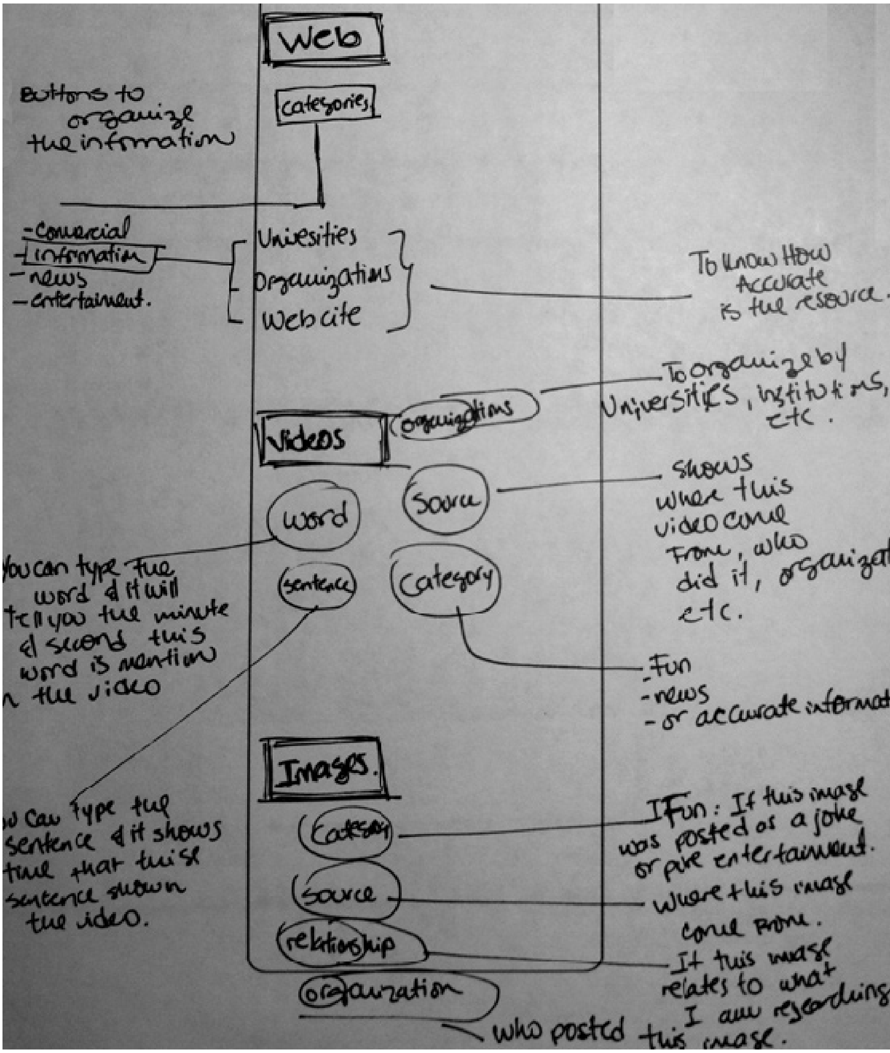


Figure 5: Nora's remote control sketch illustrating the interactions she would like to have with information.

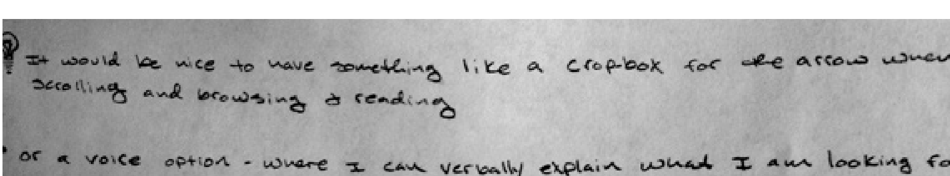


Figure 6: Andy's remote control list explaining his desire for a voice option and a crop box.

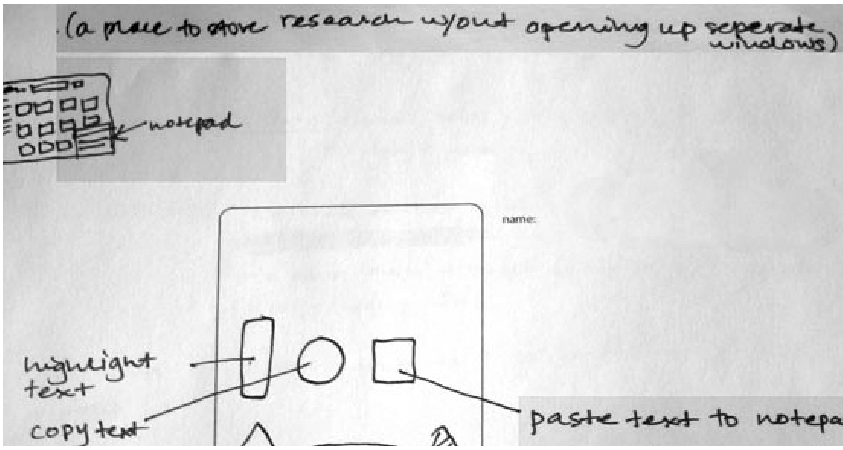


Figure 7: Jenna's remote control sketch illustrating her desire for "a place to store research without opening up a separate window."

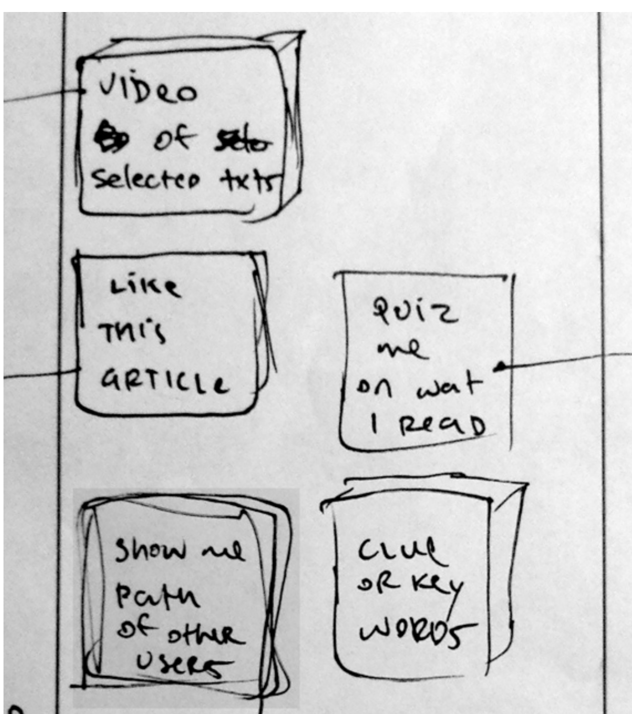


Figure 8: Bob's remote control list expressing his desire to see other users' search path.

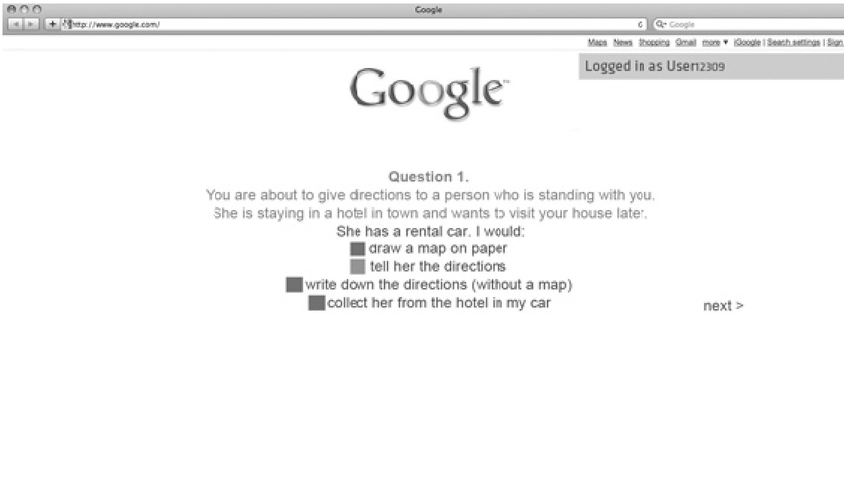


Figure 9 shows the user going through the learning style questionnaire before the research process.

Figure 10 informs the user that search results will be tailored to his learning preferences.

The results from the sketching session were revealing. The remote control device sketches displayed different learning preferences and different ways the students in the activity preferred to express themselves as well as different actions participants already valued and/or desired (*see figures 5 through 8*).

This directed sketching for interaction activity exemplifies one way in which learners can become co-creators of their online experience. By paying attention to

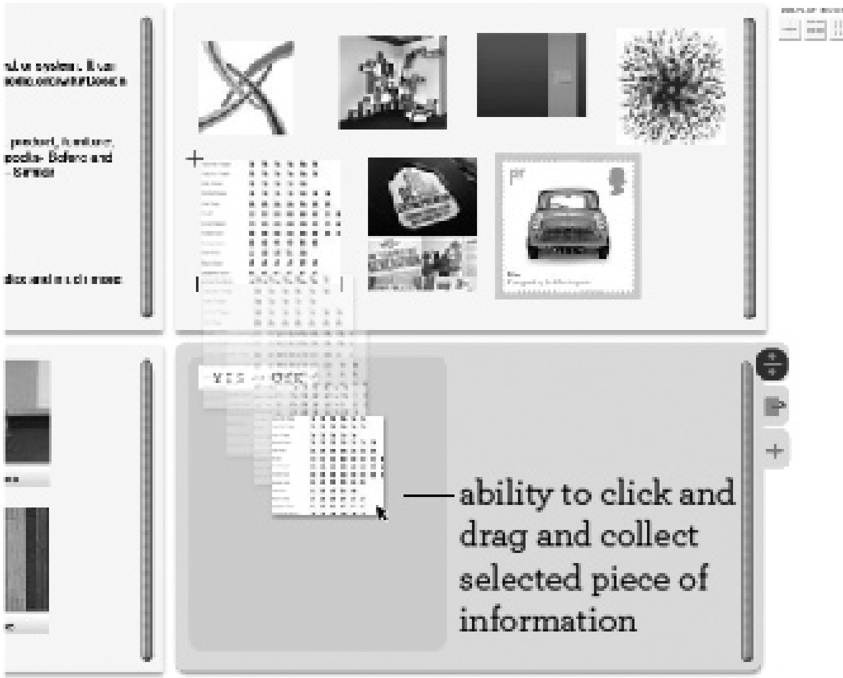


Figure 11 visualizes how the search engine can support Jenna's explicit desire—as seen in her remote control device sketch—for a notepad that is integrated in her search, thus allowing her to have a seamless workflow. The notepad becomes the user's collection as well as construction space. The visualization also shows the ability for the user to view different modes of information simultaneously. These different windows can be scaled up and down as desired by the user.

learners' learning styles and explicit needs, designers of online experiences can create more meaningful user-information interactions, thus answering this project's first sub-question: In what ways can learners become co-creators of their online experiences?

Both the process analogies session and the sketching for interaction activity were not meant to bring hard data about the users. Instead, they were more observational and qualitative in nature.

VISUALIZATION

In order to be able to provide for the different learning preferences of learners, this paper suggests the need to evaluate and assess each learner's learning style before he/she engages with any online research process. Users are asked to take a learning style test that comprises a set of multiple-choice questions before they start

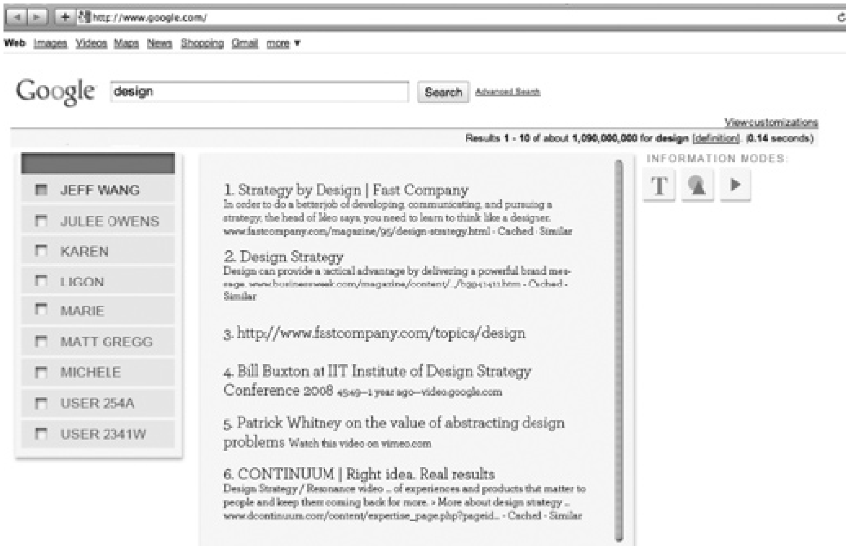


Figure 12 displays ways in which Bob's desire to see other learner's search path can be supported. The left column displays the list of users who searched the same term—design. The center column shows user Jeff's search path in text format. This search path can be filtered by text, image or video. A user can also view multiple users' previous search paths at once.

Figure 13 shows how users can also explore other users' collections.

their research process online (*see figure 9*). In this example, we use the Visual, Aural, Read/Write and Kinesthetic (VARK) questionnaire by Neil Fleming (2010). After the learner's learning preference has been identified, the search engine generates and presents information in ways that support the learner's preferences (*see figure 10*). The hope is that information display that is tailored to the learner's preference will be the first step towards motivating the learner to dig deeper.

With participants' explicit and latent needs in mind, different visual solutions have been designed. These designs have been informed by literature, existing research as well as the two activities—process analogy and sketching for user interactions—carried out with the different learners. The visualization stage visually proposes potential answers to the sub research question: In what ways can the design of interactive tools allow each learner to customize their experiences based on their learning preferences? (*see figures 9 through 13*).

Next steps and conclusion

The next step of this research project will be to run the same activities with a larger demographic of students—undergraduate and graduate—from different disciplines. The intent is to further include learners as co-creators of their own experience and gather more qualitative data that will inform the design of more cognitive tools and interfaces. Consequently it is the intent of this research project to build rough working prototypes that users can test. The prototypes will be designed to identify areas to be revised as student/subjects are observed interacting with information and with the prototype. While it might seem almost impossible to restructure existing information on the web to behave the way the prototype suggests it does, this project proposes that designers of future online experiences support deep learning as well as surface learning online. The proposed solutions demonstrate that designers of online interactions can allow for customizable experiences informed by individual learning styles. While still a work-in-progress, this research endeavor will inform both design practice and design education. Through understanding ways to set up conditions for all learners, academia may also understand how and what to teach the design students who will become the design practitioners of online information.

References

Albert, B. and T. Tullis. 2008. *Measuring the user experience: Collecting, analyzing, and presenting usability metrics.* Burlington, MA: Morgan Kauffman Publishers, 4.

British Library and the Joint Information Systems Committee (JISC). 2008. Information Behaviour of the Researcher of the Future. http://www.slideshare.net/ (Accessed December 20, 2009).

Buxton, B. 2007. *Sketching user experiences: Getting the design right and the right design*. San Francisco, CA: Morgan Kauffman Publishers.

Carr, N. 2008. Is Google Making Us Stupid?: What the Internet is doing to your brains. *The Atlantic.* http://www.theatlantic.com (Accessed December 19, 2009).

Fleming, N. The VARK Questionnaire. http://www.vark-learn.com/english/page.asp?p=questionnaire (Accessed June 15, 2010).

Galitz, W. 2002. *The Essential Guide to User Interface Design.* Hoboken, NJ: John Wiley.

Google. http://www.google.com/ (Accessed June 15, 2010).

Jonassen, D. 1992. What are cognitive tools? In Kommers, P. et al. *Cognitive tools for learning.* London: Springer Verlag, 1.

Kommers, P., D. Jonassen and J. Mayes. 1992. *Cognitive tools for learning.* London: Springer Verlag, 1.

Krug, S. 2006. *Don't make me think.* Berkeley, CA: New Riders, 22.

Leung, L. 2008. *Digital experience design: Ideas, industries, interaction.* Chicago, IL: Intellect Books, 17.

McCarthy, B. 1981. *The 4Mat system: Teaching and learning styles with right/left mode techniques.* Barrington, IL: EXCEL, Inc., 25–43.

Moore, M.G. 1989. Three types of interactions. *The American Journal of Distance Education*, 3, volume 2.

Mote, L.J.B. 1962. Reasons for the variations in the information needs of scientists. *Journal of Documentation*, 18, 169–175.

Mupinga, D.M., R.T. Nora and D.C. Yaw. 2004. The Learning Styles, Expectations and Needs of Online Students. Heldref Publications, 185-188. http://web.simmons.edu/~brady/CE/Reading%202.pdf (Accessed December 17, 2009).

Newsmap. http://www.newsmap.jp/ (Accessed June 15, 2010).

Nielsen, J. 2009. *Short-term memory and web usability.* http://www.useit.com/alertbox/short-term-memory.html (Accessed June 15, 2010).

O'Grady, J. and K. O'Grady. 2008. *The information design handbook.* Cincinnati, OH: How Books.

Sabry, K. and L. Baldwin. 2003. Web-based learning interaction and learning styles. *British Journal of Educational Technology*, 34.4, 443–454. http://www.homepages.shu.ac.uk (Accessed December 17, 2009).

Shedroff, N. 2001. An Overview of Understanding. In Wurman, R.S. 2001. *Information Anxiety 2.* Indianapolis, IN: QUE, 28–29.

South, A. 2004. Aircraft interiors international: Abstract truth, 119. http://www.ideo.com/ (Accessed December 17, 2009).

Wilson, T.D. 1994. Information Needs and Uses: Fifty Years of Progress? *Information Research Journal*, 3. http://informationr.net/tdw/publ/papers/1994FiftyYears.html (Accessed December 19, 2009).

Viewzi. http://www.viewzi.com/ (Accessed June 15, 2010).

Wurman, R. 2001. *Information Anxiety 2*. Indianapolis, IN: QUE, 28-29.

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THE APPROPRIATENESS OF ICON REPRESENTATIONS FOR TAIWANESE COMPUTER USERS

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Abstract

This experiment investigated how two factors which relate to icon representations affected Taiwanese computer users. These were: alphabetic or non alphabetic representations and cultural or standard imagery. Alphabetic representations are representations which show Chinese characters or English words/letters. Non alphabetic representations are representations which show either concrete or abstract objects. Cultural imagery is imagery that uses ethnic depictions, often shown in a traditional manner. Standard imagery is imagery used in icons found in present software packages used internationally.

Fifty-two Taiwanese citizens with a similar ability in English were shown a series of twenty-six icons on a computer screen along with a list of labels, and asked to match the labels with the icons. The results indicated that cultural elements, especially alphabetical cultural elements aided the recognition of icons by participants not familiar with computers.

