Intuitive Use of Products

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Abstract

The term “intuitive use” has been widely used with respect to various products and systems but has not yet been adequately defined. Through an extensive literature review, it was concluded that intuition is a cognitive process that utilises knowledge gained through prior experience. Intuitive use of products involves utilising knowledge gained through other products or experience(s). Therefore, products that people use intuitively should be those with features they have encountered before. A set of experiments with a digital camera was conducted to test the thesis. The results of these experiments support the thesis. It was found that prior knowledge of features or functions of the camera allowed participants to use those features intuitively, whereas unfamiliar features or functions had to be figured out, which was more time consuming and effortful.

Keywords
human factors, industrial design, interaction design, interface design, intuitive use, usability

Introduction

This study aims to explore the possible meanings and applications of “intuitive use,” what it is, how and why it happens, and how design can facilitate it. Very little work has been done in this area, and there is still limited published information on cognitive aspects of product use (Stanton and Baber 1996). However, intuitive use of products has been mentioned (although not fully addressed) by a variety of authors in diverse literature.

For example, Rutter, Becka and Jenkins (1997) conducted a case study on the design of an ergonomic chair. The design team wrote into the brief that the adjustment of the settings should be “intuitive in terms of the logic of their operation” (p29), but no research into or definition of intuitive is cited. Frank and Cushcieri (1997) wrote a case study about the design of an “intuitive” mechanical surgical grasper for keyhole surgery, where movement of the fingers was replicated by the movement of the grasper jaws. No reference is made to how they knew this was intuitive. Thomas and van Leeuwen (1999) wrote a case study describing the design of two mobile phones. One objective was for it to be intuitive to make a simple phone call. Therefore the concepts developed supported conventional dialling behaviour and allowed users to apply their existing experience, although again the authors do not define what they mean by intuitive, or how they applied intuitive usability to these products. Okoye (1998) conducted a study on intuitive graphical user interfaces. She does not detail in her thesis what intuition or intuitive use is.

The Principles of Universal Design were developed at the North Carolina State University Centre for Universal Design. Principle Three is Simple and Intuitive Use. One of the authors
of the Principles said that “we have not done any deep research in this area” and “the concept (of intuitive use) makes so much sense to me I never questioned it” (Story 2000, personal communication).

The concept of intuitive use is also mentioned extensively in product reviews and marketing literature, but it is not defined. While one can assume that intuitive use implies use without instruction, what is not clear from the existing literature is why and how this can occur. This paper addresses what intuitive use might entail and details an exploratory experiment conducted to investigate whether people can use products intuitively, what enables that process to take place and how designers could facilitate it.

**Background**

Products are often difficult to use correctly and are frequently misused for a variety of reasons. This situation could be alleviated by making products more intuitive to use. There are at least two aspects of this issue; overimputation and the division of control.

**Overimputation**

Difficulties can arise from the natural human habit of imputing one’s own knowledge to others (Nickerson 1999). Surprisingly, this is generally an effective way of ascertaining another person’s knowledge. However, when a person knows something very well and/or over a long period, it is difficult for them to put themselves in the position of a person who has none of that knowledge. Nickerson calls this problem overimputation. Designers can overimpute their specialist knowledge onto users (Norman 1988; Tognazzini 1989; Nickerson 1999). There could be two reasons for this:

The false consensus effect - “the tendency to see oneself as more representative of others (in various ways) than one really is” (Nickerson 1999, p749).

The illusion of simplicity, “whereby one mistakenly judges something to be simple only because it is familiar” (Nickerson 1999, p750).

**Division of Control**

Further to the Industrial Revolution and consequent division of labour, which separated designers from users to a large extent, the technological revolution has forced a division which may be called the division of control. The user no longer has direct manipulation of or direct feedback from the controls of many everyday products. This is all done through a digital electronic interface. The terms opaque (Fischer 1991), lack of visibility (Norman 1988, 1993) and invisibility (Sade 1999) have all been used to describe a system that does not allow its function to be perceived from its structure.

