Course Overview

Effective consumer health technologies are a result of a systematic design process, paired with a deep understanding of the needs of the population they are intended to support, knowledge of psychosocial theories that inform the design of effective intervention components, and a series of evaluations that can help the designers progressively refine and optimize the design, both for user experience and for effectiveness. This course focuses on the design processes, theories, and evaluation methods that can help you construct and iteratively test high-quality consumer health technologies, focusing on behavior-change technologies. The course covers prototyping techniques (low and medium-fidelity prototyping, wizard of oz prototyping), psychological theories and constructs with direct applicability to consumer health technologies (e.g., behavioral economics, dual process models, operant conditioning), and evaluation techniques (e.g., single-case designs, micro-randomized trials) that can be used to formatively evaluate and optimize consumer-health technologies.

Learning Objectives

In this course, you'll learn...

- To decide on the most appropriate type of prototyping that can answer a particular set of questions about a design concept or a system
- To construct low and medium-fidelity interactive prototypes
- To create Wizard of Oz prototypes to evaluate design ideas that would be too difficult to implement in another way
- To use off-the-shelf tools to quickly create fully-functional prototypes of design ideas that you want to evaluate in the real-world
- Concepts from behavioral economics, social psychology, and behavior analysis that have direct applicability to the development of intervention components of consumer-health systems
- To think about health technology development in terms of continuous optimization based on explicit optimization criteria, and to use this perspective to guide technology evaluation
Evaluation methods that you can use to generate empirical data that can inform design decisions about intervention timing and contexts in which interventions should be provided.

Class Schedule

Week 1 (9/1): Course introduction
Introduction to the course; thinking of health apps as "interventions," tensions in the design of consumer-health technologies; value of rapid prototyping, roles of evaluation in the design of health technologies.

Week 2 (9/8): Why do you think your intervention should work? Conceptualizing how and why health technologies may (or may not!) bring about change

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. Health Psychol, 27(3), 379-87. [you can skim it. Mostly need to pay attention to the table that lists the actual techniques that were identified.]


Agile Science Create Phase guide.

Week 3: Self-tracking and self-experimentation


Week 4: Prototyping 1. Testing intervention concepts: Wizard of Oz prototyping and using off-the-shelf tools to prototype functional interventions


Review the following tools:
https://pacoapp.com
https://www.textmagic.com
https://ifttt.com
Week 5: Theory 1. Behavioral economics: Framing, temporal discounting, defaults


Week 6: Evaluation 1: Goals of evaluation in design; single-case experiments


Week 7: Prototyping 2. Testing user interactions: Low-fidelity prototypes


Week 8: Theory 2. Dual process models and priming


**Week 9: Evaluation 2. Intervention optimization**


*Filling in theoretical gaps: Goal-setting (Optional readings)*


**Week 10: Prototyping 3: Medium-fidelity prototyping**


*Filling in theoretical gaps: Self-monitoring (Optional readings)*


**Week 11: Theory 3. Habit and operant learning**


**Week 12: Evaluation 3. Factorial experiments and micro-randomized trials**


Filling in theoretical gaps: Social support (optional readings)


**Week 13: Project presentations**

**Materials**

No textbook is required for this class. Course readings will be posted as PDFs on the Canvas site for the course. Each week, you should bring to class a sketchbook and a dark pen, pencil, or another sketching tool of your choice (e.g., an iPad or another tablet).

**Self-experimentation Project**

To sensitize yourself to the process of behavior change, over the course of the semester you will work on a self-experimentation project. As a starting point, pick some behavior that you would like to change. This
can be a health behavior, but it does not have to be. You may decide you want to be more physically active, or cut down how much processed food you eat, but you also may decide you want to reduce how much you watch YouTube or increase focused study time. What behavior you choose is up to you, but it should be something that you care enough about to spend time during the semester trying to understand it more deeply and to find ways to affect it. Once you pick a behavior, you will want to do the following:

- **Tracking and understanding.** Spend two to four weeks just trying to understand your behavior better. You can do this in various ways, from just journaling about it to using an app or keeping a spreadsheet to track the behavior in detail. The purpose of this initial period is to better understand both the dynamics of the behavior (when it occurs, how often, how much variation there is in its occurrence), and the factors that may be influencing it (e.g., are you more likely to watch YouTube when you are tired or when you are procrastinating on an assignment?). At the end of your self-tracking period you will write-up 1 to 2 pages that describes what behavior you chose, how you tracked it, and what you learned.