Introduction

Many present computer interfaces use icons. Horton (1994) described icons as being "the small pictorial symbols used on computer menus, windows and screens. They present certain capabilities of the system and can be animated to bring forth these capabilities for use by the operator." By using icons to present information to users productivity can be improved. Programs that predominately use icons allow software companies to export their products with little modification. The important question is whether this practice actually obstructs user understanding for certain groups. Fernandes (1995) suggested that iconic representations are problematic between different cultures.

The Iceberg model introduced by Hoft (1996) shows three metaphorical layers of culture: surface, unspoken rules and unconscious rules. The surface layer consists of cultural characteristics that are visible and obvious. They include: currency, date format and language. The two other layers of culture lie below the water level and are thus more difficult to study. They consist of cultural characteristics that exist out of conscious awareness, such as non verbal communication. It is imperative however that a designer does not ignore these two lower layers, for they form the basis for what is on the surface.

INTERFACES AND CULTURE

Most software deemed appropriate by their manufacturers for a particular nation, have their help files and menus translated into the language of that nation. However language is only one way in which nations differ. Nakakoji (1994) reported that software designed and launched successfully in one country does not necessarily suit people in another country because differences in culture can cause misunderstanding. It is thus essential to consider other factors, such as cultural symbolism, metaphors, imagery and color usage (Sears et al., 2001).

Po and Chuan (1999) compared two teams of designers who worked, independently, for Motorola on the design of pager products for the Chinese market. One design team was based in the USA and the other in Singapore. The results from the two teams were significantly different and reflected the cultural backgrounds found in each country. Another experimental study conducted by Fang and Rau (2003) examined the effects of cultural differences between Chinese and US users on the perceived usability of World Wide Web (WWW) portal sites. They found significant differences in satisfaction between each group, and in the number of steps each group used to perform the same task. The study indicated that cultural differences affect usability and task performance and that there is a need to investigate the effectiveness of icons on specific populations.

Onibere et al. (2001) carried out research in Botswana, a multi-cultural country which has two official languages (Setswana and English). One area of investigation was to find out whether Batswana (Botswanian citizens) users would prefer a localized interface. The survey results indicated that Batswana overwhelmingly desired such an interface. It is not known, however, whether this is true for the Taiwanese. This research investigates whether icons with local features are more appropriate for Taiwanese computer users than current standard icons.

REPRESENTATIONS AND APPROPRIATENESS

Signs can communicate their meanings in different ways. The road sign 'falling rocks' depicts rocks falling; the packaging symbol 'fragile' uses a picture of a glass. Generally both signs are effective even though their methods of communication are very different. The road sign uses imagery directly associated with an underlying concept (rocks falling) whereas the 'fragile' sign uses imagery indirectly associated with the underlying concept (a glass is fragile). The falling rocks sign, being more representational, is said to be more 'concrete' (Preece et al., 1994).

It has been reported that concrete icons are the easiest icons to identify because they use visual metaphors of the real world (Nolan, 1989; Ray, 1994; Stammers, 1990). Stammers (1988) also suggested, however, that concrete icons only help inexperienced computer users when they come to perform tasks. His research suggested that once experience is gained, concrete icons are no more effective than other icon types. These findings are supported by other research studies (Blankenberger and Hahn, 1991; Moyes and Jordan, 1993; McDougall et al., 1998).

A number of experiments have looked at the appropriateness of icon representations with regards to culture. Choong and Salvendy (1998) investigated how three different icon presentation modes affected performance in terms of recognition time and errors. Their experiment employed Mainland Chinese and American participants. The three icon presentation modes used in their experiment were pictures only, text only and pictures with text. The icons shown to both nationalities were the same except for the text which was written in Chinese for Chinese participants and English for the American participants. The results of the experiment showed that the icons that depicted text only were the least beneficial to Chinese participants and icons that depicted pictures only were the least beneficial to American participants. The results also showed that the pictures with text icons were not always more advantageous than text only or picture only icons.

In a similar study, Kurniawan et al. (2001) also investigated the effects of icon presentation modes on an icon's appropriateness and meaningfulness. However unlike Choong and Salvendy (1998), their study concentrated on Hong Kong Chinese computer users bi-lingual in Chinese and English. The icon presentation modes used in their study were the same as those used in Choong and Savendy's (1998) study: pictures only, text only and pictures with text only. Furthermore the same languages, Chinese and English, were used for the text elements. However unlike Choong and Savendy's (1998) study all participants were exposed to both languages. The research found that the Chinese participants rated text only icons, both Chinese and English, more appropriate and meaningful than picture only icons. When these findings are taken together with the findings of Choong and Salvendy's (1998) study, they seem to suggest that the Hong Kong Chinese differ from the Mainland Chinese with regard to the icon presentation mode they find most beneficial.

Some authors have provided guidelines regarding the use of text in iconic interfaces. Galdo (1990) suggested that designers should avoid using text with images when designing for an international market as word lengths differ from language to language. Galdo explained that these length differences can lead to practical problems getting translated text to fit in space allocated. Bradley (2001) also recommended restraint in the use of text, suggesting that interface designers should limit the use of alphabetic characters which have little or no meaning to the target user group.

AIMS OF THIS EXPERIMENT

Although American culture is not universal, standard icons generally use imagery that is based on American culture (Choong and Salvendy, 1998). In a study by Bourges-Waldegg and Scrivener (1998), the researchers commented that if a computer user does not understand an icon's imagery this can make the icon's function harder to learn. The researchers further suggested that a lack of understanding of an icon's imagery can even lead to a computer user deciding not to interact with an icon for fear of what might occur. This experiment investigated the appropriateness of Taiwanese cultural imagery in icon design, and compared it to standard imagery. In the experiment, the term *imagery* is used to describe pictures that are figurative or abstract; it is not used to describe text in any form.

The experiment was performed with Taiwanese participants and addressed the following question: *Do Taiwanese computer users find icons that use cultural imagery more appropriate than icons that use standard imagery?*

In the aforementioned study by Kurniawan et al. (2001), two varieties of text only icons were shown to Hong Kong Chinese participants. One icon variety showed

English text and another showed Chinese characters. The study found that there was no significant difference, in terms of appropriateness, between the two icon varieties. However it cannot be assumed that this finding would be reflected in Taiwan as, unlike in Hong Kong, English is not in widespread use. In addition to addressing the question above, this experiment also addressed the following question: *Do Taiwanese computer users find icons that use Chinese characters more appropriate than icons that use English letters/words?*

Method

Fifty-two Taiwanese citizens participated in this experiment. Communication with the participants was in Mandarin Chinese. The age of participants ranged from 21 to 35 years. The experiment took the form of a recognition test (Zwaga and Easterby, 1984) using icons on a computer screen. Participants were asked to match the icons shown to referents written on a list. The term *referent* is used in this paper to describe the name given to an icon by its program designer.

Prior to the commencement of the experiment, all participants completed a questionnaire written in Chinese. The questionnaire collected personal details and data relating to English ability and computer experience.

ENGLISH ABILITY

A previous study showed that English ability affects icon recognition (Wang, 2005). It was therefore decided that in this experiment, this factor would be controlled in such a way that all participants had a similar level of English ability.

Potential participants were asked to translate 12 English sentences (taken from Taiwanese junior and senior high school English textbooks) into Chinese. The sentences were arranged in order of increasing difficulty to translate. Each sentence was awarded points according to its position in the test and thus its difficulty. It was determined that the test would be used to find the largest group of individuals with a similar level of English ability. This group was made up of members that had a basic command of English; these individuals were asked to participate in the experiment.

COMPUTER EXPERIENCE

Results from other research (e.g., Wang, 2005; Gillan et al., 1995) showed that computer experience affects the identification of icons. Therefore, participants were divided into two groups according to their computer experience. The questionnaire asked participants whether they were computer literate and if so, how often they used a computer and what they used it for. This information was used to create two groups labelled: Group A, participants familiar with computers, and Group B, participants not familiar with computers.

Participants who said that they were not computer literate were placed in Group B. The remainder of the participants were placed into either Group A or Group B according to the responses they gave with respect to how often they used a computer and what they used it for. The latter was asked because it was thought that some participants who only played computer games might state that they were computer literate. This would have placed them in the wrong group for this experiment which investigated computer icons. In practice, however, this did not occur.

The questionnaire used a scale from 1 to 5, where 1 was 'rarely' and 5 was 'often,' to enable participants to indicate how often they used a computer. Participants who returned a value of 4 or more were placed in Group A, the rest were placed in Group B. Both groups had 26 participants.

Constructing the recognition test

MATERIALS

The recognition test used 26 icons shown in an environment that emulated the widely used word processing package Microsoft Word. This method of icon presentation was done by drawing the icons to be used in a computer graphics program and then importing them into Microsoft PowerPoint for presentation on a computer screen. 31 labels were also provided on a sheet of paper.

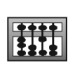
ICONS

The icons employed in the experiment are shown in Table 1. In the table they are shown categorized according to whether they are *non alphabetic* or *alphabetic* icons. A non alphabetic icon is an icon that either depicts an abstract object (a symbol) or a concrete object (an object that exists in the real world). An alphabetic icon is any icon that shows Chinese characters or English words/letters. The icons were additionally categorized according to whether they were *standard* icons or *cultural* icons. A standard icon is an icon that is found in international versions of software. A cultural icon is an icon that has cultural, national or local features.

The standard icons employed in the experiment were taken from frequently used software packages such as Microsoft Word and CorelDraw. The majority of the cultural icons were obtained from the Internet (www.gutesbo.se/icons) and (http://members.tripod.com/iconweaver/downt.htm) as well as a journal article (Ito and Nakakoji, 1996); the author designed the remainder.

When designing a cultural icon the author employed, as closely as possible, the principles used in the corresponding standard icon. For example the standard (Microsoft) icon for *bold* is the letter 'B,' an abbreviation of the word 'bold.' Additionally the icon shows the letter 'B' in a bold typeface. The author thus abbreviated the equivalent Chinese word for bold from 粗體 (bold body) to 粗 (bold) and wrote it in a bold typeface. It should be noted that the icon *spelling & grammar*

NON ALPHABETIC ICONS

REFERENT	*STANDARD*	*CULTURAL*
Home		 a
E-mail		 c
Stop		 b
Notepad		 b
Calculator		 b
Briefcase		 a

ALPHABETIC ICONS

REFERENT	*STANDARD*	*CULTURAL*
Italic	*I*	斜 d
Bold	**B**	**粗** d
Underline	<u>U</u>	<u>底</u> d
Type/Text/Font (T)	T	
Type/Text/Font (A)	A	
Type/Text/Font (漢)		漢 d
Type/Text/Font (字)		字 d
Font color	A	字 d
REFERENT (unique)	*STANDARD*	*CULTURAL*
Correction		 d
Spelling & Grammar		

Table 1: The icons shown in this experiment

NOTES: **a** Icons taken from Ito and Nakakoji, 1996, p.111. **b** Icons taken from www.gutesbo.se/icons (The cultural *notepad* icon was adapted for the experiment. The original icon showed the icon's referent written in Chinese in addition to the image elements). **c** Icons taken from http://members.tripod.com/iconweaver/downt.htm. **d** Icons designed by the author of this experiment did not have a cultural equivalent as spelling does not exist in Chinese. The closest function to spelling and grammar in Chinese is called 'correction,' and therefore an icon called *correction* was used in the experiment.

LABELS

This experiment uses the term label to refer to a possible name for an icon. A label can be either a referent (the name given to an icon by its program designer) or a dummy label. In this experiment, the term dummy label refers to a label which is not an icon's referent. Dummy labels were used in the experiment to increase the number of alternative answers a participant could pick from. The labels used in this experiment were written as a list in Chinese (all referents in the list were the names of icons as used in the Chinese language versions of the software packages). The order of the labels on the list was randomized for each participant. In total 31 labels were shown in the experiment, of which 14 were referents and 17 were dummy labels.

PROCEDURE

Prior to the tests, the participants who had never used a computer before were shown Microsoft Word and were given a brief but succinct explanation of what the program was for and how it worked. This was done not to introduce the participant to Microsoft Word *per se* but to give an overview of how computer interface tools enable computer users to carry out tasks.

All the participants taking part in the experiment were then individually shown a mix of cultural and standard icons; this mix consisted of both non alphabetic and alphabetic representations. The icons were shown on a computer screen one after the other in a random order. Participants were asked to match each icon shown with a label from a list of 31 on a sheet of paper. Participants were told that there was no restriction on how often a label could be used and that they should take as much time as they needed to respond to each icon shown. The author recorded the participants' decisions.

Results

RECOGNITION OF STANDARD AND CULTURAL ICONS

Table 2 shows the number of correct labels chosen by each group with respect to standard and cultural icons. A total of 676 icon viewings were performed in the recognition test to each group (26 different icon designs were shown to all of the 26 participants in each group).

STANDARD ICONS	GROUP A Familiar with computers	GROUP B Not familiar with computers	CULTURAL ICONS	GROUP A Familiar with computers	GROUP B Not familiar with computers
Home	16	7	Home	9	6
E-mail	9	7	E-mail	22	12
Stop	20	10	Stop	5	7
Notepad	19	9	Notepad	5	7
Calculator	7	8	Calculator	21	15
Briefcase	24	9	Briefcase	6	5
Italic	24	5	Italic	24	20
Bold	23	5	Bold	24	20
Underline	24	5	Underline	24	18
Type/Text/Font (T)	11	5	Type/Text/Font (漢)	17	15
Type/Text/Font (A)	14	4	Type/Text/Font (字)	24	18
Font color	14	3	Font color	7	11
Spelling & Grammar	17	4	Correction	22	19
Total correct for each group	222	81	*Total correct for each group*	210	173
Total across Groups A and B	*303*		*Total across Groups A and B*	*383*	

Table 2: The number of correct labels chosen for each icon. Each group consisted of 26 participants.

Combining the results of both participant groups, the total number of correct labels chosen for the standard icons shown in the icon recognition test was 303, compared with 383 for the cultural icons (*see table 2*). In other words, Taiwanese computer users recognized cultural icons better than standard icons ($\chi^2 = 9.33$, 1df, $p < 0.05$).

	GROUP A Familiar with computers	GROUP B Not familiar with computers
Standard icons	222	81
Cultural icons	210	173
All icons	432	254

Table 3: The number of correct labels chosen with respect to icon taxonomy and group.

Comparing the number of correct labels chosen for standard icons with cultural icons across the two groups shows that there is a different pattern ($\chi^2 = 24.66$, 1df, $p < 0.05$; *see table 3*).

When Groups A and B are looked at separately, the results show that participants familiar with computers (Group A) selected a similar number of correct labels for standard and cultural icons (222 and 210 in *table 3*). The reason for this was probably that the participants in Group A based their decisions on their knowledge of word processing packages and/or other computer packages and knowing what sorts of commands are found in programs, could figure out what the cultural icons represented even though they had most likely never seen most, if any, of the cultural icons before.

This result differed from those participants not familiar with computers (Group B) who found cultural icons easier to recognize than standard icons ($\chi^2 = 33.32$, 1df, $p < 0.05$; *see table 3*). In their case, the participants not having much computer experience almost certainly did not know what the majority of the icons shown were for and thus based their decisions on what they saw and on what tasks they thought computers might be able to perform. Thus it seems that a cultural representation gave Group B a better indication what an icon was for, the probable reason being that the representations were closer portrayals of the participant's world and thus conveyed their meaning more effectively.

To summarize, the results seem to indicate that cultural icons assisted Group B in the task of icon recognition. The same icons however, did not seem to further assist nor hinder Group A.

RECOGNITION OF NON ALPHABETIC AND ALPHABETIC ICONS

Table 4 shows the number of correct labels chosen by each group for an icon type. It should be noted that the table does not include data that relates to the *correction* and *spelling & grammar* icons as, due to the language differences that exist between Chinese and English, neither icon can have a cultural/standard equivalent as previously noted.

	GROUP A Familiar with computers	**GROUP B** Not familiar with computers
NON ALPHABETIC ICONS		
Standard icons	95	50
Cultural icons	68	52
Total	163	102
ALPHABETIC ICONS		
Standard icons	110	27
Cultural icons	120	102
Total	230	129

Table 4: The number of correct labels chosen for each icon type (excluding the number of correct labels chosen for the *correction* and *spelling & grammar* icons).

Excluding the *correction* and *spelling & grammar* icons, both groups were shown 6 non alphabetic *standard* icons, 6 non alphabetic *cultural* icons, 6 alphabetic *standard* icons, and 6 alphabetic *cultural* icons. Each group consisted of 26 participants. Thus the subtotals shown in Table 4 are all out of 156 (6 icons × 26 participants = 156) and the totals are all out of 312 (6 icons × 2 icon types, i.e., standard and cultural × 26 participants = 312).

The following section looks at Groups A and B separately. The results in Table 4 show that Group A recognized non alphabetic *standard* icons better than non alphabetic *cultural* icons ($\chi^2 = 4.47$, 1df, $p < 0.05$). The group recognized alphabetic *standard* icons and alphabetic *cultural* icons with equal ease ($\chi^2 = 0.43$, 1df, $p > 0.05$; *see table 4*).

The reason that Group A recognized non alphabetic *standard* icons better than non alphabetic *cultural* icons was probably because they had used the former but not the latter. However, although Group A had probably used alphabetic *standard* icons before, but not alphabetic *cultural* icons, it is likely that participants could read the Chinese characters shown on the latter and thus understand their functions.

There was no difference in the ability of Group B to recognize non alphabetic *standard* icons compared to non alphabetic *cultural* icons. ($\chi^2 = 0.04$, 1df, $p > 0.05$; *see table 4*). However, a difference in the ability to recognize icons was found when the same participants were shown the alphabetic icons. It was found that the participants were much more likely to recognize alphabetic *cultural* icons than alphabetic *standard* icons ($\chi^2 = 43.6$, 1df, $p < 0.05$; *see table 4*). The reasons for this could be that Group B, due to a lack of computer experience and only a basic command of English, could only make guesses as to what each alphabetic *standard* icon was for. In contrast, when shown an alphabetic *cultural* icon, participants in Group B could, in most cases, understand the Chinese abbreviation shown on the icon and hence simply pick out the icon's referent from the list of labels.

To summarize, the results seem to indicate that participants familiar with computers (Group A) recognized non alphabetic *standard* icons better than non alphabetic *cultural* icons, and alphabetic *standard* icons and alphabetic *cultural* icons with equal ease. However, a different pattern was found with participants not familiar with computers (Group B). They recognized non alphabetic *standard* icons and non alphabetic *cultural* icons with equal ease, and alphabetic *cultural* icons better than alphabetic *standard* icons.

