

## Abstract

Several studies show that human emotions are constantly changing and evolving. There are numerous publications (Plutchik 1994) which analyse the emotional state, their reactions and effects on an individual. One of the main factors which affects the interrelationships between the emotional state and reactions on the social condition is cultural background.

Different viewpoints and techniques have been highlighted in several studies on the built environment, which introduces the psychological adaptation of the mental process and the emotional effect on the user. This emotional transition is manifested by societies' reactions to the built environment.

The study gives an overall insight into the current realities and links the capabilities of computer technology, in measuring this subjective variable. A lot of these studies seem to reflect continuing dialogue indicating how a sense of wellbeing is affected by aesthetic considerations, colour, form etc. This sense of wellbeing plays a considerable part and a significant role in the process of human reaction(s) to the built environment.

More often than not the commercial environment is as volatile as the changes in the economic or marketing climate conditions, which inevitably affects company and consumer trends. With the consequent changeable user reactions and emotional responses to the commercial environment, it seems short-sighted to date that this area of study had not enticed further inquiry.

## Introduction

This study focuses on the impact of some aspects of the built environment; and on users' emotional reaction. It is also intended as a guide, to provide the basis of the impact of computer technology on society in general.

## Definition

The built environment in this study is defined as houses, offices, schools, shops and streets (Gilford, 1997), and are broadly classified in urban design terms as residential, commercial, educational, industrial, social and leisure.

The common variable that seemed to link the above subjects could be expressed in one word, 'individualism'. Some psychologists recognise that:

Research on the built environment in almost all cases grows out of the immediate design problems involved in the particular building or setting. The studies do not deal with the totality of all questions that might be raised in such a setting, but more typically are aimed at

those questions that are directly related to issues of interest to the designer.

(Proshansky, Ittelson and Rivlin, 1976)

However, the customary type of scrutiny used by most researchers seems to revolve around a single variable, which in turn was examined in a definitive way outside of influencing variable(s). This approach therefore allowed little opportunity to create alternative interpretations and often left issues to be taken out of context.

It appears that past and current literature practice ignores the dynamics of the human emotions and its interrelationship with the commercial environment. The ability to forecast or anticipate the reaction of the users of the commercial environment would enable designers and/or companies to plan and design in an effective way which has wider commercial implications in terms of profit making for the companies involved.

While investigating literature on the commercial environment users' influence; it became apparent that there was a gap in detailed study in relation to the influence of the commercial environment on users, with regard to door entry systems, which is the interface between the external and the internal environment.

Environmental psychology is affected by numerous variables such as colour psychology, the senses and human emotions. However, less vigorous research had been conducted linking environmental psychology and computer technology.

The available research seems to focus on the aesthetics/physicalities of entrances, and less with the users' reaction to door entry systems. (Neuffert 1997) The users' reaction to the door entry systems invariably affects their ability to use the facilities provided within the building.

## Methodology

There were four main stages to the investigations:

1. **Interviews**, which ascertained the current ideologies and commercial practices of door manufacturers and supermarket managers.
2. **Leicester Door Survey**, establishing the users' opinions and reactions to door entry systems in the commercial environment.
3. **4D Emotional Design Model**, developed to test the findings.
4. **4D Emotional Design Survey**, verified the users' opinions and reactions to the computer generated environment.

