

change. Just because something is different does not mean it is bad. If we only kept to the old, we could never improve.

The Faucet: A Case History of Design

It may be hard to believe that an everyday water faucet could need an instruction manual. I saw one, this time at the meeting of the British Psychological Society in Sheffield, England. The participants were lodged in dormitories. Upon checking into Ranmoor House, each guest was given a pamphlet that provided useful information: where the churches were, the times of meals, the location of the post office, and how to work the taps (faucets). “The taps on the washhand basin are operated by pushing down gently.”

When it was my turn to speak at the conference, I asked the audience about those taps. How many had trouble using them? Polite, restrained tittering from the audience. How many tried to turn the handle? A large show of hands. How many had to seek help? A few honest folks raised their hands. Afterward, one woman came up to me and said that she had given up and walked the halls until she found someone who could explain the taps to her. A simple sink, a simple-looking faucet. But it looks as if it should be turned, not pushed. If you want the faucet to be pushed, make it look as if it should be pushed. (This, of course, is similar to the problem I had emptying the water from the sink in my hotel, described in Chapter 1.)

Why is such a simple, standard item as a water faucet so difficult to get right? The person using a faucet cares about two things: water temperature and rate of flow. But water enters the faucet through two pipes, hot and cold. There is a conflict between the human need for temperature and flow and the physical structure of hot and cold.

There are several ways to deal with this:

- **Control both hot and cold water:** Two controls, one for hot water, the other cold.
- **Control only temperature:** One control, where rate of flow is fixed. Rotating the control from its fixed position turns on the water at

some predetermined rate of flow, with the temperature controlled by the knob position.

- **Control only amount:** One control, where temperature is fixed, with rate of flow controlled by the knob position.
- **On-off.** One control turns the water on and off. This is how gesture-controlled faucets work: moving the hand under or away from the spout turns the water on or off, at a fixed temperature and rate of flow.
- **Control temperature and rate of flow.** Use two separate controls, one for water temperature, the other for flow rate. (I have never encountered this solution.)
- **One control for temperature and rate:** Have one integrated control, where movement in one direction controls the temperature and movement in a different direction controls the amount.

Where there are two controls, one for hot water and one for cold, there are four mapping problems;

- Which knob controls the hot, which the cold?
- How do you change the temperature without affecting the rate of flow?
- How do you change the flow without affecting the temperature?
- Which direction increases water flow?

The mapping problems are solved through cultural conventions, or constraints. It is a worldwide convention that the left faucet should be hot; the right, cold. It is also a universal convention that screw threads are made to tighten with clockwise turning, loosen with counterclockwise. You turn off a faucet by tightening a screw thread (tightening a washer against its seat), thereby shutting off the flow of water. So clockwise turning shuts off the water, counterclockwise turns it on.

Unfortunately, the constraints do not always hold. Most of the English people I asked were not aware that left/hot, right/cold was a convention; it is violated too often to be considered a convention in England. But the convention isn't universal in the

United States, either. I once experienced shower controls that were placed vertically: Which one controlled the hot water, the top faucet or the bottom?

If the two faucet handles are round knobs, clockwise rotation of either should decrease volume. However, if each faucet has a single “blade” as its handle, then people don’t think they are rotating the handles: they think that they are pushing or pulling. To maintain consistency, pulling either faucet should increase volume, even though this means rotating the left faucet counterclockwise and the right one clockwise. Although rotation direction is inconsistent, pulling and pushing is consistent, which is how people conceptualize their actions.

Alas, sometimes clever people are too clever for our good. Some well-meaning plumbing designers have decided that consistency should be ignored in favor of their own, private brand of psychology. The human body has mirror-image symmetry, say these pseudo-psychologists. So if the left hand moves clockwise, why, the right hand should move counterclockwise. Watch out, your plumber or architect may install a bathroom fixture whose clockwise rotation has a different result with the hot water than with the cold.

As you try to control the water temperature, soap running down over your eyes, groping to change the water control with one hand, soap or shampoo clutched in the other, you are guaranteed to get it wrong. If the water is too cold, the groping hand is just as likely to make the water colder as to make it scalding hot.

Whoever invented that mirror-image nonsense should be forced to take a shower. Yes, there is some logic to it. To be a bit fair to the inventor of the scheme, it works as long as you always use two hands to adjust both faucets simultaneously. It fails miserably, however, when one hand is used to alternate between the two controls. Then you cannot remember which direction does what. Once again, notice that this can be corrected without replacing the individual faucets: just replace the handles with blades. It is psychological perceptions that matter—the conceptual model—not physical consistency.

