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Incorporating a Human-Computer Interaction Course into Software Development Curriculums

Thomas N. Janicki
janickit@uncw.edu

Jeffrey Cummings
cummings@uncw.edu

R. Joseph Healy
healyj@uncw.edu

Information Systems Operations Management Department
University of North Carolina Wilmington
Wilmington NC 28403

Abstract

Individuals have increasing options on retrieving information related to hardware and software. Specific hardware devices include desktops, tablets and smart devices. Also, the number of software applications has significantly increased the user's capability to access data. Software applications include the traditional web site, smart device applications and web pages that emulate apps on mobile devices. The importance of high user satisfaction is critical as users will switch quickly to other devices or sources for their information needs. To assist in developing high impact and positive user satisfaction are the theories from the field of study known as Human Computer Interaction (HCI). This research summarizes several of the key theories from HCI and recommends the placement of learning modules related to HCI in current software development courses as well as proposing an updated standalone HCI course into MIS and CIS curriculums.

Keywords: HCI (Human Computer Interaction), MIS Model Curriculum, IT Model Curriculum, Software Development

1. INTRODUCTION

The importance of sound design principles into software development courses has become more important with the expansion of development for multiple devices. Recent research reports smartphone and tablet ownership continues to grow with 58% of Americans owning a smartphone and 48% owning tablets (PewResearch, 2014). The increased use of mobile technologies has even caused a shift in device and Internet usage. In 2014, for the first time ever, mobile devices accounted for more Internet usage (at 55%) in the US compared to

PCs accessing the Internet at 45% (O'Toole, 2014). Given the small available 'real estate' of smart devices and tablets, HCI curriculum needs to be expanded to cover these devices especially with the increased pressures on designers and developers to build their output with a concern for user ease of use. Implementation of "Mobile first" development via tools such as Bootstrap has also increased the need for enhanced HCI concepts in software development curriculums.

The current 2010 IS Model Curriculum (Topi, et.al, 2010) has an elective in the curriculum related to HCI: "Introduction to Human-Computer Interaction (HCI)". The 2008 IT Model Curriculum (Lunt et. al, 2008) places more emphases on HCI principles and proposes up to six courses in an HCI track.

The goal of HCI is to make computers/software more usable and adaptive to user needs, ultimately developing interfaces that minimize the barrier between human mental models and the system/software's ability to accomplish the desired task (McCracken & Wolfe, 2004). Developers are taught how to code, but are lacking knowledge in what makes a user desire to use one program over another. By offering an introductory course in HCI, students can learn to think of designing software tools from a more user-centered viewpoint. This becomes critical as developers now have to deal with real-estate and increased emphasis on user experience.

This research has two goals. The first goal to provide examples of specific HCI concepts that may be incorporated into existing software development courses. The second goal of this research is to expand the recommended course syllabus for the model HCI course with increased topics and readings and design concepts with a mobile emphasis.

The outline of the paper will be a discussion of HCI principles, summarizing current best practices, an analysis of currently offered HCI courses and an expanded syllabus and reading list for a HCI course in a model MIS or CIS (Computer Information Systems) curriculum. It assumes the sponsoring school only has room for one HCI course in its elective list. If a host university does not have the capability for a full course offering, then modules from the expanded syllabus may be incorporated into current software development courses.

2. HCI PRINCIPLES

30 years ago the researchers in the HCI field were considered rebellious because they broke the disciplinary boundaries of computing at the time. The goal of these researchers was to present information in comprehensible formats by creating better menus, developing GUI's (graphical user interface) based on direct manipulation, improving input devices, and designing effective control panels (Schneiderman, 2012).

A major advance in HCI was the creation of the GUI in the 1980's. Following the GUI was the development of the desktop and desktop icons. The problem with desktop icons is that they can quickly become cluttered, making finding files and folders cumbersome, the opposite of the original purpose of icons. Next email created networks where people communicated through computers with other people. This was the beginning of social computing, which has evolved into today's tools such as instant messaging, wikis, and social networking (Carroll, 2013).