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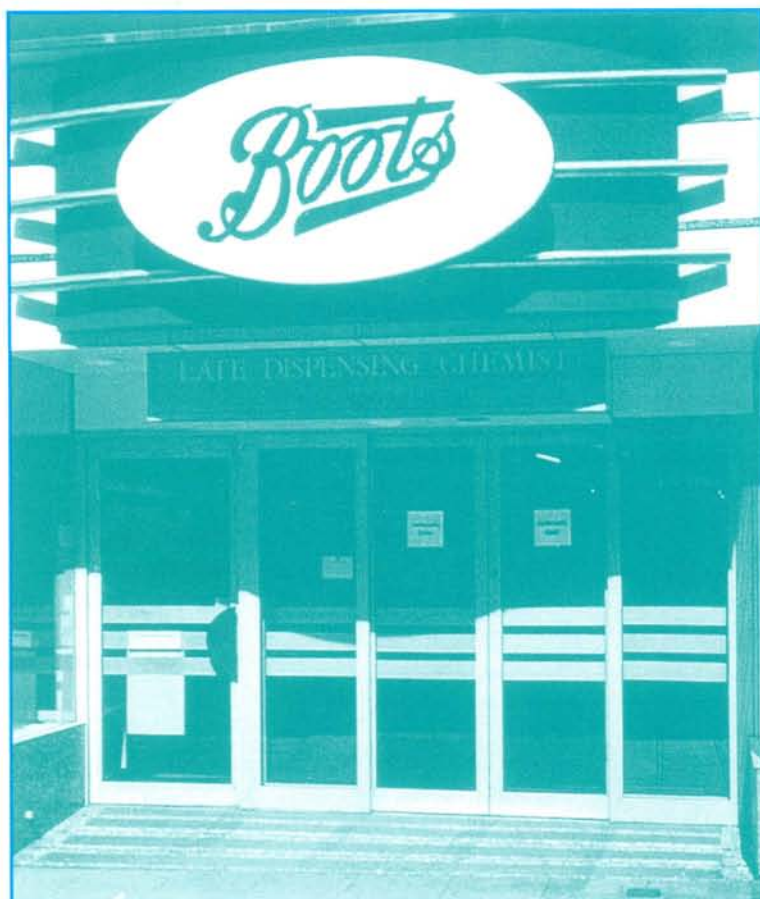


Figure 1 Automatic sliding door.

This study developed a '4D Emotional Design' tool. This is a computer simulation used to create an environment, within which 'emotional reaction' to the door entry systems could be measured in a controlled environment.

## Interviews

Interviews were conducted to establish which door entry systems were currently being used in the commercial environments. A supermarket store manager and door manufacture marketing executive gave their opinions. Although these conversations were brief, they provided enough information to establish the preferences of the consumer.

## Supermarket store manager

The store manager was not involved at the stages when the revolving door was chosen for the supermarket. However the responses which have been obtained from the users of this type of door entry system had been positive.

As expressed by the store manager:

"...there is ample space to allow for disabled access and for trolleys being pushed through them. Parents have said how easy it is to gain access with a pushchair."

Also there is a range of safety and security features that he feels are important when children and the physically impaired are involved. The store manager believes that if the doors were not inviting, practical but were difficult to manage and maintain, then fewer people would be using the store.

## Door manufacture marketing executive

Michael Parker is employed at Dorma, a door manufacture company which has seen the door entry system change considerably in the last few years.

As the interest in automatic doors grew, Dorma were researching consumers' preferences. Their findings showed that the consumers preferred automatic doors because they were convenient, gave a sense of freedom from clumsy exchanges with other users and the sense of power and/or control.

For the company 'timing' plays a significant role for the automatic door entry systems. He states that:

"...if the timing is not right, the user would know and they may feel uncomfortable going through the door."

## Leicester door survey

In order to establish the users' reactions and impressions, a pilot survey was conducted in the main commercial area in Leicester City centre. Four types of door systems were considered: automatic sliding doors, open entrances, push and revolving doors.

The intention of the survey was to highlight users' attitudes, feelings and overall impressions of door entry systems. Participants were asked to give their opinions on each type of door, and their feelings towards them. Questions were asked specifically to obtain subjective information.

A series of photographs were also shown highlighting the different types of door entry systems. The pictorial format was chosen for the instant visual recognition capabilities.

