PhD Qualifying Examination: **Human-Computer Interaction**

University of Wisconsin–Madison, Department of Computer Sciences

Spring 2015 — Monday, February 2, 2015

General Instructions

- This exam has **7** numbered pages including this page.
- Answer each question in a separate book.
- Indicate on the cover of each book **the area** (HCI) of the exam, your **code number**, and the **question number** answered in that book. On one of your books, list the numbers of all the questions answered. Do not write your name on any answer book.
- Return all answer books in the folder provided. Additional answer books are available if needed.

Specific Instructions

- Answer all **6** questions.

Policy on Misprints and Ambiguities

The Exam Committee tries to proofread the exam as carefully as possible. Nevertheless, the exam sometimes contains misprints and ambiguities. If you are convinced that a problem has been stated incorrectly, mention this to the proctor. If necessary, the proctor can contact a representative of the area to resolve problems during the *first hour* of the exam. In any case, you should indicate your interpretation of the problem in your written answer. Your interpretation should be such that the problem is nontrivial.

Question Topics

1. Quantitative Data Analysis
2. Measurement
3. Usability Evaluation
4. Computer-Mediated Communication Theories
5. Qualitative Research Methods
6. Interaction Design

Question 1. *Quantitative Data Analysis*

HCI researchers use a wide range of methods for statistical analysis, although the most frequent method of analysis is comparing two or more samples using a *t-* or an *F-test*. In employing this method, the researcher makes a number of assumptions regarding their data. Respond to the following according to Lazar et al.[1] and Hinton.[2]

(a) Describe three *assumptions* made in the use of this method.

(b) Provide an *example* of the violation of each assumption.

(c) Describe a *precaution* that the researcher can take to prevent each violation.

(d) Suggest a potential *post-hoc solution* to each violation that the researcher can explore after the data is collected and discuss the validity of each solution.

[1] Lazar, J., Feng, J. H., & Hochheiser, H. (2010). *Research Methods in Human-Computer Interaction.* Wiley.

[2] Hinton, P.R. (2004). *Statistics Explained*. 2nd Edition. Routledge.

Question 2. *Measurement*

You are serving on the dissertation committee of an HCI PhD student who is investigating user responses to a new personal assistant she developed that is similar to Apple's Siri. The student is particularly interested in measuring physiological responses to the new assistant, including emotional states, frustration, stress, and and so on. She comes to you for advice on what measures to use and learn about potential challenges in using them.

(a) Suggest three *physiological measurement techniques* and describe what each technique involves.

(b) Explain to the student the concept of *stimulus–response specificity*[3] and how it may apply to her investigation.

(c) Describe three *challenges* in collecting and interpreting physiological data and propose potential solutions that the student can explore.

(d) Propose three *non-physiological measures* that may serve as alternatives to your suggestions in (a).

[3] Lazar, J., Feng, J. H., & Hochheiser, H. (2010). *Research Methods in Human-Computer Interaction.* Wiley.

Question 3. *Usability Evaluation*

You are the user experience specialist of a small company that develops mobile applications. The development team is tasked to create a major revision of the company's flagship application designed for project management. As the only user experience specialist, you are expected to help the team determine the most informative method for evaluating the usability and user experience of the new design.

(a) Describe the *thinkaloud method*[4] to your teammates and list three strengths and three weaknesses of this method.

(b) Describe three *variations* of the thinkaloud method as described by Nielsen[4] as options for the team to consider.

(c) Provide your team with a description of *heuristic-evaluation*[5] method, contrasting it to the thinkaloud method.

(d) Discuss the role of *evaluator expertise* in heuristic evaluation and describe the *variation* of heuristic evaluation that would best fit your team's expertise in usability evaluation.

(e) Provide your team with a final recommendation on whether your team should use the thinkaloud method or the heuristic evaluation method, justifying your recommendation based on the information and discussion you provided in (a–d).

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[4] Nielsen, J. (1993). *Usability Engineering (Part of Chapter 6)*. San Francisco: Morgan Kaufmann, pp. 195–206.