INCORRECT LABELS

In this section, incorrect labels chosen are analyzed to ascertain why they were chosen by participants and to gain an understanding of what types of icon representations invite confusion.

Full records of the correct and incorrect labels chosen by participants with respect to the icons shown in this experiment are given later.

CONFUSION ANALYSIS

Table 5 shows for each group (Group A and B) and icon type (non alphabetic *standard*, non alphabetic *cultural*, alphabetic *standard*, and alphabetic *cultural*) the icons most frequently given an incorrect label and the number of participants who gave these icons an incorrect label.

	GROUP A Familiar with computers		**GROUP B** Not familiar with computers	
	ICON & REFERENT	*# OF ERRORS*	*ICON & REFERENT*	*# OF ERRORS*
STANDARD ICONS				
Non alphabetic icons	 Calculator	19	 Home	19
			 E-mail	19
Alphabetic icons	T Type/Text/Font (T)	15	A Font Color	23
CULTURAL ICONS				
Non alphabetic icons	 Stop	21	 Briefcase	21
	 Notepad	21		
Alphabetic icons	字 Font Color	19	字 Font color	15

Table 5: The icons most frequently given an incorrect label and the number of participants who chose an incorrect label for these icons according to icon type and group. The total number of responses given by each group to each icon was 26.

Standard icons

NON ALPHABETIC ICONS IN GROUP A

The non alphabetic *standard* icon that was given the most number of incorrect labels was the *calculator* icon; it was given an incorrect label by 19 participants. Interestingly it was also the standard icon given the most number of different labels by Group A (*see tables 7.1–7.4*). The icon was repeatedly given the incorrect label 'mathematics.' In fact more participants of Group A gave the icon the incorrect label 'mathematics' than the correct label 'calculator.' It seems likely that these participants saw that the icon's imagery was that of a calculator but interpreted the image too indirectly. Some participants however did seem to have been confused by the icon's imagery. A number of participants offered the label 'address book,' which suggests that they may have mistaken the image of the calculator for that of an electronic personal organizer.

NON ALPHABETIC IN GROUP B

The non alphabetic *standard* icons that were given the most number of incorrect labels by Group B were the *home* icon and the *e-mail* icon; both icons were given an incorrect label by 19 participants. The *home* icon was often given the label 'address book.' This confusion probably happened because the participants, having little (or no) computer experience, were unaware of the existence or the concept of the *home* icon and thus linked the image of the house to something associated with places of residence, such as an address book.

The *e-mail* icon seems to have brought confusion to participants not familiar with computers, perhaps because its imagery was not direct enough. Participants generally recognized the images for what they were (a letter and an envelope), but failed to make the link between the images and e-mail. The most frequent label given by participants not familiar with computers to the e-mail icon was 'write a letter.'

ALPHABETIC ICONS IN GROUP A

The alphabetic *standard* icon most frequently given an incorrect label was the *type/text/font (T)* icon; it was given an incorrect label by 15 participants. It was also the alphabetic *standard* icon that was given the same incorrect label the most number of times by participants familiar with computers; 'a letter T' was given by 9 participants. The *type/text/font (A)* icon was also given an incorrect label a similar amount of times by participants familiar with computers; 8 participants gave the icon the incorrect label 'a letter A.' The reason for this mislabelling was probably due to the icons being less direct. Unlike the other alphabetic *standard* icons shown in the tests, the two *type/text/font* icons did not indicate what would occur if used. The *bold* icon, for example, illustrated what would occur by showing a letter in a bold typeface and the *italic* icon illustrated what would occur by showing a letter in an italic typeface.

Another alphabetic *standard* icon that was mislabelled repeatedly was the *font color* icon (*see table 7.1*). The icon was given the incorrect label 'underline' by 7 participants. The most likely reason for the confusion is that the *font color* icon, like the *underline* icon, showed a line under an English letter (the *underline* icon did however show a thinner line). It is possible however that less confusion may have occurred if the line shown in the *font* icon had been multicolored in the tests.

ALPHABETIC ICONS IN GROUP B

Font color was the alphabetic *standard* icon that was most frequently given an incorrect label by participants not familiar with computers in the recognition test; 23 participants gave the icon an incorrect label. The fact that the *font color* icon used the same, or similar, image elements as other alphabetic icons (an English letter and an underline), although typically employed for a different purpose, seemed to invite confusion. Nearly eight times as many participants not familiar with computers returned an incorrect label for the standard *font color* icon, as those that returned the correct label. The label 'a letter A' was the most frequent incorrect label given to the icon by the group (*see table 7.2*).

A technique frequently used by Group B in the recognition test was to choose the label that described, in literal terms, what the alphabetic *standard* icon being displayed showed. For example the label 'a letter I' was given to the *italic* icon by over a third of the participants of Group B and the labels a 'capital letter' and 'an English letter' were given by the group to each alphabetic *standard* icon shown in the tests (*see table 7.2*).

Cultural icons

NON ALPHABETIC ICONS IN GROUP A

The two non alphabetic *cultural* icons most frequently given incorrect labels by participants familiar with computers were the *stop* icon and the *notepad* icon; both icons were given incorrect labels by 21 participants.

Most participants gave the *stop* icon, which displayed a picture of a traffic light, the label *font color*. One possible reason for this might be that the three colors used to depict the lights of the traffic light (red, amber and green) caused participants to believe that the icon had something to do with color. This belief may have been supported by the fact that the traffic light was portrayed with all three lights illuminated equally and thus led participants to reason that the image was not trying to communicate any of the conventional messages that a traffic light conveys (such as stop). Furthermore the fact that a traffic light performs its function by changing color might have led participants to believe that the icon had something to do with color change. It could also be possible that some participants did not recognize the image of the traffic light as a traffic light but instead saw it as an artist's palette, a box of watercolor paints or simply as a depiction of several colors.

The *notepad* icon, which depicts a fountain pen, a pot of ink and an envelope seemed to cause confusion due to the fact that the icon used imagery that was too indirect. It is likely, due to the fact that the most frequently given incorrect label to the icon was 'write a letter,' that participants familiar with computers recognized the image elements for what they were, but failed to make the link between the images and the intended communication.

The non alphabetic *cultural* icon *home*, which depicted a traditional Taiwanese/ Chinese thatched house, was given the incorrect label 'history' by participants of Group A nearly as many times as it was given its correct label (*see table 7.3*). This probably occurred because participants focused on the age of the house depicted rather than the house itself. The majority of houses in Taiwan are modern tiled buildings as depicted in the standard *home* icon; interestingly the standard icon for *home* was never incorrectly given this label. This suggests that the icon's antiquated imagery misled participants in Group A rather than aided understanding.

NON ALPHABETIC ICONS IN GROUP B

The *briefcase* icon was the most mislabelled non alphabetic *cultural* icon by participants not familiar with computers; 21 participants gave the icon an incorrect label (*see table 5*). (In fact the icon was also the third most mislabelled non alphabetic *cultural* icon by participants familiar with computers.) The most frequent incorrect label given to the icon by participants not familiar with computers was 'document,' 8 participants gave the icon this label (*see table 7.4*). Perhaps the reason for the scale of the mislabelling was because the imagery used for *briefcase* was not very clear. The imagery showed a traditional Taiwanese/Chinese package, which was probably too ambiguous to carry the intended message. Consequently, the icon received an array of incorrect labels as participants guessed what the intended communication was.

The concept behind the *briefcase* icon however is that of a method of conveniently managing and packaging files for travel that are usually held on a desktop computer. Files needed on a journey are placed in a folder called a 'briefcase' and copied on to a portable data storage device. This 'briefcase' is then transferred usually to a laptop. On return the updated files in the briefcase folder are then used to update the original desktop files. It could therefore be considered that the metaphor, and hence the correct label, a 'briefcase' was overly suggestive of the sort of image that should be portrayed by the icon. For example if the 'briefcase' icon had been called 'my travel bag' or 'my package of files' perhaps the icon depicting a Taiwanese/Chinese package would have been given more correct labels than it did in the recognition test.

ALPHABETIC ICONS IN GROUPS A AND B

The *font color* icon was the alphabetic *cultural* icon given the most number of incorrect labels by both Group A and Group B; 19 participants in Group A and 15 participants in Group B gave the icon an incorrect label (*see table 5*). The icon was also given the highest number of different incorrect labels. A third of participants of Group A and nearly a third of participants of Group B mislabelled the *font color* icon as *type/text/font (字)*. It is likely that this occurred because the *font color* icon showed the Chinese character '字' and on the list of labels given to each participant both the 'font color' label and the 'text/type/font' label showed the Chinese character '字'. The label for *font color* was '字型色彩' (which means 'font color' in English) and the label for *type/text/font* was '字型' (which means 'font' in English).

In contrast to the above, the alphabetic *cultural* icons for *bold, underline, italic* and *type/text/font (字)* were rarely given an incorrect label by Group A (*see table 7.3*). Interestingly, no participants in the tests gave the label 'italic' to any other cultural icon apart from the cultural *italic* icon. This most probably occurred because none of the cultural icons shown, except the cultural *italic* icon, showed an italic letter. The label was however given to other standard icons possibly because participants were unfamiliar with what italic English letters look like.

Looking at the results for the alphabetic icons as a whole (i.e., the results for Group A and B combined) alphabetic *standard* icons were mislabelled almost twice as many times as alphabetic *cultural* icons (*see table 6*).

	GROUP A Familiar with computers	**GROUP B** Not familiar with computers	**TOTAL**
Alphabetic standard icons	46	129	175
Alphabetic cultural icons	36	54	90

Table 6: The number of incorrect labels chosen with respect to alphabetic standard icons and alphabetic cultural icons in both groups.

Discussion and conclusion

The purpose of this experiment was to investigate whether Taiwanese computer users better understand cultural or standard imagery and whether they better understand cultural or standard text representations.

Participants were divided into two groups (Group A and Group B) according to their computer experience. This was done as previous research findings suggest that computer experience affects the identification of icons (Wang, 2005; Gillan et al., 1995). The results of this experiment support these research findings.

The results reveal that overall Taiwanese computer users recognized cultural icons more accurately than standard icons. However when participants familiar with computers (Group A) and participants not familiar with computers (Group B) are looked at separately, a difference exists. Group A recognized standard and cultural icons with equal ease, whereas Group B recognized cultural icons more easily than standard icons.

Looking at the imagery shown in the icons used in this experiment, the results reveal that in general Taiwanese computer users recognized standard imagery more easily than cultural imagery. However when participants familiar with computers (Group A) and participants not familiar with computers (Group B) are looked at separately, a difference exists. Group A recognized standard imagery more easily than cultural imagery, most likely because they were familiar with the images used, whereas Group B recognized standard and cultural imagery with equal ease. The results also show that some non alphabetic *cultural* icons were significantly easier to recognize than their standard counterparts. For example the cultural *calculator* icon was given three times as many correct labels than its standard counterpart by Group A, and nearly twice as many correct labels than its standard counterpart by Group B.

Therefore in answer to the question: "Do Taiwanese computer users find icons that use cultural imagery more appropriate than icons that use standard imagery?" the results suggest that only certain cultural images bring benefits.

Looking at the text shown in the icons used in this experiment, the results show that among participants familiar with computers there was no significant difference in their ability to recognize alphabetic *standard* icons compared to alphabetic *cultural* icons. However, this was not the situation for participants not familiar with computers. They recognized alphabetic *cultural* icons more easily than alphabetic *standard* icons.

Therefore in answer to the question: "Do Taiwanese computer users find icons that use Chinese characters more appropriate than icons that use English letters/words?" the results show that overall Taiwanese computer users find icons that use Chinese characters more appropriate than icons that use English letters/words.

The results suggest that Group B (participants not familiar with computers) often mislabeled icons because they were unaware of commands used in computer programs. Participants of Group B in general linked the images portrayed by non alphabetic icons with real-life activities/objects and the letters shown by alphabetic *standard* icons with letters from the English alphabet.

These results point to a number of design considerations:

- When designing interfaces for Taiwanese computer users, designers should not only address issues that relate to language, but also those that relate to the cultural interpretation of images. This suggestion is supported by Lin (1999).
- Where possible, alphabetic icons for Taiwanese computer users should use both typographic cues and Chinese characters.
- Objects that have a distinctive shape, especially those defined by their function, should be used in preference to objects that have an indistinct shape. (In the experiment the cultural *calculator* icon, which showed an abacus, fared extremely well. Conversely the standard *calculator* icon, which showed the less distinct form of an electronic calculator, fared badly.)

Many research studies look at culture and interface design. In many of these studies Taiwanese computer users are often grouped with other nationalities under the title 'Asian' (e.g., Evers and Day, 1997; Rau and Liang, 2003). However this approach can be potentially misleading as the findings are general and can have little bearing on what would be found if nations were looked at separately. Furthermore, it should not be assumed that guidelines and design considerations developed for one nation are relevant to another just because their cultures have similarities.

The final Tables 7.1–7.4 contain a full record of the recognition test for this experiment. These tables are arranged according to participant group (Group A and Group B) and icon type (standard and cultural). The tables show the labels provided, the labels chosen and the number of times they were chosen.

For each table, the labels provided for participants are listed in the left column. Labels 1 to 6 are non alphabetic icon labels, labels 7 to 12 are alphabetic icon labels and labels 13 and 14 are unique icon labels (either *spelling & grammar* or *correction*). Labels above the horizontal thick black line (i.e., labels 1 to 13) are referent labels. Labels below the horizontal thick black line (i.e., labels 14 to 31) are dummy labels.

The icons shown to participants form the headings of each column. The number of correct matches for an icon is the value in the cell which corresponds to the icon and its referent. For clarity this cell is shown in grey. All other entries in the icon column, except for the total at the bottom, are confusions.

For example, Table 7.3 shows that the cultural *calculator* icon (column 5) was given the correct label by 21 participants (indicated by grey), one participant chose the incorrect label 'briefcase' for this icon, and two participants chose the label 'calculator' for the cultural *briefcase* icon.

REFERENT							T	A	B	*I*	A	U	
1. Home	16												
2. Stop		20											
3. Briefcase			24										
4. E-mail	1			9									
5. Calculator					7								
6. Notepad					2	19							
7. Type/Text/Font (T)							11						
8. Type/Text/Font (A)								14			4		
9. Bold									23				
10. Italic										24	1		
11. Font color							2	1			14		1
12. Underline										1	7	24	
13. Spelling & Grammar													17
14. Correction													
15. Mathematics					9								
16. Document				1	2	2							
17. A letter A								8					
18. A letter T							9						
19. A letter U													3
20. A letter B									2				3
21. A letter I													
22. A letter X													
23. A number 1													
24. Change case									1				2
25. Delete		6					1						
26. History			1	1		2				1		1	
27. Translate English to Chinese													
28. An English letter													
29. Address book	7		1	1	5	3							
30. Write a letter	2			14	1								
31. Capital letter							3	3				1	
Total number of incorrect labels	10	6	2	17	19	7	15	12	3	2	12	2	9

Table 7.1: The number of correct and incorrect labels chosen by Group A relating to standard icons.

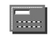
REFERENT							T	A	**B**	*I*	<u>A</u>	<u>U</u>	ABC✓
1. Home	7												
2. Stop		10											
3. Briefcase	1		9			1							
4. E-mail	3			7		1							
5. Calculator			10		8								
6. Notepad	1				6	9							
7. Type/Text/Font (T)							5					2	2
8. Type/Text/Font (A)								4			4	2	2
9. Bold									5				
10. Italic										5			1
11. Font color							1	3			3	2	
12. Underline											4	5	
13. Spelling & Grammar								1					4
14. Correction													4
15. Mathematics			2	2	5	3							
16. Document			2	2	3	6							
17. A letter A								11			9		3
18. A letter T							12						
19. A letter U												9	
20. A letter B									13				
21. A letter I										12			
22. A letter X		5											
23. A number 1										3			
24. Change case							2	1	2		1	2	4
25. Delete		11											
26. History			1										
27. Translate English to Chinese									2	1	2		3
28. An English letter							2	2	2	2	1	2	1
29. Address book	12		2	3	4	5		1	1	1			
30. Write a letter	2			12									
31. Capital letter						1	4	3	1	2	2	2	2
Total number of incorrect labels	19	16	17	19	18	17	21	22	21	21	23	21	22

Table 7.2: The number of correct and incorrect labels chosen by Group B relating to standard icons.

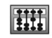
REFERENT							漢	字	粗	斜	字	底	校正
1. Home	9												
2. Stop		5											
3. Briefcase	1		6		1	1							
4. E-mail			4	22		3							
5. Calculator			2		21								
6. Notepad			1			5	1						
7. Type/Text/Font (T)						1	17		1	1	2	1	
8. Type/Text/Font (A)								24	1		10		
9. Bold							2		24				
10. Italic										24			
11. Font color	1	14	1			1					7		
12. Underline											5	24	
13. Spelling & Grammar		2	1										22
14. Correction		2	2				1						3
15. Mathematics		1	2		4								
16. Document			3			1							
17. A letter A													
18. A letter T													
19. A letter U													
20. A letter B													
21. A letter I													
22. A letter X													
23. A number 1													
24. Change case													1
25. Delete													
26. History	8	2	3			1							
27. Translate English to Chinese				1			5	1			1		
28. An English letter													
29. Address book	6		1	1		2							
30. Write a letter	1			2		11		1		1	1		
31. Capital letter												1	
Total number of incorrect labels	17	21	20	4	5	21	9	2	2	2	19	2	4

Table 7.3: The number of correct and incorrect labels chosen by Group A relating to cultural icons.

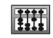
REFERENT							漢	字	粗	斜	字	底	校正
1. Home	6					2							
2. Stop		7											
3. Briefcase	2		5		2								
4. E-mail			4	12		4							
5. Calculator					15								
6. Notepad			2			7	1						
7. Type/Text/Font (T)	1	3					15		2			2	1
8. Type/Text/Font (A)								18	3	2	8	4	
9. Bold									20				
10. Italic										20			
11. Font color		12					1				11		
12. Underline										2	1	18	
13. Spelling & Grammar							1	3			2		19
14. Correction		3											1
15. Mathematics					7								
16. Document	2		8			1	1						
17. A letter A													
18. A letter T													
19. A letter U													
20. A letter B													
21. A letter I													
22. A letter X													
23. A number 1													
24. Change case											1		1
25. Delete			1										
26. History			1		2	1							1
27. Translate English to Chinese							6	5		1	1	1	2
28. An English letter													
29. Address book	15		1	7									
30. Write a letter		1	4	7		11					1		
31. Capital letter							1		1	1	1	1	1
Total number of incorrect labels	20	19	21	14	11	19	11	8	6	6	15	8	7

Table 7.4: The number of correct and incorrect labels chosen by Group B relating to cultural icons.

