Edward Tufte's 1+1=3

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> Visual activation of negative areas of white space in these exhibits illustrates the *endlessly contextual and interactive nature of visual elements*. This idea is captured in a fundamental principle of information design: 1 + 1 = 3 or more. In the simplest case, when we draw two black lines, a third visual activity results, a bright white path between the lines ... *Most of the time, that surplus visual activity is non-information, noise, and clutter.*
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> Envisioning Information by Edward R. Tufte p.61

This quote comes from Chapter 3, Layering and Separation, of Envisioning Information. While only a modest part of Tufte's broader work, this chapter has had a profound impact on my work as an interaction designer. On the surface, the chapter is about how layering and separation can calm the visual clutter that comes from 1+1=3. There is, however, a very clear corollary to interaction design.

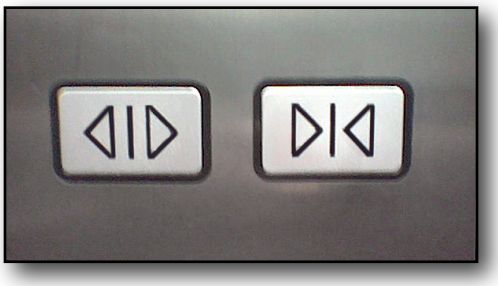
Let's review the basic idea. A single line is just a line. However, by adding a second parallel line, something special happens: a third 'object' is created. This object is the white space, or negative space, between the two lines. The effect can be seen in graph paper, musical staffs, and displays that use boxes to enclose sections. While the desire to separate and delineate information is well intended, it is the heavy handed and simplistic use of lines and boxes that has an unintended effect. The cure creates its own side effects. Tufte closes the chapter by redesigning a visual guide for a flight handbook calming down the effects of 1+1=3 and producing a significantly calmer and clearer presentation

Applying 1+1=3 to Interaction Design

I've always enjoyed Tufte's works on multiple levels: for their clear thinking, the impeccable craftsmanship, and sheer, 'here, let me show you' executional brilliance.

However, the direct transference into actual interaction design came to me while I was in an elevator. Just as the doors began to close, I could see a woman with a large suitcase running towards me. Sympathetically, I reached down to push the "door open" button. To my horror, I pushed the door close button by mistake and the doors slid silently shut. As she could clearly see me reaching over to push a button, it looked to her like and I had intentionally closed the doors. I was mortified.

Standing there in the now empty elevator, I couldn't help but thinking I had been set up. This wasn't simply 'pilot error", there was something very wrong. I took out my camera and took a picture of these buttons:



As I reflected on the experience, it was clear that as I reached down to push the open door button, I was confronted with not one but two buttons: the open and the close button. I had to choose, in split second, which to push. There was a momentary panic as my brain tried to decode arrow direction and expected outcome and, as most errors have it, I choose the wrong one.

I realized at that point I was staring at the interaction design equivalent of Tufte's 1+1=3. The issue was if there had just been a single open button, my choice would have been clear. But as there were two buttons, a third 'object' had been created: the cognitive load to visually parse, understand, and then choose the correct button. This extra load is the unseen, untallied cost of feature creep.

Where Tufte discussed visual clutter, we interaction designers have cognitive clutter. His solution of Layering and Separation also works for us. The intent is to separate the data from the framework surrounding the presentation of the data. In previous chapters, he calls this "data ink", the actual data that we need to interpret, and "chart junk", the labels, grids and overall framework for presenting the data. It may seem counter intuitive to interaction designers, but Tufte celebrates complexity. However, this is only within the data, not the chart junk. He ruthlessly removes excessive presentation detail that is not central to the data itself. That is our insight: what excessive 'presentation details' of our user interfaces are making decisions more complex?

There are two design sins that these elevator buttons have committed. The first is sloppy presentation. The buttons are identical in size, shape and color. But more importantly, the icons are nearly identical. There are just 2 elements, a triangle and a line, that make up the design of the open and close icons. While a very clever reductionist approach, it presents two icons that need to be deconstructed in order to really be sure which one is open and which is close. Bottom line: they are buttons that 'make you think.'

The second sin assumes that the need for both of these buttons is self evident: an "Open" button requires, even demands a corresponding "Close". This seems so clear, so obvious, that in pointing it out to many people, they think I'm completely overreacting. However, this is the beauty of this design problem. It is the perfect example of Tufte's 1+1=3. Not only is the presentation creating clutter, but the very existence of the second button does so as well. We need to understand this cost, not because we must remove the second button, but that we must be sure the cost is worth it.

