



PROJECT #2: DESIGN EXPERIMENTATION



Introduction: The main objective of this project is to design a simple experiment that can be implemented in a classroom setting to investigate a research question related to *prototyping in design*. In other words, you need to design an experiment that can be carried out *in class* to collect data related to the person, the process, the product, and/or the environment as designers engage in prototyping activities. We will focus on the pilot stage of experimentation, in which we explore whether or not a particular line of investigation has promise, rather than trying to prove any claim conclusively; this is a common approach in research, particularly when it involves areas of research that are relatively new, like engineering design.

In addition to satisfying your curiosity about some specific aspect of design, this project is also aimed at teaching you about the process of *scholarly research* – e.g., how research questions are identified and framed, how hypotheses are set and variables are determined, how experimental logistics are defined and data are collected, and how all of these come together as a learning experience. As graduate students, scholarly research is an important part of your academic career, and as students of design, you are fortunate to have a rich field to explore. So, let's get started!

Our Specific Experimental Context: To establish some enabling constraints for this project, we will focus on a particular prototyping activity known as the “**egg drop exercise**”, in which participants build vessels from a limited supply of simple materials to protect a raw egg from breaking in a fall. The vessels are typically dropped from different heights to see which design is best at protecting the egg. Simple as it may seem, this exercise provides an excellent (and accessible) platform through which various hypotheses can be tested, particularly with respect to prototyping.

References: While the egg drop exercise has been publicized through numerous contests and marketing stunts, it is also used by design researchers to study serious aspects of prototyping. (You may have completed this exercise at some point in your undergraduate career; if so, you'll be coming at it from a different perspective this time.) To help you understand the exercise and some previous experiments, PDF versions of several articles by Steven Dow (et al.) have been uploaded to Week 5 module in CANVAS to serve as springboards and inspiration for your own ideas. Read them carefully!

Documentation: You will be submitting a **written report** for this project, which should contain documentation on all the tasks described below. You may choose the format for your report, as long as you provide the requested information for each task in a neat and complete fashion at a level appropriate for graduate studies. In addition, writing quality (grammar, spelling, etc.) *does* count (15-20%), so pay attention to the way you express your ideas and proofread your work carefully.

Task 1: Background/Literature Review (due Sunday 11/19)

Your first task is to search the scholarly literature for articles related to design prototyping that can be used to inform your experiment design. The PSU online databases discussed earlier in the course are an excellent resource for this. There are also a number of design-related journals and conference proceedings that make good starting points, including *Design Studies*, *Journal of Engineering Design*, *Research in Engineering Design*, *Proceedings of the ASME IDETC Conference*, and *ASME's Journal of Mechanical Design*. Using these online resources, your first task is as follows:

1. Locate at least two peer-reviewed articles (i.e., from scholarly journals or conference proceedings) that relate to design prototyping and/or design experimentation using prototypes.
2. Provide a one-page summary of each article (written in your *own words* – i.e., do not simply “cut and paste” the paper abstract), including a description of the main research question(s), methods and procedures used, data collected, results and conclusions, and remaining questions (for future work). Also provide a full citation (article and source titles, volume/issue numbers, page numbers, authors, year of publication, etc.).
3. Finally, please submit PDF copies of these articles to me.

Task 2: Research Questions & Experimental Hypotheses (due for class discussion – Tuesday 11/21)

1. Based on your literature review, identify at least **3 research questions** that might be explored using the egg drop exercise. These research questions must fit our specific context and constraints, i.e., be testable with novice designers, require simple logistics, can be done in a classroom environment, do not require expensive materials or measurement devices – and, of course, be related to design prototyping and creativity!
 - a. *Example:* What is the impact of parallel prototyping on design?
2. Identify at least **2 “working hypotheses”** for each research question (i.e., general statements of what you expect to happen based on the literature, your class readings, your experience, etc.). I will give you feedback in class on the suitability of your research questions and working hypotheses before you develop your experiment.
 - a. *Example:* Parallel prototyping encourages more dissimilar designs.

Task 3: Research Methods (Experiment Design) (due for submission – Sunday 11/26)

1. Based on my feedback, choose **one research question** to investigate in detail. Develop a simple experiment based on the egg drop exercise with the following elements:
 - a. Aim(s) of the experiment: What are you trying to find out/explore?
 - b. Relevance: Why is this experiment important/useful?
 - c. Participants: Is it based on individuals or groups?
 - d. Independent variables: things you will vary in the experiment
 - e. Dependent variables: things that will vary in response
 - f. Experimental procedure: what will happen, how, when, where, etc.
 - g. Any scripts required: i.e., things that need to be said in a particular way every time
 - h. Materials/equipment required: detailed lists and specifications
 - i. Processing/analysis: how the collected data will be processed and analyzed, including mathematics used, software needed, etc.
 - j. Possible limitations: What might go wrong? What can't your experiment reveal?
 - k. Classroom implementation: any other practical notes about doing their experiment in class (How will it work? What role will you play?)
 - l. Justification: Why I should choose your experiment for testing in class! ☺

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Task 4: Realization and Reporting (due for submission – Sunday 11/26)

Experiment Implementation (Fun Stuff): Each project will be assessed in the standard way for a letter grade, but they will also be evaluated for research quality, creativity, and suitability for implementation in class. Small prizes will be awarded for 1st, 2nd, and 3rd place using these three metrics, and the winning experiments will be carried out in class on 11/28. I will supply the materials, you will perform the experiments, and we will all see the results!

Project Report: As noted earlier, the **format** for this report is really up to you, as long as it covers all the tasks, provides documentation for your efforts, and includes the specific deliverables required. It must also be neat, grammatically correct, and well-written at a graduate level. There is no minimum or maximum length for the report; be as thorough as necessary and as concise as possible!

In addition to the documentation requested in these pages, please include **your reflections** on the following questions to close out your report:

- a. Which part of this experiment design did you enjoy most? Which was most challenging? Why?
- b. What do you think of yourself as a design researcher? Would you be interested in doing more design research after this class is over?