References

Blankenberger, S. and K. Hahn. 1991. Effects of icon design on Human-Computer Interaction. *International Journal of Man-machine Studies*, 35.3, 363–377.

Bourges-Waldegg, P. and S.A. Scrivener. 1998. Meaning, the central issue in cross-cultural HCI design. *Interacting with computers*, 9.3, 287–309.

Bradley, R.K. 2001. Design and the cultural significance in international communication. In Stephanidis, C., editor. Universal access in HCI: towards an information society for all. The 9th International conference on Human-Computer Interaction symposium on human interface. London: Lawrence Erlbaum Associates, 466–470.

Choong, Y.Y. and G. Salvendy. 1998. Design of icons for use by Chinese in mainland China. *Interacting with Computers*, 9.4, 417–430.

Evers, V. and D. Day. 1997. The role of culture in interface acceptance. In Ess, C. and F.S. Udweeks, editors. Proceedings CATA'98, Cultural attitudes towards technology and communication. London: Science Museum, 1–11. Also available from: http://www.swi.psy.uva.nl/usr/evers/publications.html (Accessed April 15, 2005).

Fang, X. and P.L.P. Rau. 2003. Culture differences in design of portal sites. *Ergonomics*, 46.1–3, 242–254.

Fernandes, T. 1995. *Global interface design: A guide to designing international user interfaces*. Boston, MA: Academic Press.

Galdo, E.M. 1990. Internationalisation and translation: some guidelines for the design of Human-Computer Interfaces. In Nielson, J., editor. *Designing user interfaces for international use.* Amsterdam: Elsevier, 1–10.

Gillan, D.J., B.S. Fogas, S. Aberasturi and S. Richard. 1995. Cognitive ability and computer experience influence interpretation of computer metaphors. In Proceedings of the Human Factors Society 39th annual meeting, Santa Monica. *The Human Factors Society*, 243–247.

Hoft, N.L. 1996. Developing a cultural model. In Galdo, E.M. and J. Nielsen, editors. *International User Interfaces*. New York, NY: John Wiley & Sons, 41–73.

Horton, W. 1994. The Icon Book. New York, NY: John Wiley & Sons.

Ito, M. and K. Nakakoji. 1996. Impact of culture on user interface design. In Galdo, E.M. and J. Nielsen, editors. *International User Interfaces.* New York, NY: John Wiley & Sons, 105–126.

Kurniawan, S.H., R.S. Goonetilleke and H.M. Shih. 2001. Involving Chinese users in analyzing the effects of languages and modalities on computer icons. In Stephanidis, C., editor. *Universal access in HCI: Towards an information society for all.* (The 9th International conference on Human-Computer Interaction symposium on human interface). London: Lawrence Erlbaum Associates, 491–494.

Lin, R. 1999. Cultural differences in icon recognition. In Bullinger, H.J. and J. Ziegler, editors. *Human-Computer Interaction: Ergonomics and user interfaces.* London: Lawrence Erlbaum Associates, 725–729.

McDougall, S.J.P., M.B. Curry and O. Bruijn. 1998. Understanding what makes icons effective: how subjective ratings can inform design. In Hanson, M.A., editor. *Contemporary Ergonomics*. 1998. London: Taylor & Francis, 285–289.

Moyes, J. and P.W. Jordan. 1993. Icon design and its effect on guessability, learnability, and experienced user performance. In Alty, J.L., D. Diaper and S. Guest, editors. People & computers VIII: Proceedings of HCI '93. Cambridge: Cambridge University Press, 49–59.

Nakakoji, K., 1994. Crossing the cultural boundary. *BYTE*, 19.6, 107–109.

Nolan, P.R. 1989. Designing screen icons: ranking and matching studies. In Proceedings of the Human Factors Society 33rd annual meeting, Santa Monica. *The Human Factors Society*, 380–384.

Onibere, E.A., S. Morgan, E.M. Busang and D. Mpoeleng. 2001. Human-Computer interface design issues for a multi-cultural and multi-lingual English speaking country-Botswana. *Interacting with Computers*, 13.4, 497–512.

Po, T.M. and T.K. Chuan. 1999. Challenges in designing user interfaces for handheld Human-Computer Interaction. In Bullinger, H.J., editor. Human-computer Interaction. Vol. 1, Ergonomics and User Interfaces: Proceedings of HCI International '99, The 8th International Conference On Human-Computer Interaction. London: Lawrence Erlbaum Associates, 808–812.

Preece, J., Y. Rogers, H. Sharp, D. Benyon, S. Holland and T. Carey. 1994. *Human-Computer Interaction*. Harlow, UK: Addison-Wesley.

Rau, P.L.P. and S.F.M. Liang. 2003. Internationalization and localization: evaluating and testing a Website for Asian users. *Ergonomics*, 46.1–3, 255–270.

Ray, E. 1994. *User Interface Design*. Upper Saddle River, NJ: Prentice-Hall International.

Sears, A., J.A. Jacko and E.M. Dubach. 2000. International Aspects of World Wide Web Usability and the Role of High-End Graphical Enhancements. *International Journal of Human-Computer Interaction*, 12.2, 241–261.

Stammers, R.B. 1988. Icon interpretation and degree of abstractness-concreteness. In Adams, A.S., R.R. Hall, B.J. McPhee and M.S. Oxenburgh, editors. *Ergonomics International 88*. London: Taylor and Francis, 505–507.

Stammers, R.B. 1990. Judged appropriateness of icons as a predictor of identification performance. In Lovesey, E.J., editor. *Contemporary Ergonomics*. London: Taylor & Francis, 371–376.

Wang, H.F. 2005. Designing appropriate icons for Taiwanese computer users. Ph.D. Thesis. Reading University, U.K.

Zwaga, H.J.G. and R. Easterby. 1984. Developing effective symbols for public information. *Information Design*, 277–297.

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THE DEVELOPMENT OF AUTOMOBILE SPEEDOMETER DIALS

A BALANCE OF ERGONOMICS AND STYLE, REGULATION AND POWER

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Mitchell, 331–366
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Abstract

This paper explains the historical development of analogue and digital speedometer dial designs using the linguistics theory base of pragmatics, which asks researchers to explain a visual design by describing its purpose as well as how its various visual features meet people's needs, how people read dials and how people use dials to coordinate with one another or machines. The paper is useful for researchers interested in methodologies for studying the development of language-like visual communication, and for those interested in the history of information graphics, machine interfaces or speedometer dials in particular. A range of dial designs from the early 1900s to the current day are described and analyzed.
In this paper, results show that drivers read speedometers to avoid fines, keep safe, change gears, set cruise control or record high speeds. Designs also, however, serve marketing and aesthetic purposes. Features of analogue displays are described with the paper concluding with a taxonomy of dial features. The entire system of speed containment could be improved since even with easy-to-read dials, drivers continue to speed. Dials that work with satellite systems to continually display the current speed limit may be the way of the future.

Introduction

This paper provides a case study of how the linguistics theory base of pragmatics can be used to explain the development of visual standards. In particular, the paper looks at the visual design of speedometer dials, which have developed in response to improved understanding of driver, safety and market needs, and changing visual styles, laws and technology. Linguistics provides a helpful theory base for understanding a design such as a speedometer dial since the design is closely attached to particular meanings and as such can be said to be *language-like*.

The linguist Harley (2001) said that “Pragmatics is concerned with how we get things done with language and how we work out what the purpose is behind the speaker’s utterance” (337). He further explained that the field has two main branches, the first of which is how we extract meaning from language by drawing inferences, and the second is how we work together to maintain conversations. Another linguist, Clark (1996) said that the most useful way to study language use is from both social and individual perspectives.

These explanations from pragmatics are also obviously useful for the study of visual languages. A pragmatic approach to studying visuals is concerned with how we get things done with a particular design and how we read that design. In the particular case of speedometer dials, a pragmatic approach asks how individuals read and use the dials, and how the dials help people to coordinate with one another and with their vehicles.

A pragmatic approach is also helpful in understanding how a visual design develops over time. Such an approach looks at the initial need for the visual, how the visual meets the need and then how designers incrementally modify the visual over time as the design environment changes (e.g., technology changes) and designers come to better understand user needs.

Mitchell (2008) has provided a methodology for studying the development of designs from a pragmatic approach, which involves the following:

1. Selecting a category of visual communication and identifying the social situations in which it is used
2. Formulating open questions about the visual form…and the situations in which it is used
3. Collecting examples of the visual communication
4. Selecting research tools to study how the design is used
5. Writing descriptions of the visual communication and the situation in which it is used

6. Selecting methods for and conducting analyses
7. Discovering themes within the data and applying existing theories as appropriate (4).

This paper applies this methodology to explaining the development of speedometer dial designs. Chosen examples range from the earliest designs to the digital head-up displays (HUDs) available today. The selection could not be all inclusive but is meant to be representative of what designers have created over time and in different cultures to meet a range of needs. Examples were taken from Holland (1999), museum collections, scholarly articles and online sources. Individual selections were made based upon their historical significance and differences from one another. Key questions driving the research are as follows: For whom was the design made and for what purpose? What symbol sets, visual variables (shape, size, etc.), reference points and scale does it use? What is the underlying technology? What are the technological and cognitive affordances and limitations of the design in meeting user needs?

The paper begins by describing the types of marks that appear on speedometer dials, and then presents a range of designs for later discussion. Next the paper reviews literature on how people use speedometers, and then discusses how various visual variables work to meet driver and market needs. Unless otherwise noted, drawings in the paper are the author's and are close approximations of manufacturers' designs. The paper ends with a taxonomy of dial features.

Speedometer marks

To describe speedometer designs, a first step is to look at the set of marks on each dial. For analogue speedometers such as that in Figure 1, the set may be described as *multi-modal written* and *technologically mediated*.

The set of marks is multi-modal written since it consists of a dial shape, scale marks, numbers, letters, a needle and contrasting colors. The design is also technologically-mediated since the needle moves in response to accelerator pressure and the given terrain. For digital speedometers, the medium is written (consisting of numbers) and technologically mediated.

In composing a dial, the aim is to create a design that best meets the needs of several audiences, which include various drivers (e.g., on-road versus race drivers), authorities, car buyers and sellers and others such as design critics. As shown in Figures 2–5, designers have tried a variety of solutions for meeting those needs.

Figure 2 presents examples of early dials, Figure 3 presents examples of circular dials from the 1950s and 1960s, Figure 4 presents examples of linear dials from the 1950s through 1970s, and Figure 5 presents some current dials.

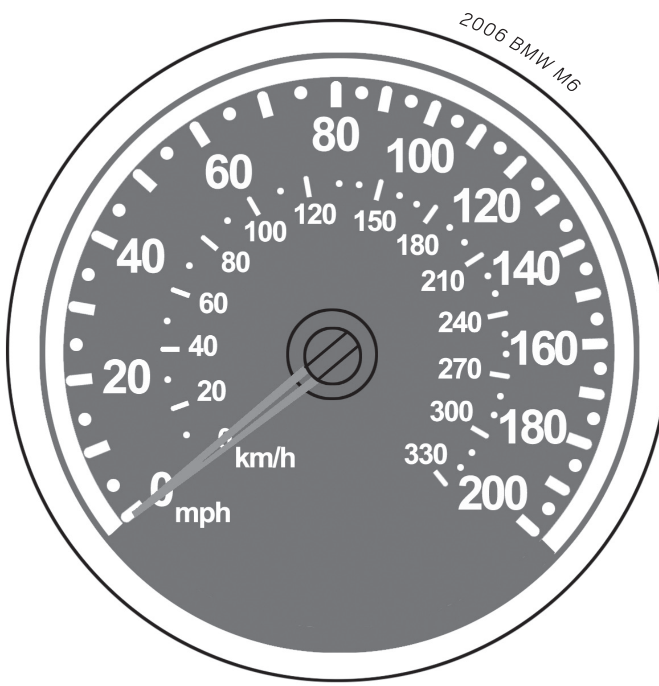
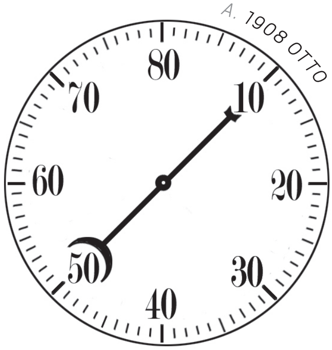
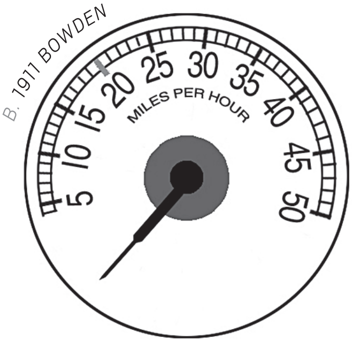


FIGURE 1:
ANALOGUE SPEEDOMETER

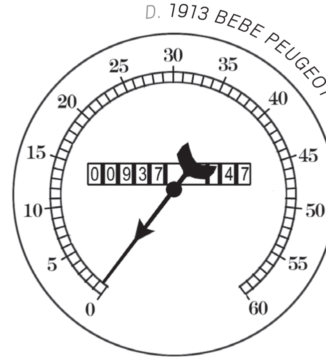


A. 1908 OTTO

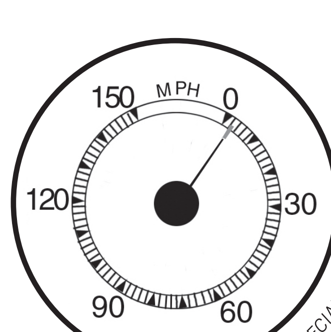


B. 1911 BOWDEN

C. 1913 NEWTON BENNETT

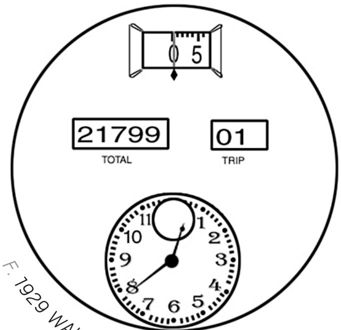


D. 1913 BEBE PEUGEOT



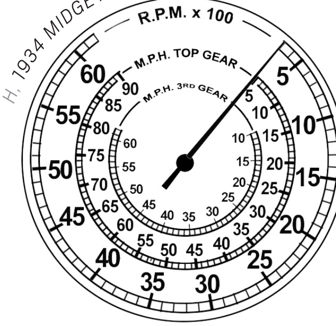
E. 1924/30 BENTLEY SPECIAL GB

FIGURE 2:
1908–1938 SPEEDOMETERS

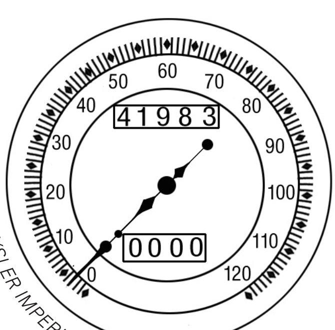


F. 1929 WALTHAM WATCH CO.

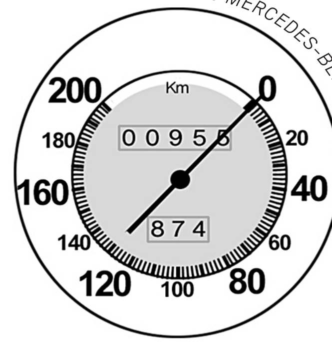
G. 1930 MINERVA AK 19



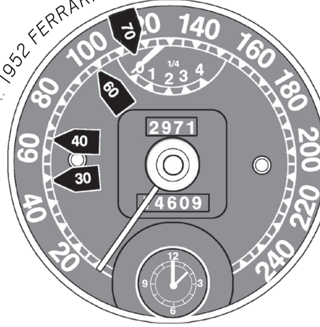
H. 1934 MIDGET PA



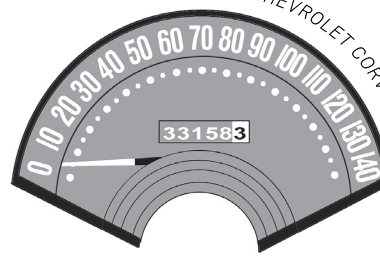
I. 1937 CHRYSLER IMPERIAL



J. 1938 MERCEDES-BENZ 540K



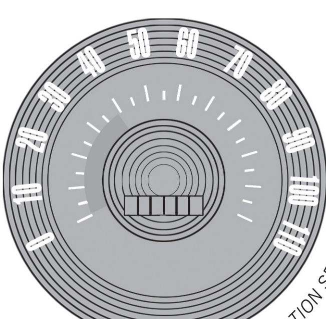
A. 1952 FERRARI 212 INTER



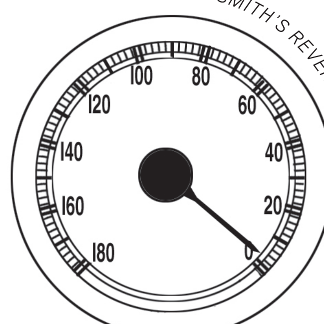
B. 1957 CHEVROLET CORVETTE

FIGURE 3:
1950s AND 1960s
CIRCULAR
SPEEDOMETERS

C. 1958 FORD EDSEL

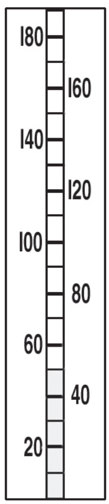


D. 1961 EK HOLDEN STATION SEDAN



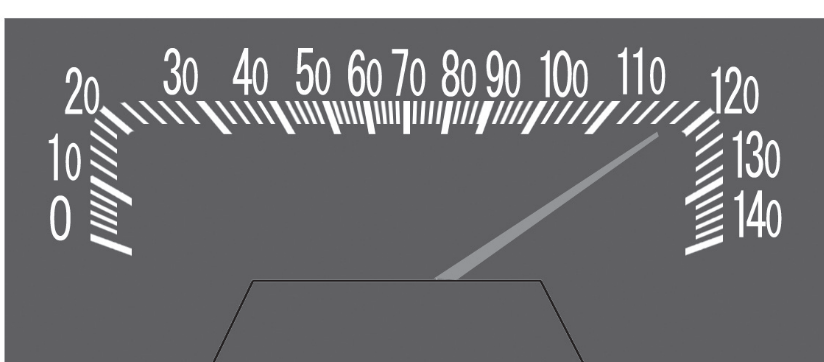
E. 1965 SMITH'S REVERSE

FIGURE 4: 1950s–1970s LINEAR SPEEDOMETERS



A. 1958–1969 MERCEDES BENZ HECKFLOSSEN

B. 1959 FORD GALAXIE FAIRLANE 500



C. 1974 DODGE MONACO

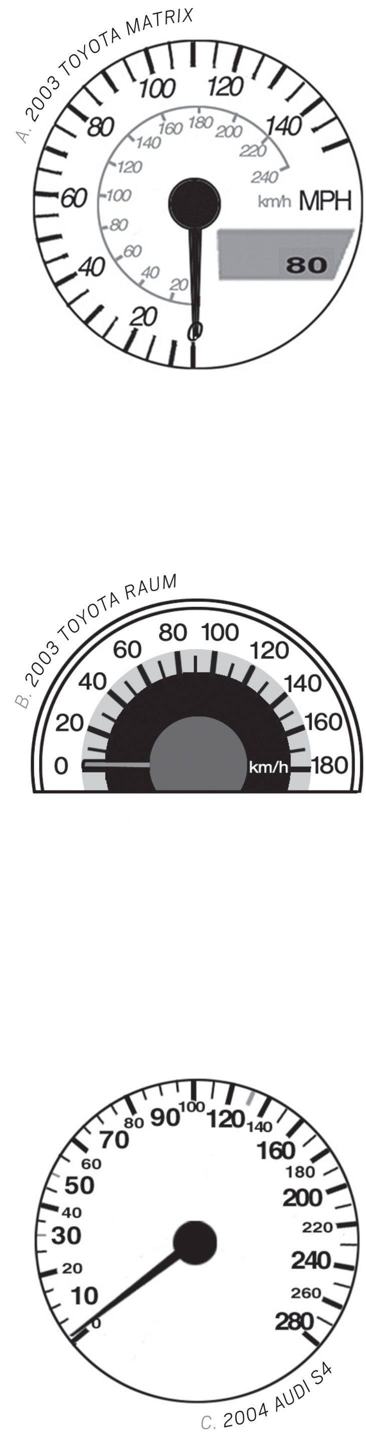
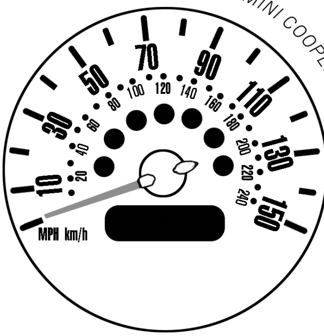
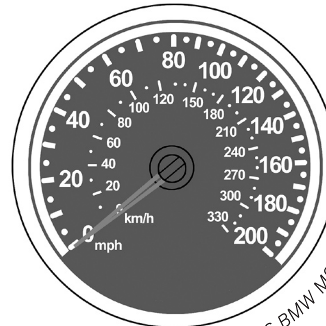