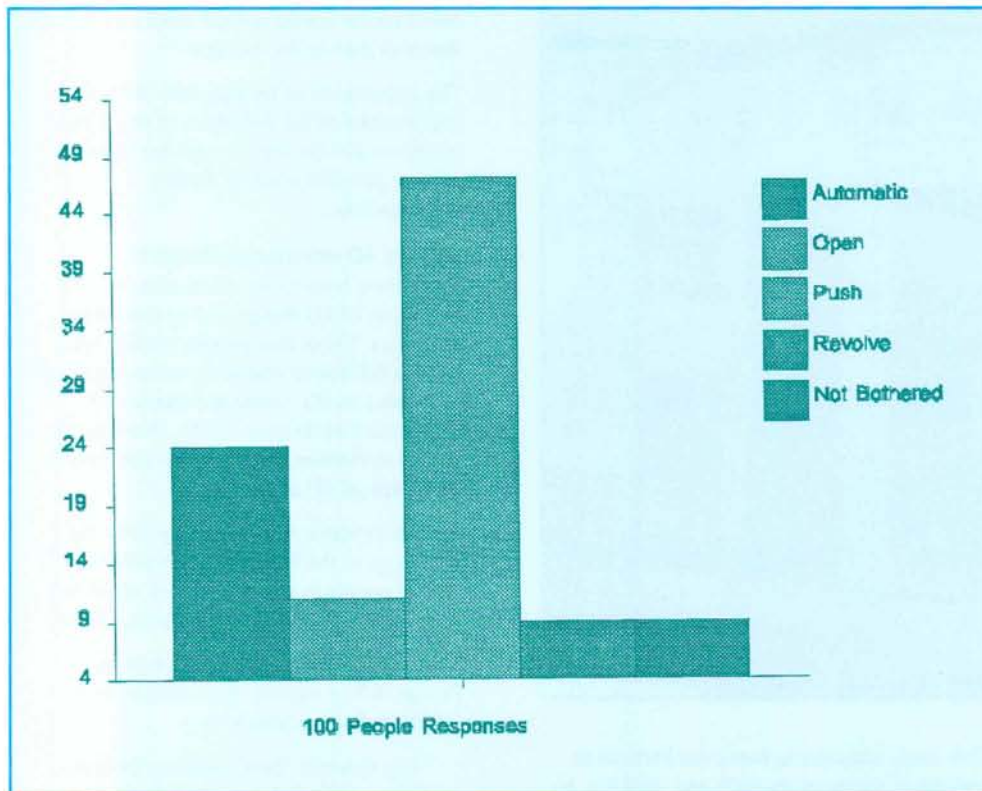
One hundred people, aged between 21 to 60, were asked to participate in this preliminary study. The results of the survey (see Table 1), demonstrates popular choices:

- Push doors at 47%
- Automatics doors at 24%
- Open entrances at 11%
- Revolving doors at 9% (on a par with the non responses).

However, other comments suggested that automatic doors might have been more popular in the survey, if convenience and size



Table 1: Door Survey.



were the issues. Users felt that the size of the revolving door hampered movement, especially if large items or bulky bags were an issue.

Participants responded well to the push door system. Although some users felt that some doors were rather heavy to move, the familiarity and traditional aspects of it meant it fared better than the automatic door entry system.

The open entrance system achieved the physical requirements relating to some of the comments above, however it did not achieve the level of preference as the automatic and push door entry systems. The psychological aspect is evident since some users were aware of the 'enticing' psychological element used especially in some jewellery shops such as Ernest Jones & Co. and H. Samuel Ltd.

Considering that there seem not to have been any revolving doors in the commercial sector in Leicester at the time of this study, it's not surprising that the revolving door system did not do as well as the others. However, the comments obtained from the observation of the doors in Birmingham and London were favourable.

#### The union of interactive design

When further investigations were made into external and internal commercial environment, it was somewhat of a surprise to find a gap in studies relating to door entry

systems. Besides aesthetics (as previously discussed), it focused on the functional aspects of entrances (AJ Focus 1992). According to Van Dalen (1979), traditional forms of study, have their place in history as to the rationale in the epoch of time. In some cases these guidelines were established to enable, a consistent recognised format of rhetoric. However, contrary to Van Dalen's research methods, this study feels it distances itself from the creative process in the world of design.

A few psychologists believe that students in the field of the built environment should:

"Provide this immediately usable information while at the same time embedding it in a context that allows for generalisations that go beyond the immediate setting and that hopefully will help shed light on the more general problems of human activities in relation to the environment." (Proshansky, Ittelson and Rivlin, 1976)

Some empirical studies suggest that the emotional response cannot be objectively measured. However this was said of Lie Detectors and DNA fingerprinting when they were first identified and were at the initial stages of study and research. Within time these theories have made a significant contribution to knowledge in these areas.