In many electronic products, there is almost no physical and spatial relationship between the controls, the indicators and the state of the system. Norman (1993) divides artefacts into two broad categories according to their visibility; surface and internal artefacts. With surface artefacts, what the user sees is all there is, but with internal artefacts, information is represented internally and invisible to the user. Internal artefacts need interfaces to transform
the information hidden within their internal representations into surface forms. Therefore users are dependant on the design of the device to make the information visible and usable.

**Intuition Research**

Although “intuition … is a universal experience” (Bastick 1982), research on intuition in psychology and cognitive science is incomplete, and there is no general agreement on a definition of intuition or how the process works (Bastick 1982; Fischbein 1987; Laughlin 1997). Good overviews of the history of the concept and its intermittent study over the centuries are provided by Boucouvalas (1997), Bastick (1982) and Fischbein (1987). Several researchers agree that intuition is a process by which understanding or knowledge is reached without evidence of a reasoning process (Noddings and Shore 1984; Fischbein 1987; Bastick 1982). The dictionary definition also runs along these lines (Simpson and Weiner 1989).

It has been argued that the reasoning process is not in evidence when intuition is used as the cognitive processing takes place outside the conscious mind so that the steps in processing are not known (Agor 1986; Bastick 1982). Many researchers agree that the understanding or knowledge is retrieved or assimilated from memory during the non-conscious processing. This suggests that intuition relies on experiential knowledge (King and Clark 2002; Noddings and Shore 1984; Bowers et al. 1990; Dreyfus, Dreyfus, and Athanasiou 1986; Agor 1986; Bastick 1982; Fischbein 1987). The intuitive process integrates the information that one already has with what is perceived by the senses, and new associations between this information produce insights, answers, recognition or judgements (Bastick 1982).

Rasmussen (1993) developed the SRK (skill, rule, knowledge) model of task performance. According to this model, people operate on one of the levels (skill, rule or knowledge), depending on the nature of the task and their degree of experience with the situation. Extremely experienced people will process at the skill-based level. This is non-conscious, automatic processing. Those familiar with tasks but lacking extensive experience process at the rule-based level. The cues in the environment trigger rules accumulated from past experience, and previous successful solutions or decisions (Schunn, Reder, Nhouyvanisvong, Richards and Stroffolino 1997; Rasmussen 1993; Wickens, Gordon and Liu 1998). When the situation is novel, people will operate at the knowledge-based level, which is analytical processing using conceptual information. In a real world context, a person might operate at the knowledge, rule or skill-based level and will switch between them depending on task familiarity.

The SRK model was expanded into an information-processing model by Wickens et al. (1998). Here they equate rule-based with intuitive processing. During intuitive or rule-based processing a person must consider a variety of cues, which trigger retrieval of appropriate rules from memory (Wickens et al. 1998). Therefore, people can only use intuitive processing if they have had previous experience to draw on.

The dependence of intuition on previous experience is generally not recognized, and many people assume intuition is instinctive or innate. However, an individual’s experience gradually accrues over time. A baby’s intuition is composed predominantly of instinctive responses to stimuli but adults include more learned responses in their intuition as they develop (Bastick 1982).
If, as Nardi (1996) claims, “all human experience is shaped by the tools and sign systems we use” (p10), the extent to which something is intuitive to use should be shaped by products people already use. It is possible for a novel stimulus, ie one not previously experienced in a specific context, to be highly associated with a group of recognised stimuli. It might be intuitively recognized as one of the group because of its many associations with the group (Bastick 1982). Therefore, a stimulus would not need to be identical to those previously experienced, just similar enough to allow the association.

So, intuition is a type of cognitive processing that is often unconscious and utilises stored experiential knowledge.

Factors of Intuitive Use

Intuitive use of a product or even a product feature is multi-faceted. Through initial observation of people using electronic products, it became apparent that there would seem to be at least three factors of intuitive use for each feature on a product.

- Location of the feature on the product.
- Appearance of the feature (eg structure, shape, colour, labelling).
- Function of the feature, how it works.

Therefore, each factor of each feature would need to be considered when investigating how people can use products intuitively.