FIGURE 5:
CURRENT ANALOGUE SPEEDOMETERS

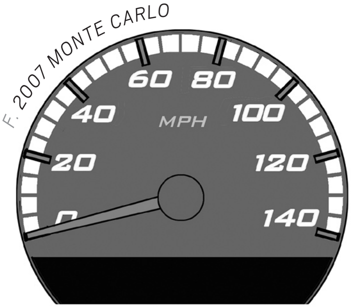
D. 2005 MINI COOPER S



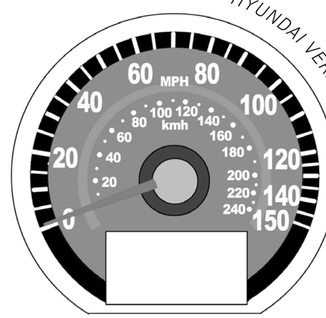


E. 2006 BMW M6

F. 2007 MONTE CARLO



G. 2007 HYUNDAI VERACRUZ



H. 2004–2006 HOLDEN GTO

Speedometer use

Although the first practical automobile appeared in 1885 with Benz's invention, the first automobile speedometer did not appear until 1902 with Schulze's patent of the eddy current (magnetic or mechanical) speedometer. Speedometers only began to become a standard feature in cars in 1910 (Siemens VDO Automotive AG, 2002) after many localities had already begun setting limits. Limits were imposed on trains and then on cars. In the United Kingdom, *The Locomotive Act 1861* limited speed to 12mph (19km/h), then *The Locomotive Act 1865* reduced it to 2mph (3.2km/h) in cities, towns and villages, and 4mph (6.4km/h) everywhere else. In 1895, *The Locomotives on the Highway Act* raised the speed limit to 14mph (22.5km/h) (Chapman, 2007). In 1901, the State of Connecticut limited speed to 12mph (19km/h) and 15mph (24km/h) for city and country driving respectively. Authorities required limits for safety and preserving roads since "hard rubber tires destroyed the dust binder on macadamized roads, creating ruts and eventually ruining the roads" (State of Connecticut, 2007, ¶16).

According to Sandoro (Hartley, 2002), drivers began installing speedometers to protect themselves from fines. He said, "At the time, police were on bicycles or motorcycles and their timing (of drivers' speeds) was done unscientifically with a stop watch. When speedometers were put in cars, the driver would often put a plaque on the back of the car saying that it was equipped with one so the police would not be so quick to give them a ticket" (¶11). Some early drivers installed one small speedometer dial for themselves and positioned another larger one for police to read at a distance (From speedometer to modern instrument clusters, 2005).

Avoiding fines continues, of course, to be a reason for speedometer use, but drivers also have other reasons. Green (1983) surveyed thirty-two US drivers to learn when and why they looked at their speedometer. He found that they used it when they saw a police car, when in various speed zones (e.g., a school zone), when shifting and when setting cruise control.

In another study, Denton (1969) observed thirty people driving under various speed conditions. He found that many people thought that they used their speedometer more than they actually did. For example, upon seeing a "reduce speed now" sign, twenty-four subjects said that they looked at their speedometer, but during observation only eight did. Denton concluded "use of the speedometer may be determined to some extent by the spare mental capacity available" (451). He suggested that drivers perhaps need "a more readable display not requiring a shift of attention from the road" for locations such as roundabouts in which "traffic behavior is changing fairly rapidly" (451).

From a safety perspective, the primary purpose of speedometers is to help drivers limit their speed, yet speeding still occurs. To understand why people speed, Gabany, Plummer and Grigg (1997) took an approach designed to decrease potential threat to subjects and improve the chances of getting truthful answers, and asked the subjects why they thought that *other people* engaged in speeding. Results suggested five reasons, which are "ego-gratification," "risk-taking," "time pressures," "disdain of driving" and "inattention" (31). For all reasons except inattention, it is possible that some drivers use their speedometers while speeding. For example, when speeding for reasons of ego-gratification or risk-taking, drivers may want to report their speed and so would read their speedometers. Indeed, some have even posted on the Internet pictures of their speedometers registering high speeds. Drivers who speed due to time pressure or disdain of driving may keep their excess speed within a narrow range above the limit to minimize risks of receiving fines or having accidents.

Speeding due to inattention may also be explained as speeding due to *unawareness*. In a survey of twenty-five drivers, Kumar and Kim (2005) found that "84%…reported that they are sometimes unaware of the current…limit. 40% reported that they are sometimes surprised that the…limit is different from what they thought [and] 68%…reported that they sometimes catch themselves inadvertently exceeding their desired speed" (1). Kumar and Kim have reasoned that such speeding occurs because roadways do not provide a constant display of the speed limit and speedometers do not draw drivers' attention to speeding.

Bringing the above research together, drivers read speedometers to avoid fines, keep safe, change gears, set cruise control or record high speeds. As a tool that simply presents a car's current speed, speedometers do not prevent drivers from speeding. The current system of legal punishments prevents much speeding, but does not prevent speeding due to unawareness. The most basic technological solution for such speeding is cruise control, but it is useful only along relatively straight stretches of highway. Other technologies will be discussed later in the paper.

Speedometer designs also serve marketing and aesthetic purposes. One design variation that serves more of a marketing than a safety purpose is the highest speed indicated on the dial. For all cars except those driven in countries with no or few limits, the maximum dial speed is much higher than that allowed on public motorways, indeed it is often more than twice as high. Most countries have motorway limits that range from 70 to 130 km/h (43–80 mph), but as shown in Table I, speedometers indicate top speeds of up to 280 km/h and 160 mph.

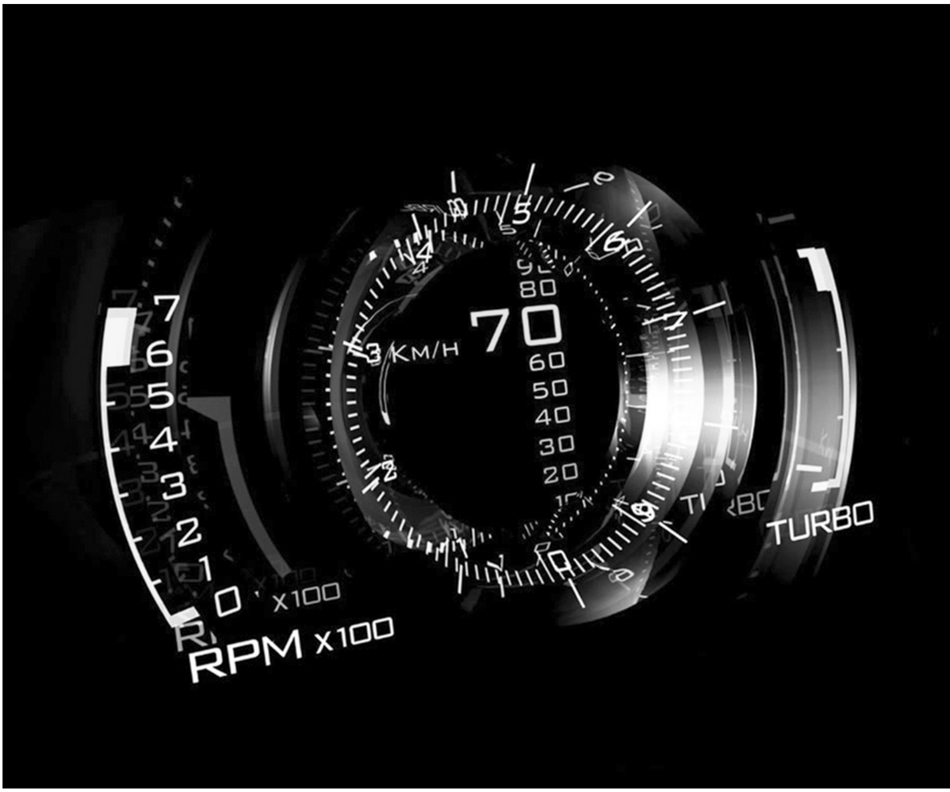
CAR	TOP SPEED (KM/H)	MAX. SPEED ON SPEEDOMETER (KM/H)	TOP SPEED (MPH)	MAX. SPEED ON SPEEDOMETER (MPH)
2007 Audi TT	251 [a]	280		
2007 BMW 6 Series E64 Convertible	250 [b]	260		
2007 Chevrolet Monte Carlo			145 [a]	140
2007 Chevrolet Uplander			111 [a]	120
2007 Mercedes Benz A-Class 170	~188 [c]	240		
2007 Mercedes Benz SLK	~230 [d]	260		
2007 Mitsubishi Outlander			115 [a]	140
2006 Nissan Altima SE-R			150 [a]	160
2007 Pontiac G6 Sedan			112 [a]	140
2007 Porsche Cayman	259 [a]	280		
2005 Toyota Camry	211 [a]	220		
2007 Volvo V50 station wagon				
5 speed geartronic	215 [e]	260		
5 speed manual	220 [e]	260		

Table 1: Examples of top speeds and maximum speedometer speeds
NOTES: **a** Car specifications directory, 2007. **b** BMW Heaven, 2007. **c** Mercedes Benz Australia, 2007a. **d** Mercedes Benz Australia, 2007b. **e** Volvo Car Corporation, 1998–2006.

Regarding worldwide speed limits, Nepal and the Isle of Man are the only two countries having no limits. There are also no limits in the Indian states of Uttar Pradesh and Kerala (Speed limit, 2007), and along the German autobahn, there is only an advisory limit of 130 km/h along three-quarters of the road network. On those parts without a limit, the average speed is 150 km/h (93 mph) (Autobahn, 2007). In Austria and the United Arab Emirates, the world's highest limit of 160 km/h (99 mph) is being tested along some stretches of road (Speed limit, 2007).

Most drivers will never attempt these high speeds, but cars are still designed to reach them and speedometers list them. Apparently, cars are designed for high speeds because limit-free portions of the German autobahn allow such speeds. Therefore, designs made for German conditions influence what is used around the world. Another reason for designing high-speed cars has to do with the desire for power. Garfield (1977) wrote, "Many of us won't accept simply any machine; we want the newest, most powerful, most advanced model—whether lawnmower or

FIGURE 6: CONCEPT CAR SPEEDOMETERS



A. 2006 SAAB AERO X (GM MEDIA ONLINE, 2007)

B. 2007 CITROEN C-CACTUS (JALOPNIK, 2007) automobile" (364). Speeds listed on speedometers therefore act as aids for safety and legal compliance, but also for power and competition. Many speedometer designs for cars on public roads are a compromise between these needs.

Some speedometer designs are made purely for marketing reasons. These designs are for concept cars, which are often radical prototypes made to test customer reactions to new ideas. If ever produced, the cars would require changes to make them cost-effective, safe and usable. Figure 6 shows unique speedometers from two recent concept cars, the 2006 Saab Aero X and the 2007 Citroen C-Cactus.

The Saab Aero X, an environmentally friendly car powered by ethanol, has no standard dials but displays information on "glass-like acrylic 'clear zones' in graphic 3D images" (GM Media Online, 2006, ¶ 5). According to the marketing literature, the green lighting of the dials reflects Saab's aviation background and aims to provide maximum clarity. The unique speedometer design is created through a vertical linear arrangement with large font presentation of the current speed.

The Citroen C-Cactus, another environmentally friendly car, has a diesel-hybrid drivetrain with low fuel consumption and CO_2 emissions. The car has a top speed of 150 kph, which Citroen (2007) said "contributes to…good environmental performance…[and] reflects Citroën's efforts to develop a green vehicle…in which the motorist is in harmony with his/her surrounding environment" (¶24). The speedometer is unique in that it is placed around the steering wheel hub and has a scale that rotates around a fixed point.

While the designs of the Saab Aero X and Citroen C-Cactus speedometers are both eye-catching, as shown, neither follows ergonomic design recommendations.

Discussion of speedometer design features starting with analogue dials then moving to digital readouts follows. The analogue design features discussed are dial shape, reference point placements, scales, typefaces, number placements, needles and color. The paper also discusses dials that provide additional assistance in controlling speed, and what design would be easiest to read and therefore safest.

Dial shape and technology

As shown in Figures 2–5, most analogue speedometer dials are circular or arc-shaped, but some are linear. Early designs were circular because of their technologies, which were based on centrifugal or magnetic (eddy current) force. One of the earliest speedometers, the 1904 Cowey (*figure 7*) was circular and contained unique features.

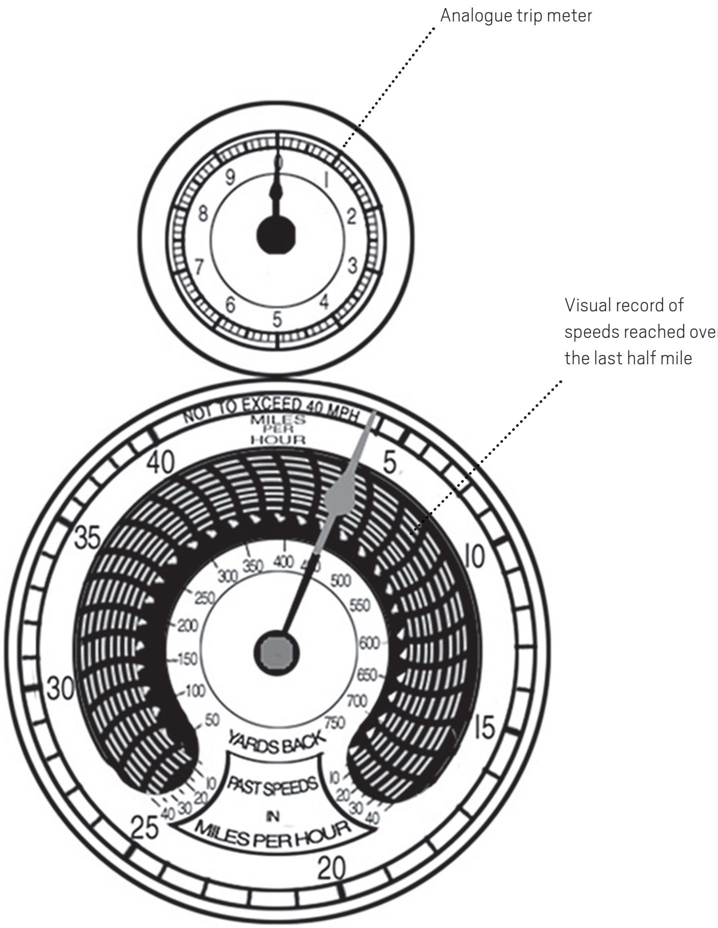


FIGURE 7:
1904 COWEY "RECORDING SPEED INDICATOR"

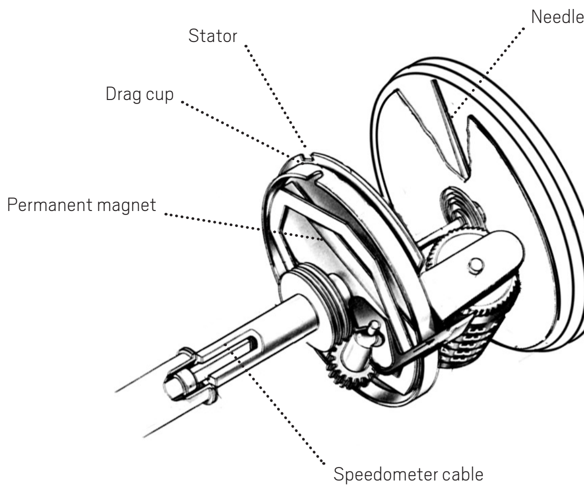


FIGURE 8
MECHANICAL SPEEDOMETER

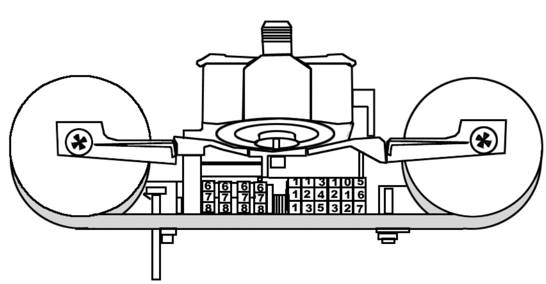


FIGURE 9
RIBBON SPEEDOMETER

While modern cars typically have a digital trip meter, the 1904 Cowey's was analogue. The Cowey also included a device to record speeds reached over distances of 50 to 750 yards, which in the early days of motoring might have appealed to designers or driving enthusiasts interested in learning the car speed capabilities in various situations.

