
Intuitive Interaction Applied to Interface Design

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Abstract: Intuitive interaction involves utilising knowledge gained through other products or experience(s). Therefore, products that people use intuitively are those with features they have encountered before. This position has been supported by experimental studies. The findings suggest that relevant past experience is transferable between products, and probably also between contexts, and performance is affected by a person’s level of familiarity with similar technologies. Appearance (shape, size and labelling of features) seems to be the variable that most affects time on task and intuitive uses. Using familiar labels and icons and possibly positions for buttons helps people to use a product quickly and intuitively the first time they encounter it. Three principles have been developed to help designers develop interfaces which are intuitive to use.

Principle one; use familiar symbols and/or words for well-known functions, put them in a familiar or expected position and make the function comparable with similar functions users have seen before. Principles one involves utilizing existing features, labels or icons that users have seen before in similar products that perform the same function. This is the simplest level of applying intuitive use. Principle two; make it obvious what less well-known functions will do by using familiar things as metaphors to demonstrate their function. Principle two requires the use of metaphor to make something completely new familiar by relating it to something already existing. Principle three; increase consistency so that function, location and appearance of features are consistent between different parts of the design and throughout each part. Principle three allows users to apply the same knowledge and metaphors across all parts of the interface.

The implications and application of these principles are discussed in the context of the design of function, location and appearance of product and interface features. Applying these principles will allow designers to draw on users past experience in order to develop products which facilitate intuitive interaction and ready acceptance of new technologies.

Key words: Intuitive interaction, Interface design, Human factors
1.0 Introduction

Intuition is a type of cognitive processing that is often unconscious and utilises stored experiential knowledge. Intuitive interaction involves utilising knowledge gained through other products or experience(s). Therefore, products that people use intuitively are those with features they have encountered before. The research reported here has been conducted over the past five years to address the questions of how intuitive use works and how designers can apply it to new devices to make things easier to use. The research has been reported in detail by these authors previously [1-4] but a brief review is provided here before the implications of the results are discussed.

1.1 Experiments

Experiment 1 was designed to test the hypothesis that intuitive interaction involves utilising knowledge gained through other products or experience(s). Twenty participants in four groups (expert, intermediate, novice and naive with digital cameras) were video-recorded while using a digital camera whilst delivering concurrent protocol. Afterwards, participants were asked to rate how familiar each feature of the camera was to them and they completed a Technology Familiarity questionnaire. Participants indicated how often they used common consumer electronics products, and how much of the functionality of those products they used. Products in this questionnaire employed similar features to the camera used in the study. The questionnaire was used to calculate each participant’s Technology Familiarity score. The results suggested that prior exposure to products employing similar features helped participants to complete the tasks more quickly and intuitively, and familiar features were intuitively used more often than unfamiliar ones [2]. The camera borrowed features from other digital products, so expert users of digital cameras who had low Technology Familiarity completed the tasks more slowly and effortfully than novices with digital cameras who had higher Technology Familiarity.

Experiment 2 was a larger study with thirty participants using a touch screen universal remote control to further test the hypothesis. Since Technology Familiarity was seen in Experiment 1 as more indicative of performance than level of expertise, participants were sorted into three groups (low, medium and high Technology Familiarity). This was determined by the Technology Familiarity questionnaire which was adapted to include products similar to the remote rather than the camera. This study supported the previous findings. Participants who had a higher level of Technology Familiarity were able to use significantly more of the features intuitively first time and were significantly quicker at doing the tasks. Those with a lower Technology Familiarity score required more assistance, and more familiar features were intuitively used more often [1].

A re-design exercise was undertaken which involved producing new interfaces for parts of the remote control according to these principles for intuitive use which had been developed from the experiments [1]:

1. Use familiar symbols and/or words for well-known functions
2. Make it obvious what less well-known functions do by using familiar things to demonstrate their function.
3. Increase the consistency between screens and features.
Eighteen postgraduate industrial designers were asked to re-design the remote control interface according to the principles. The researchers developed a brief specifying the icons to be used for particular features. The icons were developed from international standards where existing [5, 6], as it was assumed that standardised icons would be frequently applied to similar interfaces and therefore be most familiar to users. Where standards did not exist similar products such as software and other remote controls were investigated to see which icons/designs should be most familiar to users.