HCI is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them (ACM - SIGCHI). The goal of HCI is to improve the user's ability to complete a desired task by making the computer more usable and receptive to the user's needs (Jose et al., 2014). Users of advanced hardware machines are often disappointed by the cumbersome data entry procedures, obscure error messages, and intolerant error handling confusing sequences of cluttered screens have become the norm rather than the exceptions, as many researchers in the field have noticed. In particular, novice users feel frustrated, insecure, and even frightened when they have to deal with a system whose behavior is incomprehensible, mysterious, and intimidating (Bertino et. al, 2008). To understand what users are looking for, one must have a clear definition of usability which is: "the user can do what he or she wants to do the way he or she expects to be able to do it, without hindrance, hesitation, or questions" (Welsch, 2012).

The major contributors to the science of HCI include psychology, ergonomics and human factors and computer science as shown in Figure 1. An additional six areas also contribute to

effective HCI designs. These are also detailed in Figure 1.

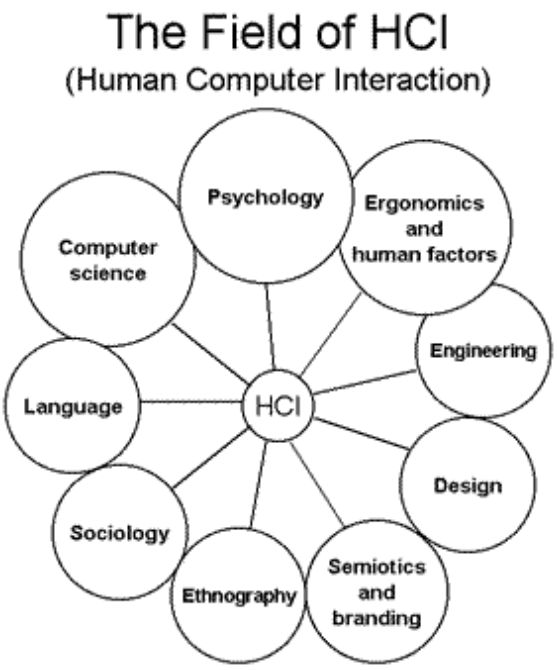

Figure 1 . Fields integrated in HCI (ACM SIGCHI).

As a result of technological advances in displays, sound, graphics, conceptual models and the physical design of input devices have contributed to improve the HCI experience. As the technological advances have increased the user experience, the application of psychological principles has become an area to include in course design as these principles are important to the design of software tools and web site interfaces, along with the effects of said principles on the implementation and usability of information systems.

Intersection of HCI and Psychology

The subject of human informational processing has provided a dominant theoretical framework for the consideration of human factors issues in HCI. Two of the key principles in the intersection between psychology and HCI is the consideration of cognitive science and perceptual-motor interaction (PMI) and performance. (Carroll, 1997)

Cognitive Science

Cognitive science is the scientific study of the mind and its processes, and is essential to understanding how users perceive an interface. Included in the cognitive science theories is attention (Cherry, 1953). Attention is the process through which information enters into working memory and achieves the level of consciousness. The important characteristics of attention are:

- It is selective, and allows only a specific subset of information to enter the limited processing system.
- Focus of attention can be shifted from one source of information to another.
- Can be divided, within certain limitations, to selectively attend to more than one information source at a time. (Cherry, 1953)

Vision is the primary modality of information transfer in HCI, however research is showing that visual-auditory interaction is becoming increasing relevant (i.e. think hearing and seeing a notification alert for an email or text message while reading information from a web page) (Ying et. al, 2011).

Furthermore, it was also reported that typing on a keyboard may in fact hinder recollection. The correlation of these findings to HCI is in an area called haptics or tactile feedback technology which takes advantage of the sense of touch. Examples of haptics are using vibration in the controls of video games and phones as well as enhancing the feeling of remote control of machines and devices by incorporation tactile sensors that measure force exerted by users on the interface (Robles-De-La-Torre, 2013). Another application of this technology involving the sensorimotor complex is using a stylus to interface with devices.

Another way interfaces might adapt is to manage interruptions based on the user's cognitive state. Cutrell, Czerwinski & Horvitz (2001) have shown that interruptions disrupt thought processes and can lead to frustration and significantly degraded task performance For example, if a user is thinking really hard, the system might be able to detect this and manage pending interruptions such as email alerts and phone calls (Tan, Nijholt, 2010).

