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

University of Wisconsin–Madison, Department of Computer Sciences

Fall 2013 — Monday, September 16, 2013

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 1. *Quantitative Data Analysis*

Consider the following statistical measures described by Hinton.[1] Describe what these measures represent and provide examples of how they might be employed in research design and/or quantitative data analysis in human-computer interaction research.

1) Spearman's ρ (rho or r_s)
2) *F*-ratio
3) χ^2 (chi-square) statistic
4) Cohen's *d*
5) *p*-value
6) Cohen's κ (kappa)
7) Pearson's *r*
8) *t*-statistic
9) Cronbach's α (alpha)
10) *z*-score

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

Question 2. *Qualitative Data Analysis*

Define the concepts *stability* and *reproducibility* in the context of assessing the reliability of analyzing qualitative data, outline the *process* for ensuring stability and reproducibility, and describe at least <u>two</u> *metrics* used to quantify reliability, including how these metrics are calculated and interpreted, as described by Lazar et al.[2]

[2] Lazar, J., Feng, J. H., & Hochheiser, H. (2010). *Research Methods in Human-Computer Interaction, Chapter 11: Analyzing Qualitative Data.* Wiley.

Question 3. *User Research*

You work for a company that designs and manufactures medical diagnostics systems. Your team is tasked with the conceptual design for an innovative new line of patient monitors for emergency units. Your boss has asked you to lead *requirements definition* and *user modeling*, following the process as outlined by Cooper et al.[3]

a) Briefly define *requirements* and describe the motivation for *requirements definition*. Outline the five-step process for requirements definition and discuss how you or your team would follow these steps in the context of the given interaction design problem.

b) Provide a brief definition of *persona*. Describe the seven-step process for *constructing personas* and briefly discuss how your team might construct personas following this process.

c) Briefly define user *goals*, describe the *types of goals* discussed by Cooper et al., and discuss the *process* you would advise your team to follow to define user goals for your design problem.

[3] Cooper, A., Reimann, R., & Cronin, D. (2007). *About Face 3, Chapters 5 & 6: Modeling Users: Personas and Goals; The Foundations of Design: Scenarios and Requirements.* Wiley, pp. 75–123.

Question 4. *Interaction Design*

You are leading the interaction design effort for building an interface that scientists in genomics will use to analyze gene sequences. Your team is made up of developers with limited experience with interaction design. Before your start the design and development work for the interface, you would like to provide your team with background on different interface paradigms and visual design principles, based on those described by Cooper et al.[4]

a) For your team, briefly define *implementation-centric*, *metaphoric*, and *idiomatic* interfaces and motivations behind following these interface paradigms.

b) Describe the potential advantages and disadvantages of using *metaphors* and *idioms* in interface design and make a recommendation for your team of which paradigm to follow.

c) Finally, describe to your team <u>three</u> key benefits of using a *grid system* and the notion of a *logical path*, particularly how one might differentiate good and bad logical path.

[4] Cooper, A., Reimann, R., & Cronin, D. (2007). *About Face 3, Chapters 13 &14: Metaphors, Idioms, and Affordances; Visual Interface Design.* Wiley, pp. 269–320.

Question 5. *HCI Principles & Fundamentals*

Discuss the *work vs. benefit disparity* highlighted by Grudin[5] in the use of groupware technologies, provide three (historical, current, or hypothetical) examples of users experiencing such disparity in the use of computer-supported collaborative work systems, compare *single-user* vs. *organizational* applications in producing such disparity, and propose two solutions to address such disparity in the design of groupware systems, contextualizing these solutions in present-day examples of groupware systems.

[5] Grudin, J. (1994). Groupware and social dynamics: eight challenges for developers. *Communications of the ACM*, 37 (1), 92– 105.

Question 6. *Study Design*

For each research question below, taken directly from human-computer interaction research, propose (1) a research design, (2) a method of measurement, and (3) a data analysis method that offers optimal *generalizability*, *precision*, and *realism*, while maximizing *validity* and *reliability*.[6]

1) "Do human and computer partners[7] differ in terms of credibility?"[8]

2) "Why is multimodal correction[9] more effective than unimodal correction?"[10]

3) "Will people's actual or perceived task time be differentially affected by a humorous person or computer compared with one that does not try to amuse?"[11]

4) "On what cues do CMC and FtF[12] interactants rely in order to reduce uncertainty[13]?"[14]

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[6] McGrath, J. E. (1995). Methodology Matters: Doing Research in the behavioral and social sciences. In R. M. Baecker, J. Grudin, W. A. S. Buxton, S. Greenberg, (eds.), *Readings in Human-Computer Interaction: Toward the Year 2000*, pp. 152–169.

[7] Computer partner here refers to a virtual agent who plays the role of a task partner.

[8] Burgoon, J. K., Bonito, J. A., Bengtsson, B., Cederberg, C., Lundeberg, M., & Allspach, L. (2000). Interactivity in human–computer interaction: A study of credibility, understanding, and influence. *Computers in Human Behavior*, *16*(6), 553-574.

[9] Multimodal correction refers to changing modalities in interactive error correction, such as using keyboard input to correct speech recognition problems, while unimodal correction refers to using the same modality for input and correction.

[10] Suhm, B., Myers, B., & Waibel, A. (1999, May). Model-based and empirical evaluation of multimodal interactive error correction. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems* (pp. 584-591). ACM.

[11] Morkes, J., Kernal, H. K., & Nass, C. (1999). Effects of humor in task-oriented human-computer interaction and computer-mediated communication: A direct test of SRCT theory. *Human-Computer Interaction*, *14*(4), 395-435.

[12] CMC and FtF refer to computer-mediated communication and face-to-face communication, respectively.

[13] Uncertainty refers to any form of ambiguity in communication, such as ambiguity in what information, object, or action a speaker might be referring to in the environment or in the task.

[14] Tidwell, L. C., & Walther, J. B. (2002). Computer–mediated communication effects on disclosure, impressions, and interpersonal evaluations: Getting to know one another a bit at a time. *Human Communication Research*, *28*(3), 317-348.