WHY DO ELEVATOR USERS PRESS CALL BUTTONS UNNECESSARILY?

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ABSTRACT

People form abstract (or "mental") models to help them predict the behaviour of complex systems. The material for these models comes from analogies drawn with other, better understood, systems and from personal observation of the behaviour of the system under consideration. The models are intended to be functional, and so long as they serve this purpose the user will cling to them, regardless of whether or not they are accurate in terms of the design of they system being modelled. At least some (and maybe most) of the unnecessary pushing of call and destination buttons by elevator users appears to be generated by the use of such models. There are indications that a deeper understanding of these models may assist the engineer to design control systems that people will abuse less readily.

1. INTRODUCTION

Psychologists have always maintained an interest, along with other Social Scientists, in how people think about the world they inhabit, and how they construct naive abstract models of its physical properties in order to predict the outcome of their actions. Some of these models are based on analogies with other systems, and are so hopelessly over-simplified that their predictions are wrong. For example people's early attempts to fly were based on analogies with bird-flight. They strapped imitation wings to their arms and either ran around flapping them, or jumped off high places becoming, respectively, very tired or dead. Although these antics make us smile nowadays, we should not lose sight of the fact that they reveal a robust inclination towards empiricism, despite (or maybe because of) the lack of any underpinning theory. Towards the other end of the scale in terms of sophistication (and correctness) we might place the navigational abilities of the Polynesian sailors. Without any instruments the most capable of these can make voyages between islands several hundreds of miles apart and be out of sight of land for three or four days. Their skills employ a most complex model which utilises as input the colour of the water, patterns in the waves and star positions. Although this model is congruent with Western scientific knowledge, and can be analysed and described within that framework, it in no way depended upon that framework for its evolution, its use nor its successful transmission from person to person. It is also worth pointing out that it took Western observers a long time to understand this system, and that the Navigators could not simply describe it, nor could they readily describe what they did, because the knowledge they had, and the procedures they followed were not readily accessible at a conscious level.

Such intuitive models can be found operating under all sorts of circumstances and (in present times) perhaps most especially in those cases in which people have to interact with electronic or mechanical machines with the aim of getting the device to do something for them. The term "Mental Model" has been adopted to refer to that assemblage of rules and properties which a User believes to describe the way in which a device works, and which thereby provides guidance for its operation. People whose business it is to design and build machines tend to expect that users will come to aquire Mental Models which are accurate reflections of how the machine works. This is a reasonable expectation if the user has expert knowledge in the same domain as the designer of the system. As increasingly sophisticated devices find their way into the domestic, educational and commercial markets, however, more and more people without such expert knowledge are becoming users and, as we shall see, developing Mental Models which may be at odds with some of the fundamental design principles of the machine. Before turning to our own data it may be illustrative to consider two well-researched examples into Mental Models in related fields.

The first example concerns the simple control system which governs a domestic central heating system. The Centre for Energy and Environmental Studies at Princeton University used automatic devices to record, over a two year period, the hourly thermostat settings (amongst many other energy variables) of 26 upper-middle class families in identical town houses (Dutt, Eichenberger and Socolow, 1979). Two very distinctive patterns of thermostat setting became apparent from which the existance of two types of Mental Model were inferred: the *feedback model* and the *valve model* (Kempton, 1986). The feedback model holds that the thermostat senses the ambient temperature and turns the boiler on and off in order to maintain that temperature at the level set on its dial. The valve model maintains that the thermostat controls the amount of heat emitted by the system; a higher setting thus causes a higher rate of flow.

In general terms, of course, the feedback theory is right and the valve theory is wrong. Yet as far as one can tell, the valve theory is widespread. One of the most obvious things that its adherents do is to turn up the thermostat setting when they feel cold, *and then turn it down again when they are warm enough.* Since their behaviour leads to the desired effect, their beliefs are not disconfirmed. Kempton describes a number of other ways in which the valve theory does quite well as a predictor of how a central heating system will react to changes.