Perceptual-Motor Interaction

Perceptual-Motor Interaction and Performance (PMI) is the foundation behind the evolution from the mouse, keyboard, and joystick to todays embedded, gestural, and tangible interfaces where people use their body to directly manipulate information objects. Many

new laptops and most mobile devices support multi-touch, allowing the fingers and gestures to control the device, while some video game systems such as the Wii and Xbox use body movements to interact with objects. These developments were born by researchers investigating the use of information-processing approaches to understand the translation of perceptual into motor space and the interaction of attention and action planning (Welsch, 2012).

An example of research in this area includes early studies performed in the 1960's and 1970's measured the error rate and speed of subjects completing a cursor positioning task using four different devices (mouse, joystick, step keys, and text keys). The speed measurement consisted of "homing time" (time taken to engage the control device and initiate cursor movement) and "positioning time" (time to complete the cursor movement). While the mouse was shown to have the poorest homing time, its advantage in positioning time produced the fastest overall time (Card, 1983).

Recent Advances in HCI Research

More recently, research has started to take into account more detailed interaction with the technology and presentation on that technology. Areas of interest have included eye motion research and haptics. Eye movement research has focused on what draws the eyes to various regions of a web page (on any device). With the increased focus on mobile devices incorporating touch, haptics research has gained popularity as we try to understand tactile aspects of HCI. In the following sections, we briefly discuss each of the areas of research.

Eye motion research

Eye movement patterns is an emerging research area which centers on studying the pathways a user's take when viewing a page. Websites exist to communicate information to users. Studying how the information is visually processed by the human eye therefore is an aspect of design that must receive attention. An example involves the Credo Mobile website.

The goals of the page were to: show a phone the customer may be interested in purchasing, display the company name, and guide the visitor to the purchase button. As shown in figures 2 to 5 in Appendix A, most of the hotspots were located in areas of the screen that were pertinent to the three goals for the page., Considering the data, the company redesigned the site according to the suggestions of the eye-movement study, locating the phone, company name, and buy button in the proven hotspots (oneextrapixel.com. 2013).

A more traditional research study on the identification of hotspots and the possibility of predicting areas of high attention was conducted at Microsoft (Buscher, Cutrell, Morris, 2009). Their report details how people allocate their visual attention when viewing web pages. They detail how an understanding of visual attentiveness could open the door to a variety of innovations, ranging from improved Web page design to the creation of compact, yet recognizable, visual representations of long pages. The goal of the study was to use visual attentiveness in a predictive manner." The study involved 20 users who viewed 361 different pages.

Key findings from their research include:

- The entire right third of the page is neglected for both information foraging and page recognition tasks.
- The center-left, top-left, and center-center regions are the most important for information foraging tasks.
- For recognition tasks, the top-left dominates
- Models of linear regression and decision trees can be used to render the most important HTML elements for optimal page recognition
- Prediction methods work well and find the most important elements for recognizing a page; however, they are biased to the upper left-hand side of the page
- Depending on screen size (desktop, laptop, mobile), methods can be used to emphasize more of the most important elements as identified by their calculated predictions (Buscher, Cutrell, Morris, 2009).

Figure 6 in Appendix A illustrates the results of their study. More recent studies have expanded this research by focusing on banner ad placement to understand user focus (Resnick & Albert, 2014). Understanding how websites communicate information is increasingly important as "real estate" becomes significant.

Haptics

Haptics involves the study of incorporating more senses into user experience, specifically the sense of touch (Nam et al., 2014). This technique is generally used for real time feedback. "Haptic feedback can be broadly divided into two modalities: vibrotactile and

kinesthetic. Vibrotactile feedback stimulates human tissues. It's been employed in mobile phones, video console gamepads, and certain touch panels. Kinesthetic feedback focuses on the gross movement of the body. It has been employed in medical simulation trainers, programmable haptic knobs, video game steering wheels, and virtual reality systems" (immersion.com 2010).

Research conducted by Immersion Corporation on both tactile feedback touch panels and on vibrotactile mobile phones indicates that, when users are given a choice between HCI with visual feedback and one with visual and tactile feedback, they express a strong preference for the latter (Serafin, Heers, Tschirhart, Ullrich Ramstein, 2007). Their research concluded that reasons users prefer tactile feedback is that the feedback can make them more efficient and reduce their error rate and stress levels.

