# CHAPTER 5: USER AND PERFORMANCE TESTING

## Chapter outline

- User testing
  - Guidelines for user testing
  - Organizing user test results
- Performance testing
- Iterating the process

Different projects call for different methods of testing. User testing improves a design and helps make sure that it meets user needs. By observing users as they attempt to perform designated tasks using your mockups, you can discover the pros and cons of those mockups. But user testing is only one method for learning more about the pros and cons of your design ideas. Drawbacks to direct user testing include the following:

- User testing demands significant time from the team and the users. It can be difficult to schedule repeated testing sessions in a short time frame.
- Not all users are qualified or willing to evaluate a design with the necessary rigor.
- Not all users can easily communicate their responses to a design. If you are designing a device for use in a tank at the Shedd Aquarium, the fish are clearly users, but poor candidates for interviews.
- In some situations, as in the design of complex systems or large structures, it is prohibitively expensive, inadvisable or impossible to conduct user testing. In those cases, you need to use your ingenuity to develop design tests that match the nature of your design problem.

## 5.1 USER TESTING

As you observe and interview users, pay close attention to their facial expressions, which often convey more than words can. Also, be objective: If you observe users having trouble with one of your favorite design features, try to figure out why they're having difficulty rather than blame them. If they like a

feature, also find out why. Keep in mind that the best designs grow out of user feedback.

## 5.1.1 Guidelines for user testing

### Setting up the sessions

1. Use these resources to help you find appropriate users to observe and interview:
   - Your client
   - Your instructors
   - Family members and friends who fit your user profile
   - Locations where the product would logically be used
2. Make an appointment. This allows you and your users to prepare and schedule time for the session. Avoid showing up unexpectedly unless your project requires ad hoc interviews with people on location. In general, follow the guidelines described in Chapter 2 for setting up user observations and interviews with experts.
3. Plan the session. Ask yourselves:
   - How many people on the team should be at the session?
   - What methods of recording the results will be most useful? Use:
     a. Paper and pencil for simple actions involving one user at a time.
     b. Video recorder to capture and review subtle details.
     c. Digital camera for use in visual documentation and preparing a report, presentation, or poster.
     d. Tape recorder to supplement handwritten notes and capture users' comments.
     e. Sketchpad or graph paper for making drawings.
     f. Tape measure for recording accurate dimensions.

   Note: Use photo and video recording only if your team has obtained the users' consent first. Take care that the users do not feel pressured to consent. Photos or videos taken to record information should have identifying tags that say who took the photo, describe the action or object represented in the photo, and include appropriate references to human subjects. Even if users have allowed you to make a photo or video record, this does NOT necessarily mean that they wish to be identified in the photo or video record. Be sure to find out if participants want you to use their names or wish to preserve their anonymity. In certain cases, you may need to use Photoshop or video editing programs to block out a user's identifying features.

## Writing the user test guide and conducting the testing

User test guides provide a consistent methodology, ensuring that all members of your team ask the right questions and that all users perform the same tasks and answer the same questions. The guide is composed of the following:

- Times at which each test session began and ended. The duration of the session can reveal a lot about the quality of the results, so in your followup summary you should also note when the session ends.
- A brief introduction of yourselves, the project, and the purpose of the session. In explaining the purpose, tell users you are watching what they do with your mockups in order to learn how to improve the design, and that they are not being tested, the mockups are. Explain that if they can't do or find something, chances are the mockup is at fault. This will put them at ease so they perform the task more naturally.
- Questions to get relevant demographic information. Avoid unnecessary or overly personal questions. For instance, there's no need to ask about gender when you can learn that simply through observation, and you may want to avoid questions about age when you are dealing with older users.
- Tasks for users to perform. The tasks should be appropriate to the materials and capacities of the mockups. For instance, if you are designing a device that enables people with limited use of their hands and arms to drink from beverage containers, then mockups made from foamcore and rubber bands may yield meaningful responses from users about how the device feels but not about how it functions to pick up a container.
  - Encourage users, as they perform the tasks, to vocalize their thoughts as they interact with the mockups. These comments can provide valuable insights into users' perceptions and feelings.
- Questions about the mockups. After observing users, ask what they like and dislike about the alternatives and whether they have suggestions. Whenever possible, give users a scale of numerical responses; this will make tabulating the answers easier. Word the questions precisely to ensure that users understand exactly what issues you want them to address. For instance, don't say, "Rank the three mockups from best to worst." Instead say, "Rank the three mockups from best to worst in terms of comfort." Similarly, don't say, "Rate the effectiveness of the first mockup on a scale of 1 to 6, with 6 being the best." Instead say, "Rate the ease of use of the first mockup on a scale of 1 to 6, with 6 being extremely easy to use."