Experiment 3 was designed to test four different interface designs on the remote control in order to establish which variable assisted in making a design more intuitive to use; location or appearance of the features. The four designs tested are shown in Table 1.

Table 1. Designs tested in experiment three

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>default design (used in experiment three)</td>
</tr>
<tr>
<td>Location</td>
<td>new location for features, default appearance</td>
</tr>
<tr>
<td>Appearance</td>
<td>new appearance for features, default location</td>
</tr>
<tr>
<td>Location-Appearance</td>
<td>new appearance and location (full re-design)</td>
</tr>
</tbody>
</table>

For this experiment, 60 participants were divided into four equal groups according to age and experimental condition. Individual differences were controlled by selecting a cross section of the community in terms of Technology Familiarity, level of education and gender for each group. The Technology Familiarity questionnaire developed for Experiment 2 was used to calculate the technology familiarity.

Concurring with the previous experiments, findings of Experiment 3 suggested that performance is affected by a person’s level of familiarity with similar technologies. Appearance (shape, size and labelling of buttons) seems to be the variable that most affects time on task and intuitive uses [4], with a combination of new appearance and location being only slightly quicker and more intuitive to use than new appearance alone, and both way ahead of the default and location designs. There was a significant difference in time between age groups, indicating that age is a predictor of the time it will take to do the tasks. Younger people, in all configurations and at all levels of technology familiarity, completed the tasks more quickly than older ones. There was also a significant difference in intuitive uses with the oldest age group (40+) achieving significantly less intuitive uses than younger ones, so younger people also used the product more intuitively.

2.0 Discussion

The results have been reported in detail by these authors previously [1-4]. Here, the implications of the results are discussed, bringing together and addressing issues to do with applying these principles to the design of artefacts, devices and systems.
2.1 Intuitive use and prior knowledge

All the experiments showed that familiarity with a feature will allow a person to use it more quickly and intuitively. However, some theories that have implications for this need to be addressed.

People employ categories all the time in basic thought, speech, action and perception. Lakoff [7] claims people could not function physically, socially or intellectually without the ability to categorise. Connectionists see the brain as consisting of networks of relatively simple processing units connected by links. Knowledge representation is based on interactions between networks, and if one unit or node is activated, the activation can spread to related items in memory that are linked through the network. Links are made by using and applying knowledge and linking it to other things. Applying connectionist theory, it can be supposed that if more links to a concept exist that concept can pass more easily over category boundaries. Spreading activation could help to overcome the limitations of categorisation by allowing people to make links between categories. Therefore, the more well known or familiar something is the more easily or quickly it should be recognised, understood or used.

It was obvious when observing less experienced users that they were not building a mental model of the product; the more time they spent the more confused they seemed to get and they seemed unable to learn the structure of the device through using it, as more experienced users did. Therefore, applying or trying to find a mental model that will suit all or even most users does not seem to be a suitable approach. Is there any reliable way to predict what the mental model might be and how to trigger it? Okoye [8] claims to have done this but is not completely convincing. Mental models are so nebulous and hard to define and it is very difficult to assess if a person or group of people share a whole model or not, which would make it difficult to successfully apply them to systems or product design. Indeed, some psychologists have suggested that mental models are a descriptive tool and not suitable to apply to design [9]. From the results obtained in this research, it can be suggested that although mental models may have some part to play in intuitive use in some cases, trying to apply them to interface design is too complex. Intuitive interaction can be designed in using features without having to try and apply one specific mental model to a device.

2.2 Innovation

Some people have been concerned that always using familiar features would lead to a loss of innovation in interface design [10] [11]. The present authors disagree as there are innovative ways in which users’ current knowledge can be applied or transferred. Applying existing icons does not mean that a new product cannot be revolutionary. It may perform functions never before thought of but in order to make the functions easy to understand it would be preferable to apply some familiar feature(s) or metaphors that users can latch onto. Features or icons do not make a whole product; the way it looks, feels and/or functions can still be innovative. Outside of the software realm there are many new devices appearing, many of which are borrowing features and functions from other things (often software). Transferring features from other products and experiences (which is often necessary with a new product type) can allow both innovative and intuitive interfaces.
2.3 Intuitive Use and Location/Appearance