- **Coming up with an intervention.** Once you have a good understanding of the behavior you were tracking, you will need to come up with one—yes, just one—intervention that you think may be a good way to change this behavior, given what you learned and the constraints of your own life. You should start this process by ideating multiple interventions, create causal diagrams for them, and work through the tradeoffs of different options until you find an intervention that you think is (1) feasible to do, (2) may plausibly help you change the behavior, and (3) you could test. You will turn in a short write-up (1 to 2 pages) describing the intervention, along with a causal diagram that shows how you think it would function to change the behavior.

- **Prototyping the intervention.** Once you have your intervention idea, you will want to create a fully functional prototype of this intervention. The prototype can purely use off-the-shelf tools (e.g., Paco or TextMagic), or you may want to build something yourself, but it should actually work, in the sense that you should be able to try it in your life and see if it works. Clearly, being able to create a functional prototype will be an important constraint in choosing which intervention you settle on.

- **Testing the intervention.** Finally, once you create a prototype, you should run a study (an N-of-1 study or a micro-randomized experiment) that will give you initial evidence on whether this intervention works for you. Thinking through what kind of study to run, for how long, and what to measure, will be a key piece of this. Likely, you will need to run the study for at least two weeks, but the duration will depend on the experimental design you decide to use. After you run the study, write-up what you did: how you prototyped your intervention, what kind of study you ran, and what you learned. The write-up doesn’t need to be long (4-ish pages is fine), but should describe concisely what you did, what you found, and what conclusions you drew from these findings.

**Project deliverables**

- Write-up of your self-tracking results (1 to 2 pages). Due: 10/1
- Write-up of your intervention idea along with a casual diagram (1 to 2 pages): 10/15
- Write-up of the self-experiment (4 to 5 pages): 11/23

**Design Project**

The main assignment in this course is a design project that you will develop over the course of the semester from an initial formulation of the health problem your system is intended to solve, to a medium-
fidelity prototype of a consumer-health technology that addresses that problem. The core of the project will be a set of features intended to support health behavior change that are based on at least two theories from behavioral science. You are free to choose which theories you want to use and can go beyond the theories we are covering in the class.

**Logistics**: You can decide to work on this project either individually, or in pairs. The nature of the project is going to be the same either way, but the scope—how many interactions you are going to prototype—will be scaled based on whether you are doing it by yourself or as part of a pair.

**Design Problem**: More than a third of the population in the U.S. is now clinically obese, and chronic illnesses—diabetes, coronary heart disease, etc.—account for more than two-thirds of all healthcare expenditures. Behavioral and lifestyle factors, such as physical inactivity, poor diets, stress, smoking, lack of regular sleep, and poor medication adherence are significant contributors to these conditions. For your class project, select a health condition that can be improved through changes in individuals’ behavior. Choose a health-promoting behavior and target population you want to focus on, and then develop a prototype of a consumer-health application that can help members of your target population to adopt—and/or successfully maintain—your chosen behavior.

Most health behaviors can be supported in many different ways. For instance, one can promote physical activity by helping individuals track how active they are being, set specific goals for how active they want to be the following week, by providing them rewards for successful goal-attainment and progress, by staging competitions with friends and family members, by providing better access to gyms or sidewalks, and so on. Many of these strategies are based on constructs that have been developed and studied in behavioral science. For your project, you will need to select at least two theoretical constructs that you will use as a base for designing features of your system that will help your target users to adopt a healthier lifestyle.