Experimental Approach

A set of experiments was designed to test the thesis that intuitive use of products is based on previous experience with products or systems that have similar features to those on the product. Relatively few experiments have been done specifically mentioning intuition (Bastick, 1982), so there was no established procedure for measuring it. Based on the understanding of intuition explained above, intuition was operationalised as relevant past experience. The experiment objectives were to establish if relevant past experience of product features increased the speed and/or ease with which people could use those features, and to establish if interface knowledge was transferred from known products to new ones.

Participants

Queensland University of Technology staff were asked if they could volunteer to take part in the study. Levels of expertise (the independent variable) were classified as expert, intermediate, novice and naïve with digital cameras. This is a generally accepted definition of participants commonly used in usability research. The participants were chosen to represent the range of levels of expertise, and a realistic distribution of gender and age groups. Five people per group (a total number of twenty) were needed for this experiment. None of the participants had encountered the camera used in the tests before the experiment began, and all participants were volunteers who received no payment in return for their participation.
**Procedure**

Participants were first welcomed to the room and all the equipment to be used was explained clearly. Intuition has been shown to be vulnerable to anxiety. Thus a calm and “permissive” environment should be provided for experiments concerned with intuition (Bastick 1982). Participants were encouraged not to worry about the experiment or their performance, and were reminded that the product was being tested, not themselves.

The participants were asked to complete two operations, each of which consisted of a number of tasks, and which between them involved use of most of the functions and features of the camera:

1. Use the camera to take a photograph in autofocus mode using the zoom function.
2. Find the picture you took. Erase your picture. Search through the other images stored in the camera to find (a specified image). Zoom in on the image so that the details become larger.

Two digital video cameras were used to record the activity. As per Vermeeren (1999), one was trained on the participants’ hands as they operated the Fuji camera, and the other recorded the whole scene. However, observation alone would not provide enough data to draw meaningful conclusions. In order to get the sort of data observation cannot provide – for example, information about the cognitive processing behind participants’ actions, a verbal protocol was used. ‘Think aloud,’ or concurrent verbal protocol, being concurrent with the actions, is commonly used in usability testing and other types of research and eliminates many of the problems involved with people forgetting details when using retrospective protocol (Ericsson and Simon 1984).

The manual for the camera was only available on request and participants were asked to try to work out the operations for themselves. Reference to the manual would mask use of relevant past experience. The experimenter answered questions and reminded participants to think aloud but otherwise did not intervene during the operations.

Immediately after the completion of the operations, a technology familiarity questionnaire was completed and a structured interview conducted. As part of the interview, participants were asked if they had been anxious during the test, either because of the presence of the experimenter, the video cameras and other equipment, or for any other reasons. None of the participants reported that they were especially anxious, so it can be assumed that intuition was not inhibited by anxiety during any of the tests.

**Apparatus and Measures**

The Fuji 4700 zoom digital camera (Figures 1 and 2) was chosen for use in this experiment. This particular product was chosen as it has a mix of features, some of which are unique to this model and others of which should be familiar to some users as they have been employed in other cameras, other digital cameras, and other products.
The variables measured through this experiment and the methods and tools used are shown in Table 1.

Table 1. Variables, Methods and Measurement Tools

<table>
<thead>
<tr>
<th>Dependant Variables</th>
<th>Methods and Measurement Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to complete all operations, and smaller tasks or components of tasks</td>
<td>Observation using Observer Video Pro software</td>
</tr>
<tr>
<td>Correct, inappropriate and incorrect uses of camera features</td>
<td>Observation using Observer Video Pro software</td>
</tr>
<tr>
<td>Conscious reasoning apparent during each use</td>
<td>Observation using Observer Video Pro software Concurrent protocol</td>
</tr>
<tr>
<td>Percentage of first or only uses of features per participant that were intuitive</td>
<td>Observation using Observer Video Pro software Concurrent protocol</td>
</tr>
<tr>
<td>Percentage of uses of each feature that were intuitive</td>
<td>Observation using Observer Video Pro software Concurrent protocol</td>
</tr>
<tr>
<td>Participants’ level of technological familiarity</td>
<td>Technology familiarity questionnaire</td>
</tr>
<tr>
<td>Familiarity of each feature</td>
<td>Structured follow up interview</td>
</tr>
<tr>
<td>Intuitiveness of each factor of each feature, based on user expectations</td>
<td>Structured follow up interview</td>
</tr>
</tbody>
</table>