You'll gain additional valuable information about users' needs and preferences by asking users to explain their numerical responses: "Why did you rank mockup 2 as the best?" "What made mockup 3 so hard to use?" During this whole process, someone on the team should take careful notes on the

users' steps, missteps, and comments. One final piece of advice: Resist the temptation to defend your design alternative or explain the rationale behind a feature to your users. Your goal is to gather as much information as possible from users, not to persuade them of a design's merit.

For an example of user testing guide, see Appendix F.

### 5.1.2 Organizing user test results

Chapter 6 explains in detail how to write formal documentation of test procedures and results. Before writing that documentation, however, you should summarize test results informally for yourselves, as the beverage container team (Donahue, Galfi & Sileika, 2006) did in the following table:

Example 5.1: Summary of qualitative user test results

User testing results and follow-up ideas

| Model | Observations and User Comments | Follow-up design ideas |
|---|---|---|
| Ratchet | Open handle is a good idea since the user doesn't have to squeeze hand into something. | |
| | Users don't always wear their brace; cannot assume that the metal piece can be inserted under a brace strap. | Add an additional Velcro strap near where the apparatus comes to the wrist; use a D-ring so that it can be fitted by the user by him/herself. |
| | Containers may slip while in the ratchet. | Use Dycem to reduce slippage and provide a better grip. |
| Harness | Holds containers very well but it's too hard for the user to install a container by him/herself. | Abandon the use of the scrunchy or use a D-ring so that users can more easily adjust the scrunchy. |
| | Platform will not fit with all container sizes. | |
| | Handle is difficult to use because users have to align their hand correctly to get it through the loop. | Make the handle open so that users can slip their hands up into it; design the handle such that it automatically tips toward the mouth. |
| Glove | Too difficult for users to put on themselves. | Use gloves that have no finger holes. |
| | Pouches are flimsy and don't hold the drink in an upright position. | Use firmer material for the pouch. |
| | Effective design for discreetness. | |

## 5.2 PERFORMANCE TESTING

In addition to user testing, you may need to test your alternative designs in a laboratory or other controlled environment to discover whether they work at all. For instance, one team was designing a toy rocket-launching kit, using a two-liter soda bottle for the body of the rocket. In designing the launch mechanism, trigger, fins, and nose cone that would attach to the bottle, the team observed and interviewed users—mostly children—to figure out the most promising ideas for these components. Then they mocked those up using foamcore and other easily available materials, attached the mockups to bot-

tles, launched them, and measured their performance. These tests enabled the team to eliminate some ideas and move forward with others.

Alternatives and supplements to direct user testing include the following:

- Laboratory tests designed to simulate real-world conditions including extreme stresses on your design. A team designing a container to keep paint from freezing in cold climates did laboratory testing of their mockups in refrigerators set to different temperatures.
- Computer modeling. A team designing a method of rapidly evacuating people from skyscrapers used computer modeling to test their design concepts.