**Scoping**: A big part of working on your project will be deciding precisely what and how much you want to prototype. One way to think about scoping is in terms of the number of steps or interactions that your system will support. Think about the process of shopping on Amazon. You first search, then the results page appears, then you click on a result to see the details for that item, then you add the item to cart, then you click to check out, etc. Each of these steps—entering a search term, clicking on a result, adding an item to cart—is a user interaction. Some of these interactions happen on the same page (e.g., adding to cart and clicking the Check Out button both happen on the item details page), while other interactions move the user to a new page (clicking on an item in the results list open the page with the detailed information for that item).

**Project done in pairs**: you should aim to prototype at least 25 to 30 user interactions (steps through the system) that take place across at least 10 to 12 panels (e.g., web pages, screens of a mobile application). Most of the panels should be unique.

**Project done individually**: you should aim to prototype at least 15 to 20 user interactions (steps through the system) that take place across at least 5 to 7 panels (e.g., web pages, screens of a mobile application). Most panels should be unique.

**Final note**: this course focuses on interaction-design, which means that we are primarily considering user-facing (front-end) aspects of consumer-health technologies: design of web sites, mobile apps, applications running on a smartwatch, etc. Many interesting problems in consumer health informatics involve sensing users’ activities, using machine learning to understand patterns in their clinical signs, and
other such processes which can have user-facing outcomes but which are not user-facing components themselves. For your projects, you can assume that you could make such under-the-hood pieces work. Your focus, however, should be on figuring out the user-facing components of the application that you decide to design. For your project to be a good project for this class, these user-facing pieces need to be rich enough and interesting enough that you can work on them throughout the semester.

Project deliverables

To keep you on track with your project, you will need to turn in several deliverables throughout the term:

- **Problem statement**: The initial statement of your working assumptions about your target population, behavior you are trying to change, and your preliminary ideas about how you might go about changing this behavior. Due: 10/8.
- **Causal diagrams for the intervention**: Due: 10/22
- **Lo-fidelity prototype v.1**: initial wireframes of your prototype for peer feedback. Due: 11/12
- **Lo-fidelity prototype v.2**: revised wireframes of your prototype for peer feedback. Due: 11/26
- **Hi-fidelity prototype and final write-up**: Due 12/10, the night before the last day of class.

The details of the process deliverables are listed below:

- **Problem statement for the project**: Submit a 2-page design problem for your group projects. Specify your current working assumptions on what population and health condition you plan to target and what behavior you will be focusing on. When you are defining the behavior, try to be as specific as possible. If you are planning on supporting physical activity, what kinds of activity do you want to encourage? How much? Are you thinking of focusing on activity during daily life (e.g., walking to work) or on structured exercise? Etc. How is the behavior you are focusing on supposed to help with the health problem you selected? Provide as much rationale for your early choices and working assumptions as you can.

- **Causal diagrams**: An important step in figuring out how a BCT should work is articulating what “active ingredients” it contains and how you expect them to work. Submit a diagram that shows causal functioning of at least 3 intervention components, including the preconditions for their effectiveness, what moderators might influence whether the component is effective or not, and the various outcomes (proximal and more distal) that the component is intended to produce.

- **Lo-fidelity prototype, version 1**: Using sketching or a prototyping tool of your choice, create an interactive paper prototype of your group project. Prototype as many features of your system as you can. Prioritize completeness over polish. The purpose of the prototype is to get substantive feedback on your design ideas, so your goal should be to get feedback on as many aspects of your system as you can—which means that you should try to make the prototype as complete as possible. For homework, turn in a video of the prototype, showing how the user would use the system and explaining how different features are intended to work. Bring your prototype to this week's class.

- **Lo-fidelity prototype, version 2**: Based on the feedback on the first version of your prototype, and your evolving understanding about the project, create a revised paper prototype of your system. Turn in a video of how the prototype works. Bring the prototype to this week’s class.

**Final deliverables and presentation**

The final prototype and write-up are due at **11:59pm on Tuesday, December 10th**. Presentations are (obviously) due in class.