The technology familiarity questionnaire and the interview were designed to establish whether or not relevant past experience is transferable between contexts. The technology familiarity questionnaire was designed for this study to reveal information about the participants’ behaviour with digital products other than digital cameras. Therefore, they were asked about whether and how often they used certain products, and how much of the functionality of those products they used. The products mentioned in the technology familiarity questionnaire were chosen as they were examples of common consumer electronic products that employed...
similar features and devices to the camera used in the study. The technology familiarity
questionnaire was used to calculate the technology familiarity score for each participant. A
higher level of exposure to and depth of knowledge of the various products in the
questionnaire produced a higher technology familiarity (TF) score.

During the interview, participants were asked to rate how familiar each feature was, from
other products they had used or from any other situations. Participants were also asked to
assess how the location, function and appearance of each feature they used on the camera
conformed to their expectations. Intuition has been equated with users’ expectations as
expectations are associated with remembered situations (Dreyfus et al. 1986), and adhering to
users’ expectations is acknowledged as desirable for ease of use and consistency (Nielsen
1989). This exercise was designed to reveal how each of the three factors of the features
compared with each other in terms of their intuitiveness, based on users’ expectations from
their past experience.

The audio-visual data obtained on the video and through the verbal protocol were coded with
the Observer software according to:

- the feature used (one entry per use of any feature)
- whether each use was correct, correct for the feature but inappropriate for the task or
  incorrect
- how much conscious reasoning seemed to be involved in each use
- time on each task
- time consulting the manual.

Since intuitive processing does not involve conscious reasoning or analysis (Noddings and
Shore 1984; Fischbein 1987; Agor 1986; Bastick 1982), the less reasoning was evident for
each use, the more likely it was that intuition was being utilised. Conscious reasoning coding
ranged from intuitive (fast decision with no evident reasoning), through quick comment
(ENOugh reasoning to verbalise a couple of words) and trial and error (random playing with
buttons or exploratory behaviour), to with working (thorough reasoning evident) and finally
using manual (relevant past experience masked). These data have been used to generate many
of the results in the next section.

Intuition is defined by some writers as necessarily correct (some researchers have even
operationaLised intuition as a correct answer), whereas most say it is only a useful guide that
rarely misleads (Bastick 1982). Bastick believes that intuition is always considered to be
subjectively correct but where there is an accepted answer for comparison (as in this case),
intuition may not always completely agree. Therefore, during the coding of feature uses, a few
incorrect uses were coded as intuitive. For example, several people tried to use the shutter as a
confirm or OK button and although this was incorrect it was affirmed during the interview
that they had felt that was the right thing to do as it was a confirm button for taking an image.

When calculating the statistics relating to the percentages of intuitive uses and intuitive first
uses, only correct or correct but inappropriate uses were counted, as incorrect intuitive uses do
not contribute to the successful use of the product. Correct but inappropriate uses are relevant
as this experiment was focusing on the features of the camera and these uses were correct
uses of those features.
Results

The data presented here were obtained from the variables detailed in table 1. Table 2 shows the means and standard deviations for the variables time to complete operations and technology familiarity score, for each level of expertise and overall. It can be seen that there are no significant differences between the mean times and technology familiarity scores for each group.

Table 2. Means and standard deviations for time and technology familiarity score

<table>
<thead>
<tr>
<th>Variable</th>
<th>Expert</th>
<th>Intermediate</th>
<th>Novice</th>
<th>Naïve</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>TF score</td>
<td>43.4</td>
<td>7.5</td>
<td>50.2</td>
<td>6.6</td>
<td>43.2</td>
</tr>
<tr>
<td>Time (secs)</td>
<td>573</td>
<td>564.6</td>
<td>657</td>
<td>216.9</td>
<td>581</td>
</tr>
<tr>
<td></td>
<td>1031</td>
<td>638.9</td>
<td>1031</td>
<td>638.9</td>
<td>710.5</td>
</tr>
</tbody>
</table>

Figure 3 presents the relationship between time to complete the operations and the technology familiarity score, and shows the strong negative correlation between these two variables, \( r(18) = -0.69, p < 0.01 \) (NB all correlations are Pearson’s product moment correlation coefficient). The level of expertise of each participant is also shown.