Experiment 3 showed that intuitive use is enabled more by the appearance than the location of features. This has implications for the design of interfaces as it seems more important to concentrate on getting the appearance right than the location. Appearance is also more multi-faceted - comprising shape, size, colour and labelling, whereas location comprises only location within local components and (for complex products) within global systems. Also, appearance was in most cases based on standards and many other AV products use similar icons. Location, on the other hand, has not been standardised, and is different on remote controls than on the products themselves. Using many products with features of similar appearance gave users more familiarity with the appearance than the location where each product may differ. This is the case with many product types, so appearance will likely remain the most important factor in intuitive interaction. Location should not be neglected altogether as there was some qualitative evidence (through observation) that the correct location could help to decrease search times for individual features. Appearance had more effect as it helped to prevent confusion and saved time in searching for the right feature. However, once a person knows what they are looking for, putting that feature in a familiar location has been shown to decrease response times [12].

2.4 Intuitive Use and Age

Well known factors of aging such as speed of reaction times and cognitive processing could be responsible for the slower times of older people. However, it does seem that a relationship also exists between age and intuitive uses. Therefore it would seem likely that there are other factors as well as symptoms of aging playing a part. There does seem to be some difference in the way that people of different ages can utilise their prior experience to intuitively use a new product. This could come about because an older person who may be familiar with the same technology as a younger one and have the same TF score has learned about that technology at a later stage in their life and therefore it has been harder to learn, or they have known about it for proportionally less time.

Weiss says that “teenagers are likely to pick up new technology quickly…Older people are also less adaptable to new interaction mechanisms” [13, p74]. He does not explain why but one possible explanation is that children and teenagers are at the right age to learn new things and their brains are more receptive to laying down this information. An older adult may still have their mental models based around the interaction techniques they learned in their youth, which are now obsolete, and it is known that older people need to make more effort in order to learn new things. This issue needs further work to determine the exact cause.

3.0 Recommendations

The following principles were extended from those used as part of the re-design process. They can be recommended as guidelines to help designers make an interface which is intuitive to use.

Use familiar symbols and/or words for well-known functions, put them in a familiar or expected position and make the function comparable with similar functions users have seen before. Principle 1 involves inserting
existing features or labels or icons that users have seen before in similar products that perform the SAME function. This is the simplest level of applying intuitive use. For example, the play and related functions for the re-designed remote control (Figure 4) were simply familiar icons designed for a new interface.

Make it obvious what less well-known functions will do by using familiar things as metaphors to demonstrate their function. Again use familiar symbols and/or words and location. Principle 2 requires the use of metaphor to make something completely new familiar by relating it to something already existing. The desktop metaphor is a good example of this sort of metaphor successfully applied.

Increase the consistency between devices and features so that function, location and appearance of features are consistent between different parts of the design and on every page/screen/part/mode. Keeping internal consistency allows users to apply the same knowledge and metaphors to all parts of the interface [14]. Principle 3 is demonstrated by the power symbols applied to the remote control interface. In the default design the power icon was different in function, location and appearance for each device; on the full re-design (location and appearance) it was consistent (Figures 1-4).

3.1 Applying familiarity

The principles stated above can be used as guidelines to help designers make an interface intuitive, especially those which are innovative in some way and so have no established interaction style. However, "...making design decisions about familiarity is not always simple." [15, p121]. Familiar terms can have multiple meanings, and familiarity to one user is not familiarity to others. Many designers believe icons have more universal
familiarity as users live in the same visual world, but even then items can look different. For example, mailbox
icons commonly used for email are based on US rural mailbox designs which are not seen in Europe. Designers
need to understand who users are and what they know. They need to identify the target market for each product
and get information about what users will be familiar with. Spool [16] recommends designers use field studies to
develop expertise about the things that various groups of users understand and can use in their normal
environments. Another possible approach would be a detailed survey instrument of the type employed by Smith
[17]. It takes some careful research to make sure the familiar features chosen are going to be familiar for all the
users, and a localisation process may also be necessary for products released internationally.

Weiss [13] recommends that designers should only retain terminology and processes from PC applications and
use them for smaller devices when they are equally appropriate for the smaller screen. Familiar features should
not be indiscriminately applied when they are not suitable for a new platform or hardware. In this case designers
may need to draw on a metaphor from a more suitable domain (applying principle two rather than principle one).
For example, for small mobile devices such as Weiss discusses, it may be appropriate to draw features from other
small devices such as phones, remote controls and personal stereos rather than PCs.