3. GENERAL DESIGN PRINCIPLES

Within the field of HCI, there are general design principles that are considered standard, meaning they are applicable to the design of any interface. General design principles from Stasko (2007), Stephanidis et. al (web resource) and Jacko (2012) include:

- Usability: ease of use and learnability of a software application, system, or website.
- Learnability principles: ease with which new users can begin effective interaction
- Predictability: I think that this action will do a certain function (i.e. clicking on a submit button will submit information entered in a form)
- Familiarity: does UI task leverage existing real-world domain knowledge?
- Generalizability: can knowledge of one system/UI be extended to similar ones? (i.e. cut and paste in different apps)
- Consistency: likeness in behavior between similar tasks/operations (interacting, output, screen layout)
- Accessibility: accessibility of a computer system to all people, regardless of disability and severe.
- Computer user satisfaction: the attitude of the user to a system – a key measure of system success. Involves psychological principles such as user perception of software's ability to accomplish desired tasks.
- Human interface design: designing interactive digital products, environments, systems, and services – more of a behavioral study.

The following are the human interface guidelines incorporated in the design of Apple's latest mobile operating system, iOS 7 (developer.apple.com):

- Deference: UI helps users understand and interact with the content, but never competes with it.
- Clarity: text is legible, icons are precise and lucid, adornments are subtle and appropriate, sharpened focus on functionality
- Depth: visual layers and realistic motion impact vitality and heighten users' delight and understanding.

Likewise, Shneiderman and Plaisant (2010) recommend eight rules of good HCI design in a little more detail for developers:

- Strive for consistency. Consistent sequences of actions should be required in similar situations; identical terminology should be used in prompts, menus, and help screens; and consistent color, layout, capitalization, fonts, and so on should be employed throughout.
- Cater to universal usability. Recognize the needs of diverse users and design for plasticity, facilitating transformation of content. Novice to expert differences, age ranges, disabilities, and technological diversity each enrich the spectrum of requirements that guides design. Adding features for novices, such as explanations, and features for experts, such as shortcuts and faster pacing, can enrich the interface design and improve perceived system quality.
- Offer informative feedback. For every user action, there should be system feedback. For frequent and minor actions, the response can be modest, whereas for infrequent and major actions, the response should be more substantial. Visual presentation of the objects of interest provides a convenient environment for showing changes explicitly.
- Design dialogs to yield closure. Sequences of actions should be organized into groups with a beginning, middle, and end. Informative feedback at the completion of a group of actions gives operators the satisfaction of accomplishment, a sense of relief, a signal

to drop contingency plans from their minds, and an indicator to prepare for the next group of actions. For example, e-commerce web sites move users from selecting products to the checkout, ending with a clear confirmation page that completes the transaction.

- Prevent errors. As much as possible, design the system such that users cannot make serious errors; for example, gray out menu items that are not appropriate and do not allow alphabetic characters in numeric entry fields. If a user makes an error, the interface should detect the error and offer simple, constructive, and specific instructions for recovery. For example, users should not have to retype an entire name-address form if they enter an invalid zip code, but rather should be guided to repair only the faulty part. Erroneous actions should leave the system state unchanged, or the interface should give instructions about restoring the state.
- Permit easy reversal of actions. As much as possible, design the system such that users cannot make serious errors; for example, gray out menu items that are not appropriate and do not allow alphabetic characters in numeric entry fields. If a user makes an error, the interface should detect the error and offer simple, constructive, and specific instructions for recovery. For example, users should not have to retype an entire name-address form if they enter an invalid zip code, but rather should be guided to repair only the faulty part. Erroneous actions should leave the system state unchanged, or the interface should give instructions about restoring the state.
- Support internal locus of control. Experienced users strongly desire the sense that they are in charge of the interface and that the interface responds to their actions. They don't want surprises or changes in familiar behavior, and they are annoyed by tedious data-entry sequences, difficulty in obtaining necessary information, and inability to produce their desired result.
- Reduce short-term memory load. Humans' limited capacity for information processing in short-term memory (the rule of thumb is that we can remember "seven plus or minus two chunks" of information) requires that designers avoid interfaces in which users must remember information from one screen and then use that information on another screen. It means that cell phones should not require re-entry of phone numbers, web-site locations should remain visible, multiple-page displays should be consolidated, and sufficient training time should be allotted for complex sequences of actions.