Figure 3. Time plotted against technology familiarity score

Figure 4 presents a scatter plot of each participant’s time to complete the operations as a function of their level of expertise. It suggests that no strong relationship exists between time and level of expertise. No significant correlation existed between these two variables, \( r(18) = -0.1, p > 0.05 \).
Table 3 shows the percentages of correct, correct but inappropriate and incorrect uses for each level of reasoning. It can be seen that the majority of intuitive, quick comment and with working uses were correct, while the majority of trial and error uses were incorrect. It must be remembered that these numbers represent all feature uses including re-uses.

Table 3. Level of reasoning and level of correctness for all feature uses.

<table>
<thead>
<tr>
<th></th>
<th>Intuitive</th>
<th>Quick comment</th>
<th>Trial &amp; error</th>
<th>With working</th>
<th>Using manual</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>64.5%</td>
<td>62.5%</td>
<td>9.6%</td>
<td>79%</td>
<td>46.2%</td>
<td>46%</td>
</tr>
<tr>
<td>Inappropriate</td>
<td>31%</td>
<td>12.9%</td>
<td>7.9%</td>
<td>5.3%</td>
<td>23%</td>
<td>19.3%</td>
</tr>
<tr>
<td>Incorrect</td>
<td>4.5%</td>
<td>24.6%</td>
<td>82.5%</td>
<td>15.7%</td>
<td>30.8%</td>
<td>34.7%</td>
</tr>
</tbody>
</table>

The total percentage of correct and correct but inappropriate intuitive uses of the features was compared with the familiarity of the features. It was found that the mean familiarity of the features correlated strongly and positively with the mean of the percentage of intuitive uses of the features, $r(18) = 0.523$, $p<0.05$. This is shown in figure 5.

So, features that were more familiar were intuitively used more often. For example, the power button showed a high level of familiarity and a high percentage of intuitive uses. The navigate function of the menu also showed a high percentage of intuitive uses and a high level of familiarity. The DISP function, which controls the displays on the LCD screen, showed a very low level of familiarity and a correspondingly low percentage of intuitive uses. Only experts who had used similar digital cameras picked up this function easily.
There was a strong positive correlation between the percentage of first or only feature uses that were intuitive and the technology familiarity score, $r(18) = 0.643$, $p<0.01$. And a strong negative correlation between the percentage of first or only uses that were intuitive, and the time on the tasks, $r(18) = -0.465$, $p<0.05$. Therefore, participants who had a higher level of technology familiarity were able to use more of the features intuitively first time and were quicker at doing the tasks. This trend can be clearly seen in figure 6.
Intuitive use is based on relevant past experience, and people use their existing knowledge when they are confronted with new systems or products (Kellogg 1989). During the interview, participants were asked to indicate their level of agreement with two statements. Statement 1 was “I use my knowledge of products that I am familiar with to guide me in using a new product of the same type.” 65% agreed strongly with this statement and 35% agreed. Statement 2 was “I use my knowledge of products that I am familiar with to guide me in using a new product of a different type.” 55% agreed strongly with this statement, 35% agreed, and 10% disagreed. The level of agreement with statement two was compared with the time each participant took to complete the operations. A strong positive correlation exists, $r(18) = 0.567$, $p<0.01$. A less strong correlation exists for the relationship of time to complete operations and level of agreement with statement one, $r(18) = 0.533$, $p<0.05$. Figure 7 shows these relationships, and demonstrates that those who agreed less strongly with the statements took more time to complete the tasks.