3.2 Managing Change

As well as fitting users’ existing stereotypes and expectations, designers may have to think about whether these
should/will change and if so how these changes should be brought about [18]. However, it needs to be well
managed otherwise users could be stuck with clunky and out of date metaphors for years to come, or could have
new and unfamiliar things foisted upon them too quickly. Instead of continuing to apply familiar features ad
infinitum to new technologies that are less and less relevant to the original metaphors, designers may need to
help users to understand new features through more appropriate icons and metaphors. For example, the desktop
metaphor was very successful in getting desk workers onto GUIs but is less applicable to younger computer
users who have never used a desk without a computer. Even the play icon and fast forward and rewind icons,
which demonstrate directionality in the way a medium moves, are less applicable to new and developing media.
Technology may evolve that makes them problematic because of the directionality they show. It is possible to
gradually develop people’s understanding through incremental changes and the use of metaphor to explain the
unfamiliar (principle two).

These ideas have been explored through design to show intuitive evolution of icons (Table 2). This work has
been produced to demonstrate how some of the common interface commands used in the products investigated
by the present authors [1, 2, 4] can be evolved to allow for more suitable metaphors. This has been done in
several steps to allow familiarity at each incarnation.

The feature menu is shown with both alphanumeric and alternative pictorial development, leading from the
familiar word, through incarnations including the word and finally to a simple letter or icon based on the
previous designs. OK/enter/confirm could progress using the familiar enter symbol or tick, the tick particularly
lending itself to use with stylus and gesture based devices. Back/cancel can be simplified to the familiar arrow of
the internet browser first with and then without the label. Playback on a digital camera, based currently on the
directionality of obsolete media, may make more sense in the future without the directional arrow. Finally,
picture mode on digital cameras is currently still based on the shape of cameras from fifty years ago. The new
icon is similar and familiar enough to allow easy transfer and it looks more like a digital camera than a Brownie.

Table 2. Intuitive evolution of icon designs

<table>
<thead>
<tr>
<th>Feature</th>
<th>Current</th>
<th>1st Evolution</th>
<th>2nd Evolution</th>
<th>3rd Evolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menu</td>
<td>MENU</td>
<td>MENU</td>
<td>MENU</td>
<td>M</td>
</tr>
<tr>
<td>OK/Confirm/Enter</td>
<td>OK CONFIRM ENTER</td>
<td>OK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back/Cancel/Delete</td>
<td>BACK CANCEL DELETE</td>
<td>BACK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review/Playback</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picture mode</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This work demonstrates that change can be managed by allowing users to apply some knowledge they already
have to each new feature, while all the time progressing towards a new design or metaphor for that feature.
Although location has less effect on intuitive use and speed than appearance, where it is necessary to change the
appearance of an icon, keeping the location consistent with previous or familiar interfaces may allow users to
easily adapt to a new icon. Managing change in this way should help to retain intuitiveness of an interface while
simultaneously moving users towards a better or more appropriate icon or metaphor.

4.0 Conclusions

Intuitive use is based on past experience and can be transferred between different products or systems. Designers can apply intuitive use to products by employing features that are familiar to the target users. This is particularly relevant to new products which do not yet have established conventions of their own. The best way apply intuitive use to a product is by using familiar features as much as possible, applying familiar metaphors to things that are completely unfamiliar and keeping products internally consistent.

Appearance of a feature is more important for intuitive use than its location. This suggests that the cues that people store in memory about a product feature depend on how the feature looks rather than where on the product it is placed. Location of features was shown to be much less important than appearance although qualitative data and traditional stimulus response work [19] would suggest that location should make some difference to the speed of sub tasks. Eye tracking studies may reveal more about intuitive search behaviour of users.

Older people take longer to complete tasks and are less likely to use features intuitively first time. There may be several reasons for this and more research is needed to establish which is the most likely. It would be interesting to see how this relationship between age and intuitive use can be explained and what designers can do to help older people (the largest consumer group in Western markets for a good few years to come) to use things more intuitively.

Detailed methods to establish which features are familiar to particular user groups need to be developed so that these principles can be applied successfully to all types of products for many groups of users. However, there is now in place a set of principles that designers can work from in order to make interfaces intuitive to use, which will allow easier and simpler transitions to new products and product types.

References