Another design, the 1911 Bowden (*figure 2b*), measured speed based on the movement of metal balls that swung out from a rotating shaft to create a centrifugal force. Although useful, the mechanical (magnetic or eddy current) speedometer proved to be more accurate.

Figure 8 illustrates mechanical speedometer technology. Such speedometers have a multi-strand wire (speedometer cable) that transfers the drive from the gearbox output shaft to the speedometer dial. The output shaft is directly attached to a circular permanent magnet that is housed in a shallow aluminum *drag cup*. Along the shaft is a steel stator, which when the car moves, is driven by electronic eddy currents set up by the rotating conductive cup. The faster the cup turns in response to an increase in speed of the gearbox output shaft, the greater the torque on the stator. The stator is connected to a hairspring, which in turn is connected directly to the speedometer needle. The larger the torque on the stator, the greater the force on the hairspring and the greater the movement on the speedometer needle.

An improvement on the mechanical design was the mid-1950's electronic speedometer (Siemens VDO Automotive AG, 2002). This device has a magnetic transducer positioned somewhere on the final output shaft of the gearbox after the overdrive unit, which eliminates the need for a cable.

Early variations on circular dials were window dials, which showed only a portion of a dial's speeds and had a moving scale and stationary pointer. One example of a window dial is the 1929 Waltham (*figure 2f*), which had numbers silk-screened onto the lip of the speedometer's aluminum cup. These numbers rotated past a fixed point on the dial. The speedometer assembly was placed vertically inside the car with the lip, not the face of the cup, visible to the driver. Mroz (1998) reported that even when a magnifying glass was used for the window, drivers had difficulty reading the numbers, which would have been moving (perhaps only slowly) much of the time. Some of the dials contained no lamp so they could be read only in daylight. The speedometer window presented a range of only about 10 mph.

The vertical speedometer of the 1958–1969 Mercedes Benz models (*figure 4a*) used ribbon technology, which was an attachment to the drag cup of a mechanical speedometer. On these speedometers (*figure 9*), the pointer is a colored tape that winds from one drum to another as speed changes. On the Mercedes Benz speedometer, yellow ribbon marked speeds up to 50km/h, a red-yellow combination marked speeds from 50 to 60km/h, and red marked speeds above 60km/h. About this device, van Eijck (1999) wrote, “…the vertical strip-type speedometer…proved hard to read and was roundly criticized by the motoring-press…” (¶3). Neither vertical nor horizontal linear designs proved to be popular and are seldom used in modern cars.

Although the circular shape of early dials was technologically determined, this shape offers many advantages over linear dials. For example, circles save dashboard space, and compared to linear designs, can display finer increments of speed around the circumference within the same amount of space. Further, on circular dials the indication of speed is visually redundant since it is marked by two visual variables, angle and position. On linear dials, speed is indicated only by position.

Reference points and direction of movement

Another important issue in the design of circular dials is where to place the key reference points, which are the initial, top and maximum highway speeds. As seen in Figure 2, the placement of the initial speed on early dials was either at the top (from 12:00 to 2:00) or in the bottom left quadrant (from 7:00 to 9:00). Eventually, placement in the bottom left quadrant became the standard. While initial speed placement at the top of the dial was based on clock design, placement in the bottom left quadrant was based upon a combination of factors, which are presented in Figure 10, using the 1911 Bowden speedometer as a model.

On the Bowden, the 4mph start was placed between 8:00 and 9:00, and the 50mph maximum listed speed was placed between 3:00 and 4:00. A red mark highlighted 20mph, which was presumably the maximum speed limit at the time.

Reference point placement on the Bowden offered several advantages. First, this design followed both the direction of conventional clock movement and left-to-right reading order. Next, since the most common speeds are on the left of the dial, the movement from lower to higher speeds increases from a lower to a higher position. Lastly, the design is aesthetically pleasing since it is symmetrical.

Most modern dials follow this same pattern for reference point placement. However, it is useful to note here that a design that has been singled out as following good ergonomic principles, the Toyota Raum (*shown in Figure 2b and again below*) also follows this pattern. The Raum was created following principles of universal design. According to Misugi, Kanamori and Atsumi (2004), universal design “is

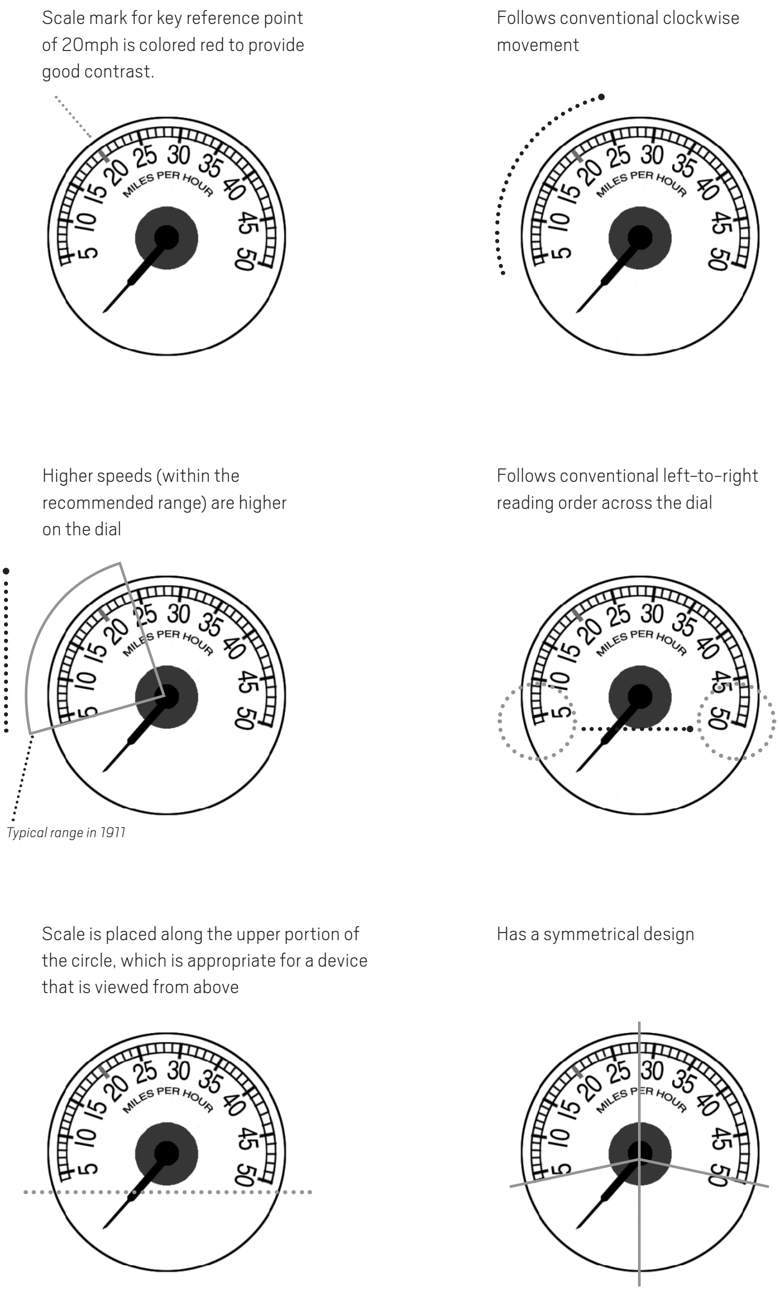
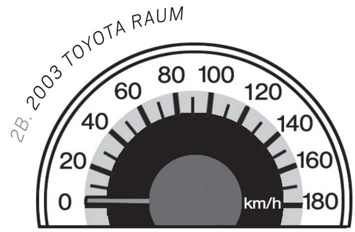


FIGURE 10: ADVANTAGES OF REFERENCE POINT PLACEMENT ON THE 1911 BOWDEN SPEEDOMETER

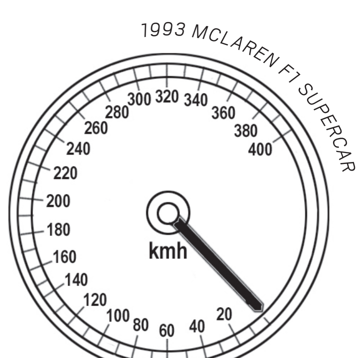


defined as providing a service or designing an object or location in such a way that it can be easily used by many people, regardless of physical characteristics such as gender, age or disability" (¶1).

In addition to its useful reference point placements, the Raum offers meter numbers set in a typeface that has "superior readability even when viewed slightly blurred," which takes into consideration the needs of "slightly far-sighted elderly drivers." Further, the meter numbers have a background of "white bands for easy recognition" (¶16). During development, the designers "confirmed" the speedometer with users over thirty times. On this dial the current Japanese speed limit of 100km/h (Speed limit, 2007) is placed near 12:00.

On a speedometer, 12:00 was a poorer choice than 6:00–9:00 for the start of measurement partly because it goes against our linguistic representation of speed, in which speed increases and decreases along the vertical dimension. In language we say things like, "She sped *up*," "She slowed *down*," "He drives at *high* speeds," and

FIGURE 11
4:00–5:00 STARTING POSITION



“He is going at a *low* speed.” When a dial starts at 12:00, the visual representation of speed moves in the opposite direction to the linguistic.

Another issue in speedometer design is the direction in which the needle should move to indicate higher speeds. The clockwise choice obviously came from the well-established pattern of clock movement. In the speedometer’s history, however, at least one design moved counter-clockwise. This was Smith’s reverse speedometer, installed in a 1965 Cobra (*figure 3e*). The Cobra had a British sports car body and an American hot rod engine, and was known as the first American muscle car (Campbell, 2005). Its unique concept appears to have inspired its unique dial.

Racing car speedometers provide an opportunity to look at the pragmatics of reference point placement. On the 1993 McLaren F1 Supercar (*figure 11*), the dial’s starting point was placed between 4:00–5:00, which was useful for racing. To provide an idea of speeds expected by such a car in a Formula 1 or Grand Prix race, in 1998 the average speed in the fastest Grand Prix was 237.591 km/h (147.633 mph), the highest speed along a straight line during a Grand Prix was 356.5 km/h (221.5 mph) and the highest practice speed was 244.413 km/h (151.971 mph) (Atlas F1 News Service, 2000). Therefore, this design aimed to place the most common racing speeds towards the top of the dial, in the area between 9:00 and 1:00.

Some modern speedometers have asymmetrical positioning of the starting and ending points. For example, the 2004–2006 Holden GTO (*figure 5*) starts at 9:00 and ends at 5:00 and the 2003 Toyota Matrix (*figure 5*) begins at 6:00 and ends at 9:00. Both designs allow the scale to fit around an information area, and both produce a unique look.

In summary, the most typical reference point arrangement on circular speedometers is a symmetrical design with a 7:00–9:00 starting position, the maximum motorway speed limit near 12:00 and a 3:00–5:00 maximum speed. Current asymmetrical arrangements are chosen so as to place the scale around dashboard information areas, provide a unique design or even associate a design with racing.

Scales

Speedometer scales vary in relation to their number and type. Many dials have dual scales, typically representing speeds in mph and km/h (*see figure 5*). At least one speedometer (the 1934 Midget PA in *figure 2h*) used dual scales for representing speeds available in different gears. In this case, one scale was for third and the other for top gear. Designers typically visually differentiate between dual scales

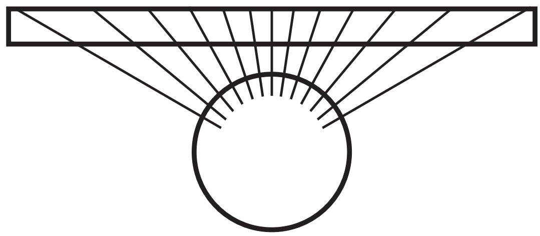


FIGURE 12
PROJECTION OF CIRCULAR SCALE ONTO A LINE

by coloring them differently, and use a smaller typeface and fewer scale marks on inner scales.

Woodson, Tillman and Tillman (1992) have recommended that dials use a single scale whenever possible because it reduces reading error. With LCD dials, dual scales for km/h and mph may no longer be needed since the technology can allow drivers to choose their preferred system. This solution was followed for the 2007 Chevrolet Monte Carlo speedometer (*figure 5f*).

The scales on most speedometers are what Stevens (1951) termed *ratio*, which is a scale that has a true zero point and organizes items from less to more by equal increments. While all car speeds *are measured* by equal increments, *visual representations* of increments may be unequal. For example, scale marks on the 1904 Cowey (*figure 7*) were unequally placed because the pointer did not move at a constant rate with the speed. As other examples, the scales on the 1959 Ford Galaxie Fairlane 500 and the 1974 Dodge Monaco (*figure 4*) have scales that project a semi-circular scale onto a horizontal line, which represents equal units of speed with unequal spacings (*figure 12*).

As on the 2004 Audi S4 design (*figure 13*), some speedometers have two different ratio scales so as to keep the most often used speeds on the left of the dial while saving space for presenting higher, less-used motorway speeds on the right and maintaining a symmetrical design.

One Hyundai speedometer (*figure 5g*) used the unique combination of three different ratio scales, two of which were placed at the end of the scale to fit in the little-used ranges of 120–140 and 140–150 mph.

Numerical increments on speedometer scales vary mostly according to when the speedometer was designed. Through the 1930's, increments of 5 or 10 were more

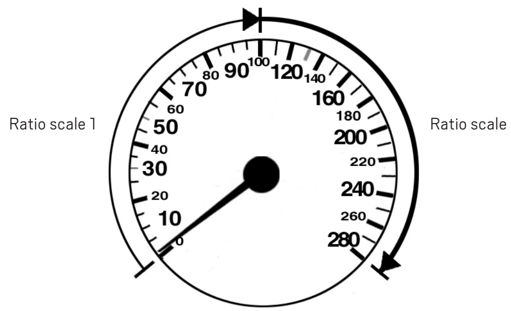


FIGURE 13
SPEEDOMETER WITH TWO RATIO SCALES
(2004 AUDI S4)

typical, although the 1924/30 Bentley Special (*figure 2e*) had increments of 30mph. Starting in the 1930s, increments of 20 became more common. To save space on the dial, the speedometer on the 2006 BMW (*figure 5e*) used increments of 30 in its km/h scale for the speeds of 150 and over. The retrospective design of the 2005 Mini Cooper (*figure 5d*) has an unusual selection of numbers on its mph scale since it begins with 10mph and then proceeds in increments of 20mph, so the numbers on the dial are 10, 30, 50, etc.

Oborne's (1995) review on the ergonomics of numerical increments said that "a system that progresses in 1s or 10s is the easiest to use" (143) simply because people are used to counting this way. Woodson et al. (1992) have said the fewest errors are made with intervals of 1 through 10 with the next best being 2, 4, 6, 8 and 10, and that intervals of 3, 6 and 9 or 4, 8 and 12 can be confusing. Therefore, speedometer dials with increments of 10 or 20 are likely to be the easiest to read.

While recent dial designs have fewer and simpler scale marks, earlier dials tended to have one mark for each mph and more decorative marks resembling those on some clocks such as track lines and combinations of lines, dots, triangles and diamonds. For functional dials, Woodson et al. (1992) recommended using simple marks and avoiding "dots…, thick marks, marks joined by a heavy base line, [and] long marks spaced closely together…" (392). According to Oborne (1995), "the major scale marks…should be emphasized, and the British Standards Institute (1964) suggests that each major marker should be two times the length of the minor marker" (143).

Typefaces and placements of numbers

While some early speedometers used serif typefaces, sans-serif faces are more common on all designs. The typeface may be regular, bold or italic. For instruments, simple typography is recommended (Woodson et al., 1992).

On most modern speedometers, numbers are placed straight up, which is another ergonomic guideline for stationary scales (Woodson et al, 1992). On earlier designs, numbers were sometimes straight up, angled (e.g., Chevrolet Corvette, *figure 3b*), or angled and turned (e.g., 1952 Ferrari 212 Inter, *figure 3a*).

Although numbers may appear on the inside or outside of a speedometer scale, Woodson et al. (1992) recommended that they appear on the outside so that the pointer does not cover them. This choice was made on the ergonomically-designed Toyota Raum (*figure 5b*).

Speedometer needles

Some early speedometers had decorative needles, but others were more streamlined and similar to those on current speedometers. As previously discussed, on some designs a band of color served as the needle (e.g., 1961 Holden, *figure 3d*). Early designs with decorative needles followed clock designs. Woodson et al. (1992) have recommended that designers avoid "artistic" designs for ease of reading, and that for applications in which users make "quick scanning look[s]," such as in driving, the pointer needs to be wider. In such designs, the pointer's tip should be tapered so that it is the same width as a scale mark and should fall just below the scale mark.

Color

Obviously, strong color contrast is required between the background and graphical elements on speedometer dials. Designers often use a third color, typically red or orange for the needle. According to Woodson et al. (1992), dials for daytime use are best seen if markings are placed on a light background. However, one way to create distinctive designs is through color, so some dials have for example blue, green, red or orange marks against dark backgrounds.

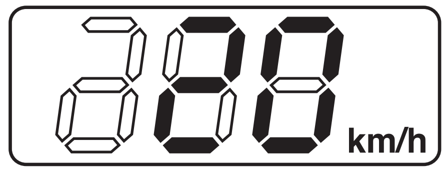


FIGURE 14
DIGITAL SPEEDOMETER
(1988 MITSUBISHI MAGNA)

Digital read-outs

In 1986, the first fully digital information system was installed in a Volkswagen (Siemens VDO, ca 2003). In modern digital speedometers, a magnetic sensor is positioned on the final output shaft of the gearbox. An electronic sensor then records every revolution of the magnet. Next, a semiconductor Eprom chip converts the sensor information to a final speed, which then appears as numbers on a backlit LCD display. When more current cars have a digital speedometer, it usually appears in a head-up display (HUD), which is a transparent display of data through a driver's windscreen.

Figure 14 presents an early digital design from a 1988 Mitsubishi Magna in which characters are formed by highlighting parts within a 7-segment framework. These designs are easier to read in sunlight and need a light source to be read in the dark.

According to Oborne (1995), 7-segment characters received criticism because they don't look like drawn numbers and the spacing between numbers can vary (in particular, the number 1 creates a wide gap). People therefore read these characters more slowly and make more errors than with printed and dot-matrix characters. More recent digital displays have acceptable character design owing to higher resolution technology.