A second example concerns the use of electronic calculators. This is of interest to us because it involves people pushing buttons in order to get a device to accomplish a series of operations. Several careful studies of calculator use have been made (for example, Mayer and Bayman, 1981; Norman, 1983; Young 1981) and some of the observations made by Norman are particularly instructive. One of his methods was to observe people using different types of calculators to solve arithmetic problems and to have them think aloud as they did so. He remarks that:

> *"although the people I observed were all reasonably experienced on the machines on which I tested them ,they seemed to have a distrust of the calculator or in their understanding of the calculator mechanics. As a result they would take extra steps or decline to take advantage of some calculator features even when they were fully aware of their existence."* (Norman, 1983; page 9).

One of the interesting behaviours he observed was that people tended to hit "clear" or "enter" buttons far more often than they needed to, explaining their actions with remarks such as:

> *"You never know, sometimes it doesn't register"*

and

> *"It doesn't hurt to hit it extra"*

or

> *"I always hit it twice when I have to enter a new phrase - it's just a superstition, but it makes me feel more comfortable."*

When people attribute their actions to superstition, Norman comments, the statement implies uncertainty as to *mechanism* but *experience* with action and outcomes. The term describes rules which work, even though they make no sense.

This was the starting point from which we began to consider the behaviour of people using elevators. We had been told that users often pressed call and destination buttons unnecessarily, and that this disrupted the proper operation of the controller and could cause excessive mechanical wear on the buttons. It seemed to us quite likely that such users have developed for themselves Mental Models of how the controller worked, based on experience with action and outcomes, and that aberrant button pushing resulted from the application of such models.

2. METHODOLOGY

As we have already noted, Mental Models take some time to evolve, although they may (at least partially) be passed on by word of mouth as part of local folk-lore. We therefore chose to study people who worked in tall office buildings and who routinely used elevators during the course of their working day, not simply as part of the process of entering and leaving their offices. They had all worked in the building for at least one year.

Extracting useful data from people in this kind of exercise is not quite as straightforward as one might imagine. Firstly there is what is termed the *demand characteristics* of the situation. If you ask a person, who is cooperating in your research, why they did something then they are quite likely to feel obliged to give you an answer even if they did not have one before you posed the question. They may also feel inclined to tell you what they think you want to know. And having generated this answer, they may then believe it themselves or, at any rate, feel compelled to act as though they believed it. Secondly people may state that they believe one thing, but act in quite a different manner. Thirdly, people *may not actually know* what they believe anyway. For these reasons it is generally useful to begin by asking people to describe what they do (rather than to explain it) and then to try to elicit the rules which generate that behaviour by posing problems - hypothetical situations in the present case - and asking for solutions in terms of procedures or actions.

3. OBSERVATIONS.

Although it seems self-evident we ought to note that the general public does not get formal instruction on how to use an elevator, nor on how elevators work. Only a restricted class of professionals understand how lift control systems work, and the majority of people who work in office blocks in the centre of Manchester do not fall into this category. It also most improbable that a user in a tower of any size could aquire a sufficiently large and accurate body of observations to enable them to infer the properties of the controller. It is all the more surprising that most of the people we have studied so far have fairly firm ideas of how the controller of their lift system works. They have generally spent some time "experimenting" with it, and have passed on to their colleagues their latest prescriptions for getting the elevator to do what they wanted it to do.

Our observations specifically excluded peak time journeys. We were concerned at this stage only with those people (messengers, filing clerks, safety and security personnel) whose work demanded that they make many trips between non-terminus floors during off-peak periods. During this time, they expect very fast, almost *personal* service:

> *"You expect it to be fast; most people are at their desks, after all"*
>
> *"What is really annoying is if you come out of the lift on files (12) and you just nip across*

the corridor- only gone less than a minute - and the bloody thing's gone off I don't know where. To the ground floor I expect. Then when finally come back ***there's nobody in it!*** *It just went off somewhere and hid. Why couldn't it stay here and wait for me?"*

This desire for personal service, coupled with the belief that, at off peak times, such service is possible seems to motivate some of the multiple call-button pushing. Although it is our metaphor not theirs, is seems as though they use the call button like a door bell. More presses indicate increasing urgency (or decreasing patience) but, furthermore, more presses are needed *in case the car is so far away that it cannot "hear" the calls too well.*

"I push the button, and if nothing seems to happen I push it again. Sometimes you have to wake it up."