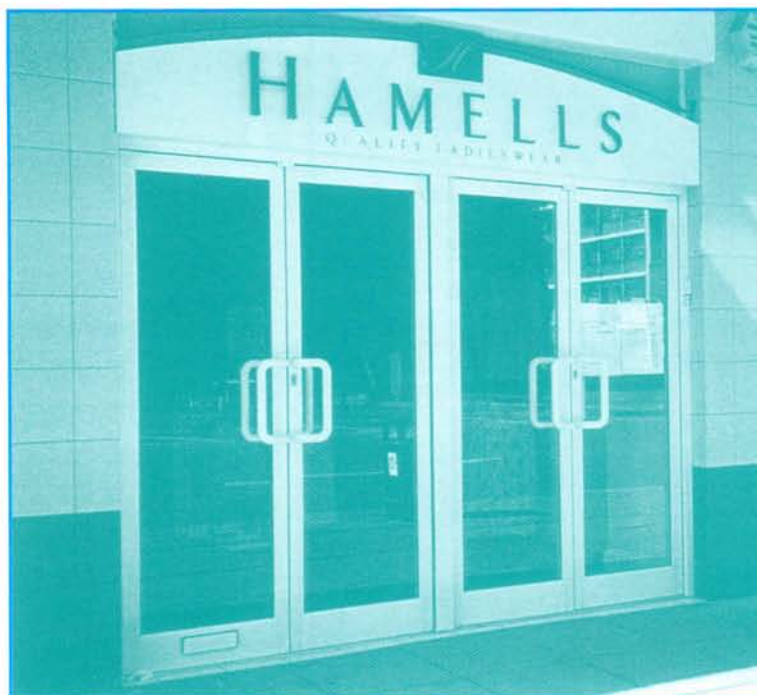


Figure 2: Push door.

This study attempts to break the barriers in traditional forms of research and thinking, by adopting a new way of processing ideas and information.

According to 'Popper', drowning the conceptual expressive process with stringent terminology defeats the overall thinking process. (Magee, 1982) An example of this innovative thought process can be best expressed in terms of the 'Danger Model', hypothesised by Polly Matzinger (Channel 4 programme).

Her belief is that the body's immune system responds to danger and not simply to foreign bodies. The latter theory for a long period of time was the acceptable norm. Until her 'naïve' discovery and interpretation of the 'Danger Model' was taken seriously by renowned researchers and scientists as being creditable.

The other point of interest is the use of design in most aspects of our lives. Western society is constantly bombarded with images, products and services that influence choices.

The growth of computer technology has an effect on commercial interests, which in turn affects the individual. Therefore in a society which is constantly changing, it is important to embrace new forms of creative thinking which accommodate and anticipate change.

This study communicates the results of the surveys conducted, to show the significance of human reactions and emotions on the users in the commercial environment. A '4 Dimensional Emotional' tool was also created

based on the results gained from participants that took part in the surveys.

The importance of looking into the future implications of the dynamics of the human emotions and the commercial environment suggest possible areas of further investigations.

## What is 4D emotional design?

There have been many discussions on the definition of 4D design and its associated dynamics. These discussions conflict with what is defined in scientific terms, especially in Physics as 4D – time and space (4D Dynamics Conference, 1995). However the nearest definition that relates to the study's definition of 4D design is:

"the dynamic form resulting from the design of the behaviour of artefacts (sic) and people in relation to each other and their environment". (Robertson, 1995)

This study's definition of 4D Emotional Design differs slightly from Robertson's (1995) definition which is:

"The dynamic form resulting from the design of the behaviour of elements and individuals relationship to each other, their environment, emotional reaction and sensory responses."

The behavioural aspects of the user in relation to their environment is significant since it affects the emotional state of an individual and in turn dictates their reaction to that environment. This study shows how the built and other environments can be simulated by using computer technology.

Computer simulation is increasingly being utilised to get the overall impression or feel of a building or interior. In some cases virtual reality is geared towards the mental submergence of the user in a computer generated environment. In other cases this technology has been used to record and monitor movement of an individual. However the fundamental point revolves around the interaction between the user and the computer simulated environment, accumulating in the development of the '4D Emotional Design Model'.

## The 4D emotional design model

As an integral part of the study a '4D Emotional Design Model' was developed. The 4D environment was born from the concept of a 'doughnut'. The purpose was to create an environment that would act as a corridor and be continuous in movement and to guide the user through the environment intuitively. The shape needed to be simple, almost deconstructive in its ideal. This was necessary



to enable the user not to be distracted by any form of embellishment.

With this objective in mind two structural environments were created, to simulate both positive and negative responses. This would provide the sensory reaction to the space.

Silicon Graphics was used to develop the structure, colours, textures and animation of the environment. For the sake of speed and time, circles, cones, cubes, cylinders, squares and triangles were manipulated to create the main structures and surfaces. Then a series of line drawings developed the doors, interior forms and floor surfaces.

Colours and textures were created and assigned individually to selected surfaces of each environment. The design of the doors was created to appeal to the visual, functional and emotional status of the intended participants.