A digital speedometer's strengths are that it provides precise reading at any instant (although this is not usually important while driving), uses less dashboard space and can have large numbers for easy viewing. In a 1980 study of speedometer formats conducted with 400 drivers (Simmonds, 1983), drivers provided the most accurate readings when using digital speedometers. According to this study, a "substantial majority preferred...the digital speedometer," but thought curved designs were more attractive. There was also a "significant minority who did not

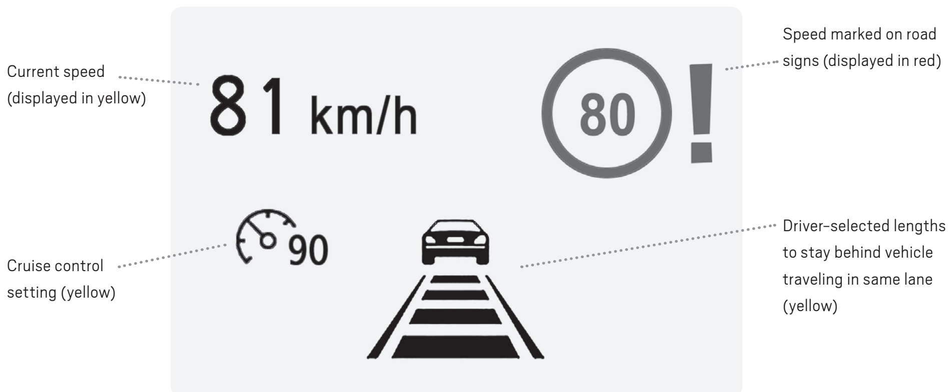


FIGURE 15
HUD FOR SIEMENS VDO ADAPTIVE CRUISE CONTROL AND TRAFFIC RECOGNITION SYSTEM

FIGURE 16
DESIGN THAT PROVIDES A CONSTANT READOUT OF THE SPEED LIMIT (KUMAR & KIM, 2005, 2)

like digital instruments” (100). Among the study group, those most preferring digital read-outs were aged over fifty. Some of this group said “that they had been able to read the speedometer clearly for the first time in years” (100).

On the other hand, analogue dials have strengths that for many outweigh those of digital dials. Woodson et al. (1992) noted that analogue dials are often preferable because “the dial…provides…additional information in the form of advance warning, rate of change and/or opportunity to make ‘cross-dial’ extrapolation [which is because] the pointer position and motion act as…additional qualitative cue[s]…to what is happening” (390). Analogue dials are also a better choice for reading fast changes (Oborne, 1995). Since the majority of cars have analogue speedometers, there is obviously a driver preference for them.

Designs that provide additional assistance in controlling speed

As previously noted, speedometers alone do not control speed. Currently, drivers themselves under the influence of government punishments are responsible for maintaining speeds within limits. While cruise control offers one solution to motorway speeding due to inattention, there are now more sophisticated technologies available. For example, Siemens VDO has developed adaptive cruise control (ACC) and traffic sign recognition (TSR) systems that monitor roads using a global positioning system (GPS), computer technology and camera. These systems will automatically reduce a car’s speed under three conditions, which are if they detect a slower-traveling vehicle in the same lane, if the TSR detects a speed limit sign that shows less than the car’s current speed, or if the GPS detects that the car has entered an area with a lower speed limit. The systems allow drivers to specify how closely they would like to travel behind any in-lane vehicles. The user display for these systems appears on a dashboard LCD but can also appear as an HUD (*figure 15*).

Kumar and Kim (2005) have designed a speedometer that displays both a car’s current speed and the road’s speed limit as determined by GPS, or for temporarily hazardous areas such as construction zones, a beaconing system. In this design, speeds above the limit are marked with a band of color (*see figure 16*). When cars exceed the limit, the speedometer either sends an audible warning (e.g., beeps) or presents visual cues (e.g., a flashing needle).

The safest design

So what design works best from a safety perspective? Research in this paper suggests that most drivers prefer an analogue dial, that the design of the 2003 Toyota Raum speedometer most closely follows the principles of ergonomic design, that drivers who speed due to unawareness need a speedometer that provides a constant readout of the current speed limit, and that drivers need either a speedometer that remains in their view at all times (e.g., an HUD speedometer) or one that provides speeding alerts. Such a design could also offer the option of advanced GPS-based cruise control such as Siemens' design. In the future, it is possible that governments may combine GPS with car technology to physically restrict speeds.

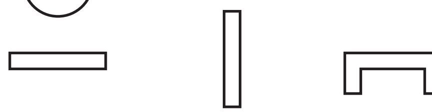
Conclusion

Automobile speedometers appeared at the turn of the century and although many were at first similar in design to clocks, they soon developed their own pattern as a result of greater understanding of drivers' needs, speed limits, the practicalities of fitting the dial onto the dashboard, style preferences and changes in technology. In developing dials, designers have experimented with different positions of reference points; dial shapes; analogue and digital read-outs; the number and shapes of scale marks; multiple and reconfigurable scales; increments, style and placement of numbers; needle designs; moving versus stationary scales; and colors. Figure 22 presents a taxonomy of dial features.

Speedometer designs continue to evolve with inventions such as GPS and head-up displays. Further, just as clocks influenced speedometer designs, speedometer designs are now influencing software applications such as graphical representations of business performance indicators.

DIAL SHAPE

Circular or semi-circular 

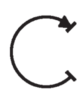
Vertical or horizontal, linear  *Unique*

REFERENCE POINTS AND DIRECTIONS ON CIRCULAR OR SEMI-CIRCULAR DISPLAYS

Start 7:00–9:00, end 3:00–5:00,
motorway limit near 12:00 

Start and end at or near 12:00,
motorway limit near 6:00  *Some early designs,
based on clocks or timers*

Asymmetrical  *Fits around other information,
information, and maintains
visual ratio scale for high speeds*

Start near 5:00, end near 1:00  *Racing*

Start near 4:00, end near 8:00  *Eccentric*

Start and end near 6:00,
motorway limit near 12:00 

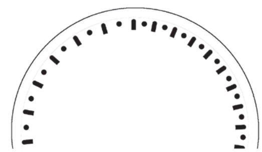
REFERENCE POINTS AND DIRECTIONS ON LINEAR DISPLAYS

Reading order  Moves upward 

TYPES OF SCALES

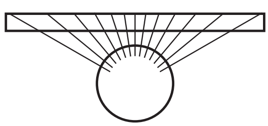
Ratio

Two or three connected
ratio scales



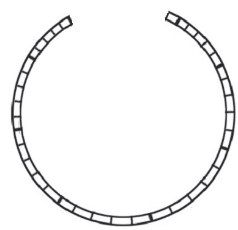
Conserves space, retains symmetry on dials that have high top speeds

Semi-circular ratio scale
mapped onto horizontal line



Unique

Uneven



Early design based on early technology

NUMBER OF SCALES

1 (mph or km/h)

2 concentric (one for mph and one for km/h)

2 concentric (each for a different gear)

NUMBER OF SCALES MARKS

1 mark = 1 mph, major mark every 5 mph	*Early design*
1 mark = 2 mph, major mark every 10 mph	
1 mark = 5 mph, major mark every 10 mph	
1 mark = 1 km/h, major mark every 5 km/h	*Early design*
1 mark = 2 km/h, major mark every 10 and 20 km/h	
1 mark = 5 km/h, major mark every 20 km/h	
1 mark = 10 km/h, major mark every 20 km/h	*Racing*
1 mark = 20 km/h	*2nd, minor scale*

SCALE MARK SHAPES

Major scale marks

Line | Circle | Double lines | Diamond | Triangle

Some earlier designs

Minor scale marks

Line | Circle

Marks may be joined by single or double track lines
Identically shaped minor marks may be smaller

NUMBERS PRESENTED ON THE DIAL

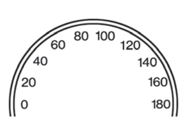
(0), 10, 20, 30, 40… mph	
(0), 20, 40, 60, 80 … mph	
30, 60, 90, 120… mph	*unique*
10, 30, 50, 70…mph	*unique*
(0), 10, 20, 30, 40… km/h	
(0), 20, 40, 60, 80… km/h	

FONT

Serif	*Early design*
Sans-serif	*Follows ergonomic design recommendations*

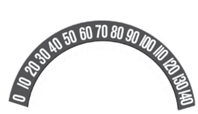
PLACEMENT OF NUMBERS

Straight up

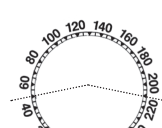


Follows ergonomic design recommendations

Angled



Angled and turned



Early design

POINTER

Decorative		*Early design*
Simple		*Follow ergonomic design recommendations*
Band of color		*Unique*

MOVING SCALE VERSUS MOVING POINTER

Moving scale	*Early design, Unique*
Moving pointer	*Follows ergonomic design recommendations*

COLOR

Light background, contrasting graphics and pointer

Dark background, contrasting graphics and pointer

Key reference point may have unique color

References

Atlas F1 News Service. 2000. The FIA's 66 answers to 66 questions. http://atlasf1.com/news/1999fiafaq.htm#q28 (Accessed June 8, 2010).

Autobahn. (2007, August 13). Wikipedia. http://en.wikipedia.org/wiki/Autobahn (Accessed August 13, 2007).

British Standards Institute. 1964. Recommendations for the design of scales and indexes. Part I Instruments of bold presentation and for rapid reading BS 3693. London: BSI.

BMW Heaven—The BMW knowledge base. 2007. http://www.bmwheaven.com/6-series/126-222?start=13 (Accessed June 8, 2010).

Campbell, E. 2005. American muscle car—Legendary inspiration. http://www.65cobra.com (Accessed January 27, 2007).

Car specifications directory. 2007. http://www.carspecsdirectory.com (Accessed June 8, 2010).

Chapman, G. 2007. History of British road safety. http://www.chapmancentral.co.uk/wiki/History_of_British_road_safety (Accessed January 17, 2007).

Citroen 2007, Sept 2. Citroen C-Cactus. A new ecological and attractive take on the essential car. http://www.citroenet.org.uk/prototypes/c-cactus/c-cactus.html (Accessed June 9, 2010).

Clark, H. H. 1996. *Using language.* Cambridge: Cambridge University Press.

Denton, G. G. 1969. The use made of the speedometer as an aid to driving. *Ergonomics*, 12.3, 447–454.

From speedometer to modern instrument clusters (2005, January). *AEI*, p.89. https://shop.sae.org/automag/features/futurelook/02-2005/1-113-2-89.pdf (Accessed June 8, 2010).

Gabany, S. G., P. Plummer and P. Grigg. 1997. Why drivers speed. The speeding perception inventory. *Journal of Safety Research*, 28.1, 29–35.

Garfield, E. 1977. The computer: Practical tool, ultimate toy. *Current Comments*, 3.52, 364–366. http://wiredforbooks.org/garfield/computer.htm (Accessed June 8, 2010).

GM Media Online. 2006, Feb 27. World premier at Geneva auto show. Aero X Concept showcases future Saab directions. http://archives.media.gm.com/archive/documents/domain_503/docId_23484_pr.html (Accessed June 8, 2010).

Green, P. 1983. What do drivers say they use speedometers and tachometers for? [Report No. UMTRI-83-49]. Ann Arbor, MI: University of Michigan Transportation Institute.

Harley, T. 2001. *The psychology of language: From data to theory.* East Sussex, UK: Psychology Press.

Hartley, T. 2002, November 15. Speedometer passes the 100 mark. *Business First of Buffalo.* http://buffalo.bizjournals.com/buffalo/stories/2002/11/18/story5.html (Accessed June 8, 2010).

Holland, D. 1999. *Dashboards.* New York, NY: Phaidon Press.

Jalopnik. 2007. Citroen C-Cactus Concept Car. http://jalopnik.com/photogallery/citroenccactus/2488070 (Accessed June 8, 2010).

Kumar, M. and T. Kim. 2005. Dynamic speedometer: Dashboard redesign to discourage drivers from speeding. Paper presented at CHI 2005, April 2–7, Portland. http://hci.stanford.edu/research/speedometer/LBR-197-kumar.pdf (Accessed June 8, 2010).

Mercedes Benz Australia. 2007a. Technical data for the A-Class http://www2.mercedes-benz.com.au/content/australia/mpc/mpc_australia__website /en/home_mpc/passenger_cars/home/products/new_cars/a_class_5door/technical_data/petrol_models.html (Accessed January 17, 2007).

Mercedes Benz Australia. 2007b. Technical data for the SLK-Class. http://www2.mercedes-benz.com.au/content/australia/mpc/mpc_australia__website /en/home_mpc/passenger_cars/home/products/new_cars/slk_class_roadster_facelift/technical_data.html (Accessed January 17, 2007).

Misugi, K., H. Kanamori, H. and B. Atsumi. 2004, December 7–12. Toyota's program for universal design in vehicle development—Universal design for the Toyota "Raum". Paper presented at Designing for the 21st Century. An International Conference on Universal Design. http://www.designfor21st.org/proceedings/proceedings/plenary_iaud_toyota.html (Accessed February 3, 2007).

Mitchell, M. 2008. Conducting ethnographic research on language-like visual communication. Refereed paper presented at the *Australian and New Zealand Communication Association 2008 Conference*, Wellington, N.Z., 9–11 July. http://anzca08.massey.ac.nz/massey/depart/cob/conferences/anzca-2008/anzca08-refereed-proceedings.cfm (Accessed June 8, 2010).

Mroz, A. 1998, November 30. Speeding through time. TTNews.com by Transport Topics Online. http://www.ttnews.com/articles/printnews.aspx?storyid=395 (Accessed June 8, 2010).

Oborne, D. J. 1995. *Ergonomics at work. Human factors in design and development.* West Sussex, UK: John Wiley & Sons Ltd.

Siemens VDO Automotive AG. 2002, November 7. 100 years of speedometers: The history of driver information. http://www.siemensvdo.com/press/releases /interior/2002/SV_200211_001_e.htm (Accessed November 1, 2007).

Siemens VDO. 2007. Pro.pilot road. http://www.siemensvdo.com/products_solutions/cars/driver-assistance/road/index.htm (Accessed October 24, 2007).

Simmonds, G.R.W. 1983. Ergonomics standards and research for cars. *Applied Ergonomcs*, 14.2, 97–101.

Speed limit. 2007, August 19. Wikipedia. http://en.wikipedia.org/wiki/Speed_limit (Accessed August 19, 2007).

State of Connecticut. 2007. Chapter 2 DOT History. Connecticut Department of Transportation. http://www.ct.gov/dot/cwp/view.asp?A=1380&Q=259694 (Accessed June 8, 2010).

Stephens, S.S. 1951. *Handbook of experimental psychology.* New York, NY: John Wiley & Sons.

Van Eijck, M. 1999. Safety. http://www.heckflosse.nl/safety4.htm (Accessed June 8, 2010).

Volvo Car Corporation. 1998–2006. Volvo V50. Model year 2007. All technical data. http://www.volvocars.com.au/models/v50/techSpec.htm (Accessed February 12, 2007).

Woodson, W.E., B. Tillman and P. Tillman. 1992. *Human factors design handbook.* New York, NY: McGraw-Hill.

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HELVETICA, THE FILM AND THE FACE IN CONTEXT

Dietmar R. Winkler

Middleborough, Masschusetts
Winkler, 367–378
Visible Language 44.3

Abstract

Little historic context is generally provided regarding design phenomena; ideas, names, events and relationships are disregarded in design's typical superficial coverage; it is as though design exists in a vacuum. This paper seeks to put Helvetica, the face, the font and the movie into context by exploring its relationship to Swiss Design philosophically and practically. The infiltration of Helvetica, the font, into American design practices is also explored, along with some variation on typographic education from both a formal and informal perspective.

The King has been dismissed.

Long live the Commoner or
long live the next king
(and the next prevalent fad).

Most likely, anything useful about “Helvetica,” the film, has been said already. The individual designers who were interviewed during the documentary process framed some of the reasons for its success, as they perceived it. I personally had hoped for a very lively insightful debate on Helvetica’s aesthetics, but was left without hearing a philosophical defense or reasons why Helvetica is considered a “better” typeface than Brush, Hobo or Cooper Black or as a matter of fact, Univers. If anything, the film declared Helvetica a very safe social convention, with its pros and cons recognized by a variety of practitioners, very much like Kleenex—everybody uses it, but usually outside of awareness of social and cultural consequences. That should set the public at ease, because among reader-tests of a fairly large sample of CEOs and decision-makers, most were unaware of font differences and could not distinguish between serif and san-serif types. It is also interesting that the film deals mostly with environmental graphics—posters, super-graphics, signage, short verbal statements and directives. Maybe one of the major reasons is that in this documentary style, it is easier to stay with Helvetica in display sizes to avoid having to camera-zoom in and out of the much smaller page environments—not at all like E. F. Schumacher, who thought that “small makes beautiful economics, especially when people matter—and not just the ego, élan and showmanship of designers. Big seems still more beautiful, even though the monumental *Bauhaus* book, a 1969 MIT Press door-stop, cannot be read in leisure or with reading pleasure, even though it is composed in Helvetica. What the film did not do, especially for younger generations of designers, is set the complex stage that made the typeface successful. The film reminds us of the many design history accounts that present the subject in heroic terms, tiptoeing through a vast political minefield, leaving the reality of the competing contexts unexplored.

The film is also not very insightful in that it does not recognize the long history of Swiss cultural aesthetics; Swiss Design did not as easily walk off an assembly line as its not culture-referenced interpretation did in the US. It was diligently grounded in Swiss cultural traditions, and, even more importantly, in the indigenous visual language of drawing, printmaking and painting. Unlike American designers, the Swiss gladly acknowledged their roots in the arts, celebrated them and never attempted to forget them or get away from them. Also, Swiss Design was not just about systemic and modular typography but much more about sophisticated aesthetic form in the development of letters, graphics and photographics. Ingenious form was the hallmark of Swiss design. This was practiced by few in the US then, and exists no longer.

Let’s face it, when Walter Herdeg introduced the new generation of Swiss designers in *Graphis* magazine during the fifties, it stood on a solid and culturally supported platform. The list of competent predecessors is extremely long. It includes the early group of Otto

Baumberger, Augustino Giacometti or Burkhard Mangold, which begets Fritz Bühler, Donald Brun, Hans Erni, Hans Falk, Herbert Leupin, Niklaus Stoeklin, from which emerge those designers that create the Swiss Design phenomenon, and among many others such as Max Bill, Karl Gerstner, Hans Hartmann, Armin Hofmann, Gottfried Honegger and Warja Honegger-Lavater, Richard Paul Lohse, Thérèse Moll, Ruth Näpflin, Hans Neuburg, Siegfried Odermatt, Emil Ruder, Nelly Rudin, Max Schmid, Anton Stankowski, Peter van Arx, Carlo Vivarelli, and Kurt Wirth.