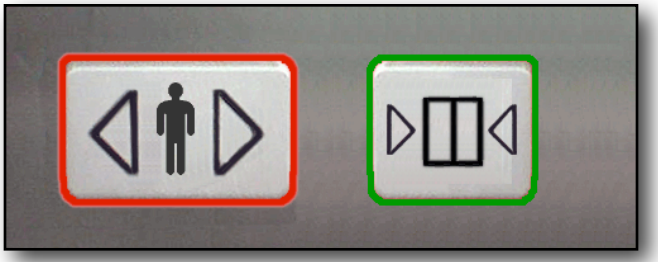
Fixing Sin 1: Reduce the clutter

In order to redesign the buttons, we must first understand their context of use. I'm simplifying a bit but the Open button is usually a spur of the moment, one shot use. It is used by novices in an infrequent act of helping others.

The Close button is much different, it is meant for people who are in a hurry. They will use this button frequently, possibly pushing it multiple times in a single trip. It is used by expert users that perhaps drink a little too much coffee.

This allows us to address the cognitive clutter problem much better. The Open button is a more panic use button. It needs to very clearly labeled, possibly even much larger than the Close button. It has to be very obvious and easy to understand. The Close button can be harder to find. This isn't a concern as it will be used repeatedly by a more seasoned user: they'll quickly get over any initial targeting problems.

Here is a potential redesign of these buttons:



There are many possibilities of course. I'm taking a fairly conservative approach. In this example, the Open button is larger in physical size and the icon conveys the situation, opening the doors to let in a person. The Close button is smaller with an icon of the closed doors. They don't have the extreme graphical simplicity of the earlier icons but they are trying to do something else: to be easier to decode in a hurry. One last touch, as a redundant encoding, the buttons have a red and green border, respectively, to further reinforce the stop/go nature of these buttons.

Now there are many quibbles you can make about these buttons: neither colors nor icons may internationalize well and this could indeed be true. The broader point is the process: 1+1=3 warns us to be wary of presentation confusion. Recognizing that these buttons were nearly identical was the first step as it framed the problem better: we had cognitive clutter. By reflecting on what is actually required, when, and by whom, we can create a choice task that is easier for the target user, creating a much calmer decision for the user to make.

Fixing Sin 2: Remove the choice altogether

The ultimate solution to reducing the clutter is to just remove the second choice completely. Instead of having two buttons, just go to a single button to open the door:

We have gone back to just "1". There is no more "1+1" with this solution. While indeed this clearly solves the cognitive clutter problem completely, it usually raises screams of protests, normally from programmers and product managers. For them, it is anathema to remove any functionality.

This is the tension that is at the core of most design problems: the ostensibly obvious value of the Close button contrasted with unseen and hard to quantify cost of its extra cognitive clutter. What is more important, the functionality of "+1" or the cost of the "=3"?

The goal here isn't to prove that the button must be removed but to point out we have a real choice here. I've presented this design problem in many talks and I always get a very strong reaction: the second button just must be there. What amazes me is how unquestioned the desire is to have this second button. Even if they admit that removing the Close button reduces the clutter significantly, it is still, in their eyes, not worth the removal of the functionality. The user just needs to 'figure it out'. I believe this is a core decision making pattern for many people as having a complete list of features is easier to understand (and defend) than the more complex task of understanding which features are actually needed and how they are used.

In this case it isn't as simple as having an Open and a Close button. The issue is to understand why this extra Close button needed. It isn't just the opposite of Open, its use is far different. Open is a fixing a problem, stopping a situation in a quick and urgent matter. The Close button is far different. It is primarily meant to hurry things along. The door will close no matter what; this button just closes it a bit faster. It really isn't a Close button at all but, in fact, is actually a "Hurry" button. This is very different indeed.

If it only closes the door 2 seconds faster, can you really argue this is feature worth dying for? In that case, it doesn't seem bad to remove it. However, what if the door really does speed up a significant amount, what then? Doesn't that just beg the question, "Why does the door stay open so long?" Isn't it the case, that by having such a nice and easy to use open button, we could actually decrease the wait time on the elevator doors a bit so there isn't even any need for the Close button?

There is no perfect solution to this problem nor should there be. The point of this essay is to show that design problems, much like Tufte's 1+1=3, can be full of presentation clutter that confuses and complicates interaction. Many people first react to this by denying the significance of the clutter. Their second reaction is that the perceived cost of removing the feature is considered a far greater risk than removing the clutter. This all stems from a lack of insight. A little exploration can often unmask the various "Close" buttons in our work as the pretentious little "Hurry" buttons that they truly are. However, even knowing that 1+1=3 effects are possible is a powerful motivator to explore problems in more detail, finding the underlying issues that are at the heart of designing an appropriate solution.