4. ANALYSIS OF CURRENT HCI OFFERINGS

This section will detail an analysis of the ACM (from the 2010 IS Model) model curriculum for an elective course in HCI as well as HCI courses offered at six universities. It will highlight the similarities and differences in order to provide a framework for an updated, current HCI course.

Per the 2010 IS Model Curriculum (Topi, et. al, 2012) the learning objectives for the HCI elective course are:

- Design, implement and evaluate effective computer interfaces.
- Understand the concepts of user differences and user experiences
- Understand the basic cognitive psychology issues involved in HCI
- Understand the different devices for input and output
- Interact with the software design process in order to create computer interfaces
- Understand the role of theory and framework
- Apply a number of design concepts
- Apply contemporary techniques to evaluate computer interfaces.

These basic learning objectives still are sound and form the basis of an updated syllabus for an HCI elective course for MIS and CIS students.

To gauge current course offerings and their content, research was done to find publically available syllabi for HCI courses. Five schools were chosen as they had detailed topics included in the syllabi. The schools investigated and their particular course numbers were: Bowling Green State University (BGSU) (CS 324), Carnegie-Mellon University (CMU) (HCI105), Loyola University (COMP388), Northeastern University (IS4300), Northwestern University (EECS330). As noted, the courses were 'housed' in various disciplines from Information Systems to Computer Science to Electrical Engineering/Computer Science to one with its own HCI major.

Table 1 details the common topics found in the curriculums for the introductory courses. The

table also list the topics as found in the model ACM curriculum for HCI.

Topic	Reviewed Curriculum
Introduction to HCI and or History of HCI	ACM, all schools
Psychology – attention/cognitive	BGSU, Loyola, Northeastern, Northwestern
Task Analysis	ACM, BGSU, CMU, Northeastern
Interface evaluation	ACM, BGSU, CMU, Northeastern,
Web design	CMU, Loyola, Northeastern, Northwestern,
Feedback/Prototyping	ACM, BGSU, CMU Northeastern, Northwestern,
Heuristics/Usability/Usability engineering	BGSU, CMU, Loyola, Northeastern
Interface Design, User-centered design	ACM, BGSU, CMU, Northeastern, Northwestern

Table 1. Common Topics in HCI Course Curriculums

Understandably, the majority of the courses include many of the topics suggested by ACM. These topics correspond to the major principles of HCI.

Table 2 details topics that were only offered in one or two of the schools surveyed. It is interesting to note that only 2 schools out of the five have been able to provide specific instruction for mobile devices.

Topic	Reviewed Curriculum
SDLC	ACM, BGSU
Dimensions of interface variability – language, menus/windows, user support/doc/training	ACM
Wireframes	CMU, Northeastern,
Designing for mobile	ACM, CMU, Northeastern,
Programming languages – HTML,JS	BGSU, Northwestern

Table 2. Topics That Differ in HCI Course Curriculums

5. POTENTIAL SYLLABUS AND JUSTIFICATION FOR THE NEW TOPICS

Table 3 follows which is an abbreviated syllabus for a sample HCI introductory course. Table 4 in the Appendix B provides justification for the new topics as well as additional reading for instructors and students. The course can be summarized with the following topics:

1. Overview
2. The Past and the Future
3. Principles for Design
4. Understanding users and their tasks
5. Designing with the user
6. Basic human factors
7. Designing visual interfaces
8. Interface technology
9. Implementing GUIs
10. Evaluation and experimental design

Items in *italics* are new learning modules added to the model curriculum, while items in **bold** pertain to additional instructions for mobile devices.