![Figure 7. Time plotted against responses to statements 1 and 2](image)

When asked about the intuitiveness (based on expectations) of the three factors of each feature, some participants rated one factor of a feature at one end of the scale and another factor of the same feature at the other end. Ratings ranged from 1 (low, unexpected factor) to 6 (high, very familiar and expected factor) For example, the camera icon had high means of 4.00 for function and 4.20 for appearance but a lower mean of 2.95 for location. This icon is located in an ambiguous position so it could be a label for one of two or three different buttons on the interface. The power button had a high mean of 5.15 for function, but lower means of 4.10 for appearance and 3.10 for location. The power button is located inside the mode switch, and is not colour coded or very clearly labelled, which made it difficult for many participants to find, although all knew they had to find a power button or switch of some kind as the first step.
Discussion

From these results, it can be suggested that prior exposure to products employing similar features helped participants to complete the operations more quickly and intuitively. The Fuji camera borrows, or transfers, features from other digital products, so even expert users of digital cameras who had limited experience with other digital products completed the tasks more slowly and effortfully than novices with digital cameras who did have experience with the features employed in the camera from using other products. This is shown in the strong negative correlation between time and TF score.

The fact that there is no correlation between time and level of expertise with digital cameras also supports this conclusion, and suggests that grouping participants into expert, intermediate, novice and naïve with the product seems to be less relevant when investigating intuitive use than some other aspects of usability, because intuitive use involves applying knowledge from other contexts and other products. A grouping based on technology familiarity score may be more relevant in this situation.

The high percentage of intuitive uses that were correct seems to confirm Bastick's (1982) statement that intuition is generally correct but not infallible.

Participants with little or no experience with digital cameras who had used other digital devices seemed to be able to use familiar features intuitively. This conclusion is supported by the correlations between familiarity of features and percentage of intuitive uses, and correct or correct but inappropriate intuitive first uses and technology familiarity score. The first uses results are particularly important as the participants had not yet had the opportunity to learn about the feature but used it either correctly or correctly but inappropriately the first time they encountered it. They could only base their actions on relevant past experience of similar features or things, so this result offers strong support for the idea that including familiar features in a product will allow users to use them intuitively first time.

The correlation between level of agreement by participants that they use knowledge gained from the use of one product to help them learn about another and their time to complete the operations also supports the hypothesis that intuitive use is governed by past experience. The more time a person took to complete the task, the less strongly they believe that they use their knowledge of familiar products when they are faced with an unfamiliar product, particularly of a different type. These people were less likely to transfer knowledge from other products and apply it to the use of the camera. Because the camera borrows so many features from other digital products, not primarily from cameras, transferring knowledge from other types of products was necessary in order to complete the tasks quickly and intuitively.

Through the interview process, it has been confirmed that location, function and appearance of features on the product are factors that need to be separated for purposes of analysis. Also, as can be seen from the analysis of the results above, this differentiation can show quite clearly which factor of a feature may be responsible for usability problems. This would allow designers to correct the right problem (eg, location of the power button) not the wrong one (eg, function of the power button).
Conclusion and Relevance to design

These findings suggest that relevant past experience is transferable between products, and probably also between contexts. The participants with relevant past experience with the different features show faster and more intuitive use of those features, so it should be possible to conclude that relevant past experience has contributed to that. Therefore, including familiar features and controls in a product, in a way that is easy to follow and is consistent with the user’s expectations according to her/his past experience, should increase the intuitive usability of those controls.

Intermittent users of inconsistent or counter-intuitive products, or users attempting to carry out new tasks, would have problems, although more regular users may be able to use the product well once they had learned it, suggests Kellogg (1987). Also, she found that users tend to see an inconsistent software system as undependable and unfriendly. Counter-intuitive products could well be viewed the same way.

In the current market place, there is a proliferation of electronic gadgets and a high turnover of consumer electronics products, with new models and upgrades appearing constantly. Products become more and more complex as new technology allows designers to include more functions. There are many intermittent and casual users, and many available functions within these products that are learned only when needed and not necessarily when the manual is available. Also, some products, such as office machines and equipment, are shared or passed around, and manuals become lost in the process. Therefore, designers need to make these products easier to learn and use if the current trends are to continue.

This research could contribute significantly to the design and usability of various products for all types of users. Issues that can be further explored in relation to intuitive use include how to use design to make products more intuitive, how to ascertain which sorts of features will be familiar to certain populations and applying these ideas outside the realm of products and to related fields such as software.
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