An EDC team (Syed, Erisken, Kuo, & Tang, 2004) was designing a method to prevent a new, environmentally friendly paint from freezing when transported or stored in cold conditions. One of their mockups consisted of a Styrofoam container with heat packs. Below is the test procedure they developed, along with the form for recording the results:

Example 5.2: Performance test procedure and table for recording results

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Team 3, Section 15

Test Procedures for Heat Pack Mockup

1. Set freezer to 10 degrees Fahrenheit.
2. Leave box in freezer for three days.
3. Open cardboard box after three days.
4. Carefully cut off Styrofoam lid with an X-acto knife.
5. Open paint canisters.
6. Record observations in table under “After 3 Days.”
7. If paint is frozen, end the test; otherwise continue.
8. Use Instafoam to seal box.
9. Tape lid down.
10. Repackage paint in boxes.
11. Set for one hour for foam to harden.
12. Maintain paint for another two days at 10 degrees Fahrenheit.
13. After two days, check condition of paint as above.
14. Record observations under “After 5 Days.”

| **Time** | **Observations (i.e., degree of ice formation, condition of boxes, how hot heat packs are)** |
|---|---|
| After 3 Days | |
| After 5 Days | |

Chapter 6 explains in detail how to document test procedures and results. Chapter 21 explains how to write specific, well-organized instructions.

## 5.3 ITERATING THE TESTING PROCESS

Although you may have figured out a design direction after your initial round of testing, you still must decide on the components of that design by continuing to generate and test alternatives. For example, the team designing the bottle rocket kit faced a host of questions after their initial tests led them to narrow down the kind of launch pad and fin shape they wanted. So they continued to generate and test alternative ways for the bottle rocket to attach to the launch pad. Similarly, while they kept the basic shape of the fins that their

early tests showed to be best, they had to mock up different-sized fins and attach them at several different positions on the bottle rocket. They also needed to conduct these tests with potential users as well as with themselves. These iterative tests, which continued into the final days of the project, helped them make further decisions.

In EDC, you learn that good designs are user-centered—they take into account and accommodate the full range of user needs, characteristics, patterns of behavior, and environments. For that reason, it's often a good idea to evaluate your early design ideas through user testing. User feedback can help you eliminate unpromising ideas early in the design process.

But user testing is not the only way to learn more about your proposed designs. Performance testing also helps ensure your design's suitability for your target users. Such tests let you learn more about how your design would behave under circumstances that might be difficult or dangerous to simulate in the context of user testing. In addition, the controlled environment of performance testing makes it likely that you will be able to obtain high-quality, quantified information about your design—especially important if you seek to establish safety parameters for its construction or use. Finally, performance testing takes advantage of the team's special skills and knowledge, allowing you to gather information about the design that may not be readily apparent from a user testing session.

Consider this example: a team working with Engineers for a Sustainable World (ESW) needs to develop a system for transporting drinking water to cattle that can be used, maintained, and repaired by inhabitants of a rural community in Panama. The team must then provide the inhabitants with an instruction manual for installation, maintenance, and repair of the system.

For such a project, both user and performance testing are vital to the success of the solution. Without user feedback, the team will be unable to evaluate which systems are appropriate to the environment or require too much technical knowledge and expensive equipment for the users to maintain easily—or whether the instruction manual tells them what they need to know. Without performance testing, the team will have difficulty determining how the pump and filter system would behave under adverse climate conditions, such as when the local stream is running low and clogged with debris. Without both kinds of information—and iteration—the team is unlikely to develop a successful final prototype.

Keep in mind that the complexity of the testing process mirrors the complexity of the design problem. Any team that relies solely on one kind of testing procedure or one set of tests will likely end up with a design that may work in theory, but fail in practice. In the final analysis, user-centered design typically requires both.

## 5.4 REFERENCES

Donahue, K., Galfi, R. & Sileika, T. (2006). *Grip&Sip: final design report.* Engineering Design and Communication, Northwestern University.

Syed, S., Erisken, S., Kuo, J. & Tang, S. (2004). *Second progress report.* Engineering Design and Communication. Northwestern University.