Late submissions will have points deducted. If you aren’t able to meet this deadline and you have special circumstances, please contact me by April 8nd to discuss.
Final Medium Fidelity Prototype: Upload links to your prototype and to a video of the walkthrough of your prototype to Canvas.

Final Write-up: Your group write-up should be 5 to 10 pages single-spaced with sketches and screen shots as appendices. Please don’t feel the need to add as many screenshots as you possibly can. Select ones that convey useful information. Focus on quality and polish as if you were delivering it to a client.

Suggested outline for write-up:
1. Problem statement.
2. Solution overview
3. Describe the final design
   - Describe the functionality (i.e., what you can do with it)
   - Provide a description of the main parts of the design flow. This is important because it will provide you with a record of how the design worked or was intended to work, long after the implementation no longer works. It could in principle also act as a deliverable to hand off to an implementer.
   - What was left unimplemented?
4. For each of the key behavior-change features, describe the following:
   a. the theoretical constructs on which the feature is based
   b. the alternative designs you considered for this feature
   c. tradeoffs of these different alternatives and how and why you decided to go with the option you implemented.
5. Going forward: If you were to really develop this app, how would you change it and what would you want to add to it and why.

Presentation details
Presentation length: **5 minutes** followed by about 2 minutes of questions. This length will need to be strictly followed to ensure that everyone gets a chance to present their project and that we finish the class on time.

Presentation content: The main purpose of the presentation is to showcase to the class what you have been working on this term. To do this effectively in such a brief time, I’d suggest something like the following structure:
- A brief description of what problem you tried to solve in your project and why this problem is important.
- A high-level overview of your solution. (e.g., “we created a prototype for a mobile-phone application that enable users to do X, Y, and Z.”)
- A walkthrough of the key features of the application. You can do this with screenshots in your slides, or you can create a video that walks the audience through these features. Please don’t try to do a live demo! Script what you want us to see and then either video-record it or practice to do the walkthrough effectively with slides.
- The design rationale for the key design decisions you had to make during the project. This is to give us a flavor of the kind of thinking that went into the project.

The above is a suggested format, but this format is not required. If your group decides you can give an effective introduction to your project using a different format, go for it. Feel free to do whatever you think will give your peers and me a good understanding of what you did and how you thought about your
Logistics: please bring your presentation on your own laptop or arrange in advance to share the laptop with another group in the class (and have the presentation preloaded on the machine). We'll need to transition between groups pretty quickly.

Grading
Here is how grades will work in this class:

- **Group project: 60 points**
  - Problem statement: 8 points
  - Causal diagram: 7
  - Lo-fidelity prototypes: 15 points
    - Lo-fi prototype 1: 7 points
    - Lo-fi prototype 2: 8 points
  - Digital prototype and final write-up: 25 points
    - Prototype: 15 points
    - Write-up: 10 points
  - Final presentation: 5 points

- **Self-experiment writeup: 40 points**
  - Write-up of your self-tracking findings: 10 points
  - Description of your intervention idea, including a causal diagram: 10 points
  - Write-up of the self-experiment: 20 points

Final Grades will be assigned according to the following scale:

- **A+** 98-100%
- **A** 93-97%
- **A-** 90-92%
- **B+** 87-89%
- **B** 83-86%
- **B-** 80-82%
- **C+** 77-79%
- **C** 73-77%
- **C-** 70-72%
- **D** 60-69%
- **F** below 60%

Attendance
This class does not have a formal attendance policy but in-class activities rely on you being in class. If you miss a session, you are responsible for finding out what you missed by referring to the syllabus and consulting with your classmates.
Accommodation for students with disabilities

If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way we teach may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the Office of Services for Students with Disabilities (SSD) to help us determine appropriate accommodations. SSD (734-763-3000; http://www.umich.edu/~sswd/) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. I will treat any information you provide as private and confidential.

Academic integrity

Unless otherwise specified in an assignment, all submitted work must be your own, original work. If you are referencing others' work, put it in quotes! If you are directly quoting, or building on others' writing, provide a citation. See the Rackham Graduate policy on Academic and Professional Integrity for the definition of plagiarism, and associated consequences.