The operation of faucets needs to be standardized so that the psychological conceptual model of operation is the same for all types of faucets. With the traditional dual faucet controls for hot and cold water, the standards should state:

- When the handles are round, both should rotate in the same direction to change water volume.
- When the handles are single blades, both should be pulled to change water volume (which means rotating in opposite directions in the faucet itself).

Other configurations of handles are possible. Suppose the handles are mounted on a horizontal axis so that they rotate vertically. Then what? Would the answer differ for single blade handles and round ones? I leave this as an exercise for the reader.

What about the evaluation problem? Feedback in the use of most faucets is rapid and direct, so turning them the wrong way is easy to discover and correct. The evaluate-action cycle is easy to traverse. As a result, the discrepancy from normal rules is often not noticed—unless you are in the shower and the feedback occurs when you scald or freeze yourself. When the faucets are far removed from the spout, as is the case where the faucets are located in the center of the bathtub but the spouts high on an end wall, the delay between turning the faucets and the change in temperature can be quite long: I once timed a shower control to take 5 seconds. This makes setting the temperature rather difficult. Turn the faucet the wrong way and then dance around inside the shower while the water is scalding hot or freezing cold, madly turning the faucet in what you hope is the correct direction, hoping the temperature will stabilize quickly. Here the problem comes from the properties of fluid flow—it takes time for water to travel the 2 meters or so of pipe that might connect the faucets with the spout—so it is not easily remedied. But the problem is exacerbated by poor design of the controls.

Now let's turn to the modern single-spout, single-control faucet. Technology to the rescue. Move the control one way, it adjusts temperature. Move it another, it adjusts volume. Hurrah!

We control exactly the variables of interest, and the mixing spout solves the evaluation problem.

Yes, these new faucets are beautiful. Sleek, elegant, prize winning. Unusable. They solved one set of problems only to create yet another. The mapping problems now predominate. The difficulty lies in a lack of standardization of the dimensions of control, and then, which direction of movement means what? Sometimes there is a knob that can be pushed or pulled, rotated clockwise or counterclockwise. But does the push or pull control volume or temperature? Is a pull more volume or less, hotter temperature or cooler? Sometimes there is a lever that moves side to side or forward and backward. Once again, which movement is volume, which temperature? And even then, which way is more (or hotter), which is less (or cooler)? The perceptually simple one-control faucet still has four mapping problems:

- What dimension of control affects the temperature?
- Which direction along that dimension means hotter?
- What dimension of control affects the rate of flow?
- Which direction along that dimension means more?

In the name of elegance, the moving parts sometimes meld invisibly into the faucet structure, making it nearly impossible even to find the controls, let alone figure out which way they move or what they control. And then, different faucet designs use different solutions. One-control faucets ought to be superior because they control the psychological variables of interest. But because of the lack of standardization and awkward design (to call it “awkward” is being kind), they frustrate many people so much that they tend to be disliked more than they are admired.

Bath and kitchen faucet design ought to be simple, but can violate many design principles, including:

- Visible affordances and signifiers
- Discoverability
- Immediacy of feedback

Finally, many violate the principle of desperation:

- If all else fails, standardize.

Standardization is indeed the fundamental principle of desperation: when no other solution appears possible, simply design everything the same way, so people only have to learn once. If all makers of faucets could agree on a standard set of motions to control amount and temperature (how about up and down to control amount—up meaning increase—and left and right to control temperature, left meaning hot?), then we could all learn the standards once, and forever afterward use the knowledge for every new faucet we encountered.

If you can't put the knowledge on the device (that is, knowledge in the world), then develop a cultural constraint: standardize what has to be kept in the head. And remember the lesson from faucet rotation on page 153: The standards should reflect the psychological conceptual models, not the physical mechanics.

Standards simplify life for everyone. At the same time, they tend to hinder future development. And, as discussed in Chapter 6, there are often difficult political struggles in finding common agreement. Nonetheless, when all else fails, standards are the way to proceed.

Using Sound as Signifiers

Sometimes everything that is needed cannot be made visible. Enter sound: sound can provide information available in no other way. Sound can tell us that things are working properly or that they need maintenance or repair. It can even save us from accidents. Consider the information provided by:

- The click when the bolt on a door slides home
- The tinny sound when a door doesn't shut right
- The roaring sound when a car muffler gets a hole
- The rattle when things aren't secured
- The whistle of a teakettle when the water boils