[5] Nielsen, J. (1993) *Usability Engineering (Chapter 5)*. Morgan Kaufmann, pp. 115–163.

Question 4. *Computer-Mediated Communication Theories*

Microsoft Corporation hires you to as a consultant to provide them with feedback on their new Hololens prototype—a head-worn display that projects information in the form of 3D holograms onto the physical environment and recognizes the gestures and speech of the wearer. They are particularly interested in your assessment, based on your knowledge of research in computer-mediated communication (CMC), of the benefits the new technology over mobile phones and computers in terms of its support for how people communicate and collaborate.

(a) Briefly describe three *CMC theories* based on Whittaker[6] and provide predictions on the benefits the Hololens may have over a mobile phone/computer based on each theory.

(b) Similarly describe three *CMC models* proposed by Walther and Parks[7] and characterize the Hololens according to these models.

(c) Outline the design of a laboratory or field study that would test the predictions of one of the CMC theories or models you described in (a–b), detailing the experimental setup, task, manipulations, and measures.

[6] Whittaker, S. (2003). Theories and methods in mediated communication. In Graesser, A., Gernsbacher, M., and Goldman, S. (Ed.) *The Handbook of Discourse Processes*. Mahwah, NJ: Lawrence Erlbaum Associates, pp. 243–286.

[7] Walther, J.B. and Parks, M.R. (2002). Cues filtered out, cues filtered in. *Handbook of interpersonal communication*, pp. 529–563.

Question 5. *Qualitative Research Methods*

The Federal Aviation Administration (FAA) is expected issue the regulations that will enable and provide guidelines for the commercial use of flying robots (a.k.a. drones) by late 2015. You are interested in better understanding the commercial use of these technologies for purposes such as journalism, law enforcement, and city management and planning to conduct an ethnography when commercial use is no longer banned in order to inform the development of more effective interfaces for controlling and monitoring these systems.

(a) Briefly describe the *guiding principles of ethnography* according to Blomberg et al.[8] and discuss how they will shape the design of your study.

(b) Describe the *roles*[9] that you can play in conducting your ethnography, discussing the advantages and disadvantages of each role in the context of your study.

(c) Define *triangulation*[9] and discuss how it applies to your study.

(d) Outline the *ethnographic research process* according to Lazar et al.[9] and discuss how it differs from experimental research.

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[8] Blomberg, J., Giacomi, J., Mosher, A., & Swenton-Wall, P. (1993) Ethnographic field methods and their relation to design. In D. Schuler and A. Namioka (eds.), *Participatory Design: Principles and Practices*. Hillsdale, NJ: Lawrence Erlbaum, pp. 123-155.

[9] Lazar, J., Feng, J. H., & Hochheiser, H. (2010). *Research Methods in Human-Computer Interaction.* Wiley.

Question 6. *Interaction Design*

You work for a company that plans to design, develop, and manufacture a wearable computing platform similar to the Google Glass—a lightweight head-mounted display designed to support "micro" interactions with information. Your team leader has asked to you, the interaction designer of the team, to do an analysis of the Google Glass[10] platform, including software and hardware, to inform your team's design of the new platform.

(a) Describe three *types of affordances* proposed by Gaver et al.[11] and give examples of each type of affordance in the Google Glass.

(b) Provide definitions for *metaphors* and *idioms*,[12] discussing their differences, and give examples of a metaphor and an idiom used in the design of the Google Glass.

(c) Describe the three *layers* involved in the design of idioms as discussed by Cooper et al.[12] and identify these levels in the idiom you described in (b).

(d) Briefly describe three of the *principles of visual interface design* proposed by Cooper et al.[12] and evaluate the Google Glass interface based on these principles.

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[10] If you are not familiar with the Google Glass platform, briefly describe a wearable computing platform that you are familiar with, such as a smart watch or an activity tracker, and answer the questions based on this platform.

[11] Gaver, B., Dunne, T., and Pacenti, E. (1999). Design: Cultural probes. *Interactions* 6 (1), 21–29.

[12] Cooper, A., Reimann, R., & Cronin, D. (2007). *About Face 3 (Chapters 5-6)*. Wiley, pp. 75–123.