Week	Topic	Topic details
Week 1	Introduction	• Why study HCI • History of HCI • Importance of interface design – examples that illustrate
Week 2	HCI : an overview	• Identifying daily personal interactions with technology • Major principles of HCI
Week 3	Psychology of HCI I	• *How does psychology apply to HCI* • *Human factors* • **User satisfaction**
Week 4	Psychology of HCI II	• *Cognitive Science - Human information processing* • ***Eye tracking*** • *Perceptual-motor interaction*

		• *Attention*
	Task Analysis I	• What is task analysis? • How is task analysis applied? • Use cases • User profile, needs analysis
Week 5	Task Analysis II	• Using task analysis as basis for design • In class exercise
Week 6	Interface Design I	• General design guidelines • Interface design rules • **Interaction styles (menus, touch, windows) – interface variability**
Week 7	Interface Design II	• *Applying psychology to interface design* • User goals/perception • Designing for a task
Week 8	HCI and SDLC/usability engineering model	• How does HCI fit into the SDLC
Week 9	Heuristics/ usability testing	• Importance of testing • Evaluating without users
Week 10	Incorporating user feedback/ iterative design	• Involving users in testing/designing testing methods
Week 11	Web design I	• How does HCI apply to web design • Wireframes
Week 12	Web design II/ evaluating HCI in webpages	• *Appearance/content and graphics* • *Methods for evaluating HCI in webpage*
Week 13	***Using JavaScript/ jQuery/ designing for mobile***	• ***Screen sizes and HCI considerations*** • ***Haptics***
Week 14	*HCI future/current research*	• *Incorporating advances in hardware/technology* • Future of interfaces/virtual reality/brain-computer interface

Table 3. Topics That Differ in HCI Course Curriculums

Additional justification for expanding the current concepts found in the model curriculum includes:

- Weeks 3 and 4: Psychology of HCI I and HCI II – the application of psychological principles to HCI is emphasized more heavily in this curriculum than others in order to provide students with a greater understanding of how psychological principles are applied to designing more effective user interfaces. Research of other course curriculums demonstrates that human factors (aka user psychology) are a major focus of contemporary HCI design. Covering user psychology in more detail will allow students to better understand how psychology is incorporated in the design process.

- Week 7: Interface design II – the emphasis here is on how applying the psychological principles.

- Week 12: Web design II – an additional lecture for implementing HCI principles covered in Web Design I lecture is needed. Using heuristic evaluations done by other students to provide feedback on interface designs.

- Week 13: JavaScript, jQuery, mobile design – HCI considerations for mobile device design and responsive webpages. Web applications and websites must be responsive to different devices and screen sizes without sacrificing usability. An introduction to jQuery and JavaScript will be covered in order to familiarize students with these popular UI tools.

- Week 14: HCI future, current research – emphasize importance of learning to use new technologies (hardware, psychological studies, ergonomic advancements). Promote continuing education by keeping up with new practices and tools by reading UI blogs. Good examples of blog sites:
    - http://hci-design.blogspot.com/
    - http://uxmag.com/

Resources including suggested books and websites can be found based on the various HCI topics on the potential syllabus in Appendix B.

As mentioned earlier one of the goals was to offer suggestions on potentially incorporating HCI concepts into current software development courses. This past academic year, a "Device Development Course" which is primarily a HTML5, CSS and jQuery course included new HCI modules. The modules included were:

- Week 1 – Introduction
- Week 4 – Task Analysis
- Weeks 5 and 6 – Interface Design
- Week 13 – Screen Size considerations.

Feedback from students in the course was generally favorable as the class moved from strictly 'coding' issues to why and where items should be placed on a device.

6. SUMMARY

As technology instructors we all face changes in order to stay current in our field. The model curriculums proposed by various groups help to found a foundation for many MIS and CIS course. This research project was undertaken to increase and summarize concepts in HCI that instructors of software development courses as well as specific HCI courses may use as background materials.

The research project also did an analysis of five current HCI offerings and merged the common threads between those courses with the ACM suggested curriculum. Finally the research project expanded the proposed topics with additional topics and potential background materials to enable MIS and CIS instructors to consider offering all or parts of the curriculum in current software development courses or stand-alone courses.