"I'm sure that if the lift is a long way away it ignores you until it's come nearer for some other person. It's like, er, it only has a limited range, so you keep pressing so that when a lift is in range it can tell that you want it."

People simply do not seem to take into account other demands on the cars. During this off-peak period they believe that they are more or less the only people on the move:

"There are six lifts here - you would think that would be more than enough."

A lit call button does *not* generally signify that the controller has received the user's call, and at least partly this seems to be due to the fact that people are not at all sure of the locus of the controller (as we shall see below) but are quite sure that it is not behind the button panel alongside the lamp. Pressing the control button is what lights the lamp, but the controller is not perceived as necessarily being involved at all:

"When you press the button, the lamp lights. It shows you that the thing is working. It's no guarantee that the lift is coming, of course."

Where, we asked, is the controller?

"Who knows? I suppose it's either in the basement where all the other electrical stuff is, or it's going to be up in the roof at the top of the lift shaft. Anyways, it's a long way from here."

So what was the relationship between the lit call button and the controller?

> *"I'm not sure really. I know that when you press the button you light the light. But I don't know what else happens. I don't know what the light is for, but it tells you the lift is working."*

In the buildings where we made our observations there was no information about the current location of the cars available on intermediate floors, so:

> *"of course you have no idea whether it's heard you. That's why you keep pushing. If you had some definite information that it was responding to you personally, then you'd stop of course."*

One should not lose sight of the fact that the people using these lifts had a job to do and that they did not want to waste time waiting around for the elevator; at least in general they did not! One group of people studied often made return trips, that is to say they left their "base" flooor for a brief period to accomplish a task (often moving some paper around) and then returned to their "base" floor. These people did some quite unexpected things in order to *"keep the lift's attention"* as they put it. They spoke as though they felt that it could be very difficult to attract the attention of a lift, perhaps because it was initially rather far away, or attending to someone else, so that once one had "captured" the lift and made the outward journey from the "base" floor it was important to keep it busy so that it didn't go off and service someone else before one had a chance to make the return journey. One pair of girls routinely collected trade periodicals circulating on one floor and took them back to the information room three floors down, returning with a trolley already loaded with another batch to be distributed on the "base" floor. They performed this task twice a day. As they left the car at the end of the outward (downward, in this case) journey one girl pressed the destination button for three floors further down, while the other girl simultaneously pressed the "up" call button on the landing. This procedure had been refined over some time. They had experimented with non-simultaneous button pressing, and with pressing destination buttons for floors further away from theirs, and in both directions. The one they now routinely followed was the one which they felt minimised their wait for a car on the return journey which was made (as far as they could judge) within two minutes of arriving at the floor.

> *"What we do is simple. We send it down 3 floors and at the same time press the button to go up. The lift goes down three floors, opens the doors, realises that someone has put in a call three floors up and comes back for us."*

We found this a very interesting account. Firstly the girls spoke as though *they* had control of a particular car. They spoke as though they were sending a child on an errand, the whole purpose of which was to keep it from being distracted by competing users. Secondly their Mental Model of what was happening was held in the face of conflicting information. We enquired whether it was always the same car that came for them on the return journey, and what happens when a competing user was waiting three floors down? We were told that no, it wasn't always the same car, but that it didn't matter:

It's still worked, hasn't it?"

If a competing user got into the car three floors down, then they would simply have to come up as the car answered the girls' call; they would have priority because their button push would be first in the queue:

That's the whole point of pushing the call button and the down button together - no-one can get in before us, so it has to come back to us"

And so, we said we supposed, they sometimes found people in the car when it returned? Yes, we were told; that proves it works.

The notion of call queuing in terms of temporal priority is one on which we hope to present more information shortly, along with a more detailed elaboration of the points we have briefly made here. We are, of course, some way from establishing the generality of these Mental Models, and would only claim to have made a small advance in describing the kinds of properties which people may ascribe to lift systems. Nevertheless if becomes possible to make generalisable statements about these Models, then it should be possible to use this knowledge profitably in controller design.

4. REFERENCES

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