The European design community became instantaneously aware of the enormous shift in conceptual design attitudes toward a more responsible, precise and nearly scientifically correct "New Objectivity" (*Neue Sachlichkeit*), which never had come to fruition before 1945, interrupted by the deceptive and loud propaganda of war. For this particular generation, design was a philosophy of positivism, a commitment to a specific modern form interest, not modish or faddish, but encapsulating a constructive worldview (*Weltanschauung*) leading into a future of direct response to the phenomena provided by contents and contexts. It was about extending the arts into new areas of minimalism, abstract-objective and nonobjective concrete art (*Kalte Kunst* or *cold/cool art*), kinetics and metamorphosis. The movement included artists, colorists, illustrators, designers and typographers as equals, based on concepts of integrity, clarity, precision, accuracy, thoroughness and refinement, backed by the knowledge accrued by the intellectually active printing guild and a deep professional reverence for skill and craft and investment in controlled experimentation for the sake of better understanding. At that time in Switzerland, most studios were small, and those who worked there, were truly committed, highly skilled practitioners. Looking at their repertoires, they were able to perform eloquently in a variety of quality visual languages, from objective super-realism to abstract expressionism and concrete Suprematism.

Another fact eludes the film, namely the long timeframe it took during that period to assemble pertinent design examples of the new language for publication and dissemination within Switzerland as well as from the outside world. The design audience was rather small and the publication venues were very few. The journal *Neue Grafik/New Graphic Design/Graphisme actuel*, edited by Richard Paul Lohse, Josef Müller-Brockmann, Hans Neuburg and Carlo Vivarelli, presented subjects on design theory and practice. Books like *Publicity and Graphic Design in the Chemical Industry* by Hans Neuburg and by Josef Müller-Brockmann, Karl Gerstner, Emil Ruder and Armin Hofmann, showed professional and student work, completed decades earlier. Nothing happened over night. However, these texts became the bibles for the American interpretation of "Swiss Design."

Also, one cannot forget the unique and successful corporate image of J. R. Geigy Ltd, the leading chemical and pharmaceutical company. Working at that time at Chemie Grünenthal in Germany, an emerging German competitor, one became aware of the distinct and striking visual presentation differences between Geigy and Eli Lilly, American Cyanamid or Lederle in America or BASF Baden Aniline and Soda Factory, Hoechst or Beyer in Germany. Without overstating, Max Schmid shaped one of the first commercially successful and totally integrated corporate identities, both in text and image, at Geigy, which became the model for other international corporations, copied even by Unimark. Interestingly, the Swiss designers of that time, did not use Helvetica, but were totally vested in Haas Akzidenz Grotesk. By the time Helvetica was accepted world-wide, the minimalist design phase in Switzerland was over, succeeded by Weingart's more self-expressive work, which again was copied by American designers; it greatly influenced Carson's work.

Also, until the seventies, there doesn't exist deep design curricula in the US. The curricular thinness is exposed by the very limiting thirty-two credit MFA requirements at most schools. At Basel, Armin Hofmann and Emil Ruder developed the Advanced Class for Graphic Design, meant to deepen the design studio experience especially for designers who had completed their education at US design programs. It began to shape the next generation of design educators at nearly all US schools through curricular contributions by Basel alumni moving or returning to the US to work and teach, among them Dan Friedman, April Greiman and Ken Hiebert. They joined Inge Druckrey, Steff Geissbuhler and Willi Kunz, who had received official Swiss federal diplomas in design and were practicing design in the US.

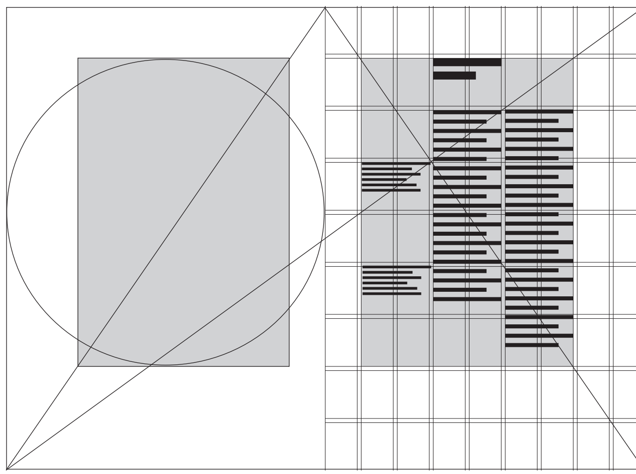
In the US, Swiss Design was nothing more than a style, a quick opportunity for direct plagiarism by the not so well skill-trained typographers and designers. It was new to most citizens and its aesthetics had to be learned before they became elitist conventions and later were considered a common language. US designers were short-changed by education in printmaking and painting, lacking typography, letterform and concentrations on form development. Their urge was to escape the stigma attached to the label of applied arts and to move up a parallel ladder to the corporate and institutional administrative structure, from commoner (commercial artist) to the interface with middle management. This allowed them to sever ties with the traditional commercial hierarchy in which advertising agencies controlled most of the communication territories, while concentrating on lucrative contracts of space-advertising and production of TV-commercials and at the same time outsourcing other assignments, like information graphics, corporate and institutional publications and corporate identities to freelance graphic designers.

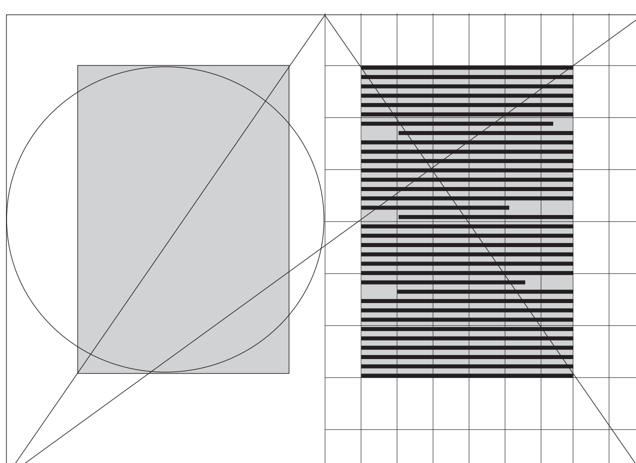
Copying the work of Swiss designers, made it possible for new studio specializations to evolve, like design for corporate identities and branding, focusing on exhibition and package design and then later, energized early by Peter van Arx at Basel, design for moving graphics and animated type. Until the dawning of the Internet, New York designers relied heavily on income from studio specializations in design for corporate identities and annual reports. This set the stage for unsavory present-day attitudes; the unfortunate disdain by most designers toward art, illustration, marketing and advertising, and the skills necessary to succeed in these areas. The digital design world further emphasized typography to the point that there are many more typographers than designers that are able to competently shape graphic images. Unlike in Switzerland where designers held themselves to the standards and conduct of the age-old guilds, in the US the designers developed a sense of entitlement and self-importance. The field now has an abundance of design talkers, who posture about the importance of design, but in truth don't have the variety of skills held by the Swiss. In American design education many more teachers never practice in the field, or have the skill and knowledge to visually craft eloquent images.

Two major theses accompanied the introduction of Swiss typography. One was Karl Gerstner's *Designing Programmes*, while Josef Müller-Brockmann's *Grid Systems in Graphic Design* followed a few years later. It is interesting to recognize how more quickly Josef Müller-Brockmann's book, a very deterministic text on dividing two-dimensional planes into typographic and proportional grids was adopted in the US. It is totally a logical, mathematical process. His text dispels any contextual concerns and eliminates any randomness. Müller-Brockmann's approach is very passive and seems to resemble the boilerplate arrangements of present-day design application programs in the parameter instructions and requests for page size, margins, gutters, columns and uniform subdivisions. It unfortunately recommends that the practitioner respond very passively to the contents or the context as well as technical conditions. Pages break down in relationship to frozen formulas, even if they can be based on specific proportional ratios.

Corporations, institutions and governmental agencies easily adopted Brockmann's pigeonhole-approach. It was perfect for single page items and boilerplate formats for a series of publications, predetermined long before contexts and contents were revealed. Boilerplate formats rarely deal with physical, emotional or ergonomic conditions—where and when the thumb or fingers interfere with reading or obliterate the view of the page. They also are usually unaware of formal etiquettes of introducing readers to the document environment, helping them to leave the noise of the outside world behind. On this level, even in Brockmann inspired modernist books, one falls directly into the intellectual fracas. There is no time to take off one's coat at the door and adjust. There are none of the transitional concerns that courts of law, churches, temples and the theater observe. In the boilerplate theater the curtain is always up.

ARIAL





Not so with Gerstner's *Designing Programmes*, which makes clear that the underlying system is not just a mathematical or proportional exercise, but is geared to reflect the quality and construction of the context in relationship to the subject. In Gerstner's design, the content provides the form and rhythm for the simple, complex or progressive proportional system of typographical structures; for him the document is an environmental space to be traversed. This fact has eluded most designers, including those who are now praised as high priests and interpreters of Swiss Design. Inventing an individual and appropriate structure is very time-consuming and that stands against New York élan. It either depends on forcing the contents and subjecting it to an enslaving structure imposed by the designer, or responding to the signals revealed by the quality and hidden structures of the contents. Gerstner requires intelligence and progressive logic, not just geometric skills.

On the other hand, what escapes most critical purist typophiles, for whom Jan Tschichold is the intuitive anti-system hero, is that they don't understand that Tschichold's "Divine Typographical Proportions" coincide and support both Karl Gerstner's *Designing Programmes* and Müller-Brockmann's *Grid Systems*. Jan Tschichold prepared his in the architectural tradition, while Gerstner and Müller-Brockmann make use of proportional gutter spaces between text-carrying spatial units. Tschichold's renaissance system would function and very much resemble the grid, because it is also void of context and content relationships. His, as interesting as it is, is still one system that fits all contents, very much like Müller-Brockmann's.

In the final analysis, the film is a grave marker for a bygone American design epoch, because Swiss Design had come to closure already at the dawning of the early nineteen-sixties, even if American professional nostalgia buffs don't want it to ebb that early. In Switzerland, the major minimalist work was done at that point. In the US the Swiss "*Neue Sachlichkeit*" or "new objectivity," found a home in the corporate sector and at intelligence-starved art schools, helping them to change the nomenclature from common "commercial art" to special "graphic design". The public stayed unaware, even if designers felt that Helvetica took on different communication qualities. After asking neighbors about Helvetica, and after lots of trials to involve them in complex analyses, they claimed they were not able to distinguish it from other typefaces, serif or san serif, but they were able to read it.

In truth, for the American public-relations conscious market, the nineteenth century version of Helvetica, Akzidenz Grotesk, was improperly named. Who in the US would dare to convince a client to use a typeface with a name laden with foreboding, superstition and calamity and with misshapen and disturbing qualities? The faulty translation of terms from German into English engendered very negative coronations. In German, "*akzidenz*" means simply the concept of where the sun is setting (occident, the western hemisphere in contrast to orient, the countries of eastern Asia), and "*grotesk*" means that the typeface is gothic, a square-cut typeface without serifs or hairlines. Still, who would hop on an airline with an identity shaped by a grotesque typeface, which evokes visions of accidents and calamities? The name metamorphosis from Haas Akzidenz Grotesk to Haas Neue Grotesk to Helvetica changed that. But it did not change the attitudes of American designers, who with very few exceptions, did not see Swiss Design as a philosophical analysis, experimentation with logic, Spartan or Calvinist philosophies, or even as a social approach for equalizing visual communication between diverse groups of citizens.

Even in the early seventies, excellently trained and disciplined Basel graduates, returning to the US to be integrated into design practice were unable to find positions, because their Basel certificate was not yet considered equal to an US MFA or BFA in Design. This was reversed a lot later, when Paul Rand and Armin Hofmann fostered tighter relationships between Yale and Basel. In cities like Boston, the concept of ideal and highly focused simplicity, reducing complexity without losing or distorting contents and context, was quickly overlooked by the imposition of Yankee expediency, allotting little time for figuring out what the ideal line length or configuration for a certain type size or line spacing should be. After all, it was assumed that everybody could learn the Basel system quickly by just buying the books. The thorough process and self-discipline was not understood. It was considered dilettantish, too self-absorbing and not time efficient.

The major problem lay in the extraordinary cost of anything to do with handset or machine-set typography. Typography budgets for the design practitioner were always lean. If mistakes happened and changes were made, type for a poster or book jacket could bankrupt the budget. The true quality of the process lay in the hands of highly qualified, skilled and literate type-composers. Graphic designers or art directors only marginally controlled quality. Usually, it was declared by the limits of the budget and lack of type experience.

In design education, the operation and maintenance of an art/design school typeshop, fully simulating a professional typesetting experience, was so outrageously expensive that only schools like Rochester Institute of Technology or Yale University, the latter on a much more abbreviated scale, could provide. All others had very rudimentary equipment, facilities and type assortments, unlike European schools in which composers for type houses were trained together with graphic designers. Also, all the way into the sixties, European designers had to apprentice in professional printing and typesetting plants before certification. There may have been some schools in New York or Chicago that had state of the art typography facilities, but most type-shops were undernourished.

Even the technical teaching literature was very sparse. In contrast, in Switzerland, continuously since 1933, *Typographic Monatsblätter*, a journal of typography, writing and visual communication, instructed professional designers. In Germany, *Der Druckspiegel* and its archive of many years, referenced the work of prominent European designers before some of the professional design journals did. Both journals were available to students. The fact is, that until the introduction of photo and digital typesetting, there were no earth-shaking typography-instructions delivered at US art/design schools. The programs dealing with letterform used standard texts from the holdings of bibliophiles or of disciplines like calligraphy, lettering and type rendering. Editor and historian Max Hall writes in *Harvard University Press: A History* of three courses in printing and publishing, given by the Harvard Business School intermittently from 1910 to 1920, organized with the help of The Society of Printers, depending on distinguished lecturers like D.B. Updike, Bruce Rogers and William A. Dwiggins. There was nothing equivalent at art/design schools. US designers of that period learned the use of type on the job in agencies and studios. Dwiggins died in 1956. In 1960, Harvard was still considered a center for typography, not so much for practice, but for the extensive library holding of documents of typographical history; likewise, the Anne Mary Brown Memorial Library at Brown University with an extensive collection of the Incunabula.

It is odd to think that the credit for Swiss Design or Helvetica should go to Americans or anybody of another nationality. The true contribution to the field cannot lie in active plagiarizing or copying the inventive work of Swiss designers. Even though Unimark and Container Corporation of America should be credited with popularizing Helvetica, most American designers of that time had little notion of the arduous discipline of modular typography. Swiss designers did not see the process as completed. There was always the need to push investigations further. For example, Thérèse Moll brought the new disciplined design methods to MIT in 1958, invited by John Mattill, then director of the Office of Publication, to instruct his untrained design staff by direct example. Ms. Moll designed a series of recruitment folders for MIT‘s budding Summer Session Program, which was distinctly recognizable because of its highly integrated design quality. However, she had to substitute another gothic typeface for Akzidenz Grotesk, because none of the type houses in Boston carried it, and New York houses dealing mostly with advertising agencies were too expensive and the mail-process too slow.

Even then, it took a long time for systemic typography to find sure footing. Muriel Cooper, an art education major, and Jacqueline Casey, graduating with a fashion design/illustration degree, were not even trained in any traditional design techniques. Their typographic knowledge was very sparse. Both would travel to the Mead Library of Ideas in New York to procure quality design examples. They then would take tear sheets of typographical arrangements they liked and attach them to manuscripts as style guides for typesetters to follow. Although untrained in design, they were quick understudies; both were enthusiastic design autodidacts, learning quickly from Thérèse Moll as well as Paul Talmann, a Swiss minimalist artist, and George Teltscher, a former student of the Bauhaus, who also were in the office.

The designer who was more instrumental in fostering minimalist typography and design was Ralph Coburn, very much overlooked by American professional design history. While enrolled at MIT in the School of Architecture, through his studies alone, he was introduced in depth to work by Mondrian and de Stijl, and exposed to work by Max Bill, Karl Gerstner, Josef Müller-Brockmann as well as Joseph Albers. He also worked in the MIT Office of Publications, first part-time then fulltime. Ralph Coburn insisted that the use of Helvetica should not be seen as a style fad. He backed up his arguments with his own visual work as a minimalist artist. Coburn began a lifelong friendship with Ellsworth Kelly, the minimalist painter, who had been a student at the Museum School in Boston. He and Kelly discussed, explored and collaborated on numerous concepts hoping to resolve them into a “concrete” language. Ralph Coburn did not just adopt Swiss Design. He explored and expanded it, melding what he had learned into a very personal approach. The many visits by Müller-Brockmann, Hofmann and Gerstner to the office, the MIT Press and later to the Media Lab, strengthened the understanding and commitment to structural graphic design. For several decades Helvetica became the identity of the university, because most other institutions mimicked the classical style of Harvard.

The world is always confusing for the uncommitted. For them design is not linked to any specific philosophy of life. It is much more like picking a winner—out of context. When the King gets demoted to Commoner, what happens to the camp followers?

References

Gerstner, Karl. 2007. *Designing Programmes.* Baden, CH: Lars Müller Publishers.

Hall, Max. 1986. *Harvard University Press: A History*. Cambridge, MA: Harvard University Press.

Hustwitt, Gary. 2007. *Helvetica.* London: Swiss Dots Ltd.

BENTON GOTHIC

Müller-Brockmann, Josef. 1996. *Grid Systems in Graphic Design*. Sulgen, CH: Verlag Niggli.

Neuberg, Hans. 1967. *Publicity and Graphic Design in the Chemical Industry*. Zurich, CH: Edition ABC Zurich.

Wingler, Hans M. 1969. *Bauhaus*. Cambridge, MA: MIT Press.

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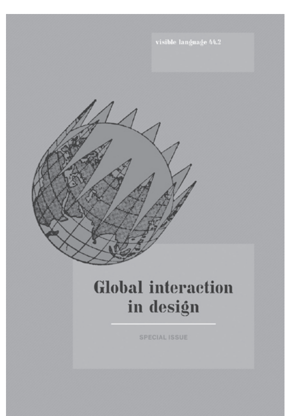

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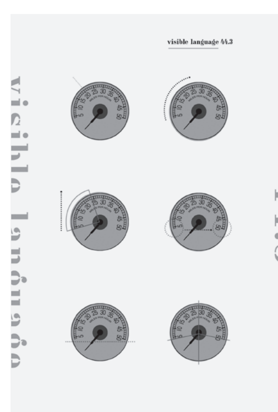

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