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APPENDIX A. – Hot Spots

Figure 2. Previous site (oneextrapixel.com)

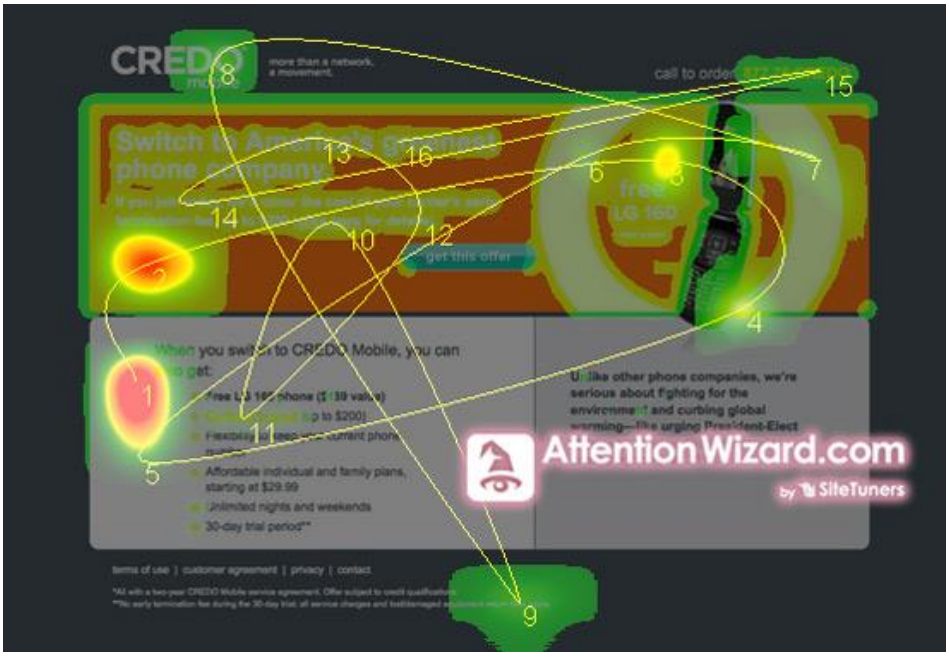

Figure 3. Eye tracking for previous site (oneextrapixel.com).

Figure 4: New site redesigned for hotspots (oneextrapixel.com)

Figure 5 Eye tracking for new site (oneextrapixel.com)

Figure 6: Heat map for 20 users during a page recognition task
(Buscher, Cutrell, Morris, 2009).

APPENDIX B – Potential Syllabus with justification and readings

Table 4 – Detailed topics, justification and additional readings

Week	Topic	Topic details	Justification	Instructor or Student Supplemental Readings and Sample Exercises
Week 1	**Introduction**	• Why study HCI • History of HCI • Importance of interface design – examples that illustrate	Common topic	
Week 2	**HCI : an overview**	• Identifying daily personal interactions with technology • Major principles of HCI	Common topic	***Design of everyday things***: Chapter 1: The Psychopathology of everyday things, found in: Book: "Psychology of Everyday Things", by Donald Norman The perfect brainstorm in the "The Art of Innovation", by Tom Kelley *Demonstrations of examples: Affordance), Mapping, Mental modes*
Week 3	**Psychology of HCI I**	• How does psychology apply to HCI • Human factors • User satisfaction	Suggested topic	**Design: Defining goals:** Book: "Bringing Design to Software", by Terry Winograd Universal Tools: Recruiting and Interviewing (only pages 117-127) Book: "Observing The User Experience", by Mike Kuniavsky Understanding users: Qualitative Research Modeling Users: Personas and Goals Book: "About Face 2.0", by Alan Cooper and Robert Reimann *Demonstrations of examples: Development Cycle, Iteration, Prototyping, Storytelling*
Week 4	**Psychology of HCI II**	• Cognitive Science - Human information processing • Eye tracking • Perceptual-motor interaction	Suggested topic	**Design Prototype:** Making a Paper Prototype Book: "Paper Prototyping", by Carolyn Snyder

		• Attention		
	Task Analysis I	• What is task analysis? • How is task analysis applied? • Use cases • User profile, needs analysis	Common topic	**Design: Evaluation** Designing the Palm Pilot Book: "Information Appliances and Beyond", by Eric Bergman (Ed.) *Demonstrations of examples: Flexibility-Usability Tradeoff, Scaling Fallacy*
Week 5	**Task Analysis II**	• Using task analysis as basis for design • In class exercise	Common topic	**Historical Perspective:** The Xerox Star: An Influential User Interface Design Book: "Human-Computer Interface Design", by Lawrence H. Miller, Jeff Johnson. The Xerox Star: A Retrospective J. Johnson, T. Roberts, W. Verplank, D. Smith, C. Irby, M Beard, K. Mackey (in IEEE Computer, Sept'89) *Demonstrations of examples: Iconic Representation* **The Human Information Processor I** Book: "The Psychology of Human-Computer Interaction", by Card, Moran and Newell *Demonstrations of examples: Fitt's Law, Highlight, Interference Effect, Orientation Sensitivity, Performance Load, Performance vs. Preference*
Week 6	**Interface Design I**	• General design guidelines • Interface design rules • Interaction styles (menus, touch, windows) – interface variability	Common topic	**The Human Information Processor II** Skill Acquisition Book: "Learning and Memory", by J. Anderson *Demonstrations of examples: Chunking, Hick's Law. Recognition over Recall*
Week 7	**Interface Design II**	• Applying psychology to interface design • User goals/perception • Designing for a task	Elaboration on suggested topic	**High Level Theories** Information Processing and Skilled Behavior Book: "HCI Models, Theories, AND Frameworks : Toward A Multidisciplinary Science", By J. Carroll. Chapter 4.

				Demonstrations of examples: Depth of Processing, Feedback Loop
Week 8	**HCI and SDLC/usability engineering model**	• How does HCI fit into the SDLC	Common topic	**Conceptual Models** Cognitive engineering; Direct Manipulation Interfaces Book: "User Centered System Design", by Donald Norman and Stephan Draper *Demonstrations of examples: Cognitive Dissonance, Flexibility-Usability Tradeoff, Mapping, Mental Model, Iconic Representation, Recognition over Recall*
Week 9	**Heuristics/ usability testing**	• Importance of testing • Evaluating without users	Common topic	**Usability Heuristics I** Evaluating the design without users Book: "Task-Centered User Interface Design" *Demonstrations of examples: Gutenberg Diagram, Ockham's Razor, Mnemonic Device, continue in next lecture*
Week 10	**Incorporating user feedback/ iterative design**	• Involving users in testing/designing testing methods	Common topic	**Usability Heuristics II** *Demonstrations of examples: Progressive Disclosure, Recognition Over Recall, Consistency, Visibility Confirmation, Forgiveness* Flash examples: icecream.fla and icecream.swf **Computer Technology** There's more to interaction than meets the eye, Book: "User Centered System Design", by Donald Norman and Stephan Draper
Week 11	**Web design I**	• How does HCI apply to web design • Wireframes	Common topic	**Graphics Design** Organization and visual structure, Book: "Design Visual Interfaces", by Kevin Mullet and Darrell Sano *Demonstrations of examples: Alignment, Closure, Entry Point, Figure-Ground Relationship, Garbage In - Garbage Out, Good Continuation, Hierarchy, Legibility, Proximity, Similarity, Symmetry, Uniform Connectedness, Escaping Flatland,* Book: "Envisioning Information", by Edward Tufte.

Week 12	**Web design II/ evaluating HCI in webpages**	• Appearance/content and graphics • Methods for evaluating HCI in webpage	Elaboration on topic suggested	**Evaluation** Setting the Stage for Discovery, Book: "Science And Its Ways Of Knowing", by John Hatton and Paul Plouffe Examples from the literature: • Stanford Prison Experiment, (Wikipdia entry) • Milgram Experiment (Wikipedia entry) IRB: The role of visual feedback in graphical user interfaces
Week 13	**Using JavaScript/ jQuery/ designing for mobile**	• Screen sizes and HCI considerations • Haptics	Suggested topic	**Qualitative Evaluation** Introduction to Usability Test Facilitation Book: "Paper Prototyping", by Carolyn Snyder Usability Tests Book: "Observing The User Experience", by Mike Kuniavsky
Week 14	**HCI future/current research**	• Incorporating advances in hardware/technology • Future of interfaces/virtual reality/brain-computer interface	Suggested topic	**Qualitative Evaluation** Quantitative analysis of scrolling techniques by Ken Hinckley, Edward Cutrell, Steve Bathiche and Tim Muss, Published in SIGCHI 2002. Growing Up: Moving from Technology-Centered to Human-Centered Products Book: "The invisible computer", by Donald Norman