Finally, the 'queuing theory' was considered in the positioning of the doors to allow the free and natural movement throughout the two environments. This approach enabled spontaneous comments to be evaluated objectively, which were considered in the Emotional Design Survey.

#### **The 4D emotional design survey**

The '4D emotional design' survey was developed to test the reactions and responses to the door entry systems in the computer generated environment in order to test whether similar results could be achieved. These reactions were then incorporated into the computer model by using 'timing' and animation to achieve the objectives set out for the 4D Emotional Design Survey.

The study was undertaken at the Imaging Research Centre, the Video Production and Editing Centre at De Montfort University as well as residential settings in Leicester and Birmingham over a period of six weeks.

Sixty four participants, aged between 14 to 60, unbeknown as to what was required of them, were asked to give their opinions and reactions to a computer generated design simulation of the door entry systems similar to those used in the Leicester door survey. They were also not aware their reactions were being observed.

The participants were made aware of the two conditions under which they were using the 4D environment. The first was to give the users the basic information required for the 4D Emotional Design simulation, and the second was to relate their impressions as if the same door entry systems were put into a 'real' commercial environment setting.

The participants were asked the same questions as in the original Leicester Door Survey. Their comments had to be interpreted differently, since they also related to the 'timing' aspects of the animation of the computer generated environment more readily than, in the physical setting.

#### **Results of the 4D survey**

As previously stated, 'timing' was important and necessary for the computer generated environment. This became evident when testing the reactions of the participants. The door entry system sequencing process was meticulous in its positioning since it generated the maximum response to the experiment.

In the 4D Door Survey, the following comments highlight the varying opinions expressed for each door entry system.

#### **Automatic doors (sliding)**

##### **Impressions of the commercial setting:**

- less demanding for shoppers, hygienic
- not having to worry about bulky shopping
- design could be suitable for computer game stores.

##### **Impressions of the simulated 4D environment:**

- some liked the futuristic aspects of the doors
- aware of the differences of automation in the separation of the doors
- some preferred the timing on the second door than the first.

#### **Push doors**

##### **Impressions of the commercial setting:**

- some felt the automatic opening system would benefit disable people
- visual familiarity.

##### **Impressions of the simulated 4D environment:**

- knew what to expect from the push door system, instantly recognisable compared to the automatic doors
- a little plain in design although in the first environment it seemed different
- majority felt comfortable in the first environment than in the second.

#### **Open entrances**

##### **Impressions of the commercial setting:**

- the type of entrance one would expect from large stores, or jewellery shops in the Shires (shopping complex situated in Leicester City centre).



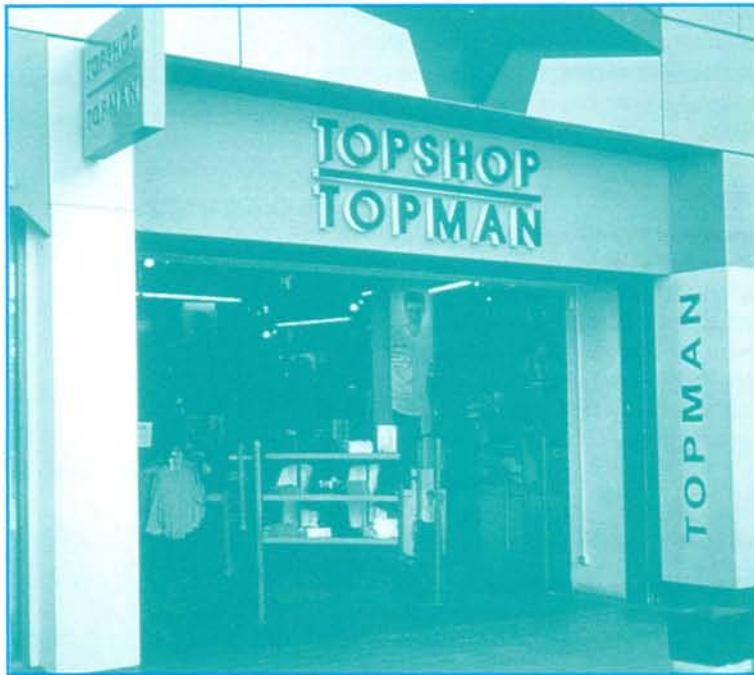


Figure 3: Open entrance.

## Impressions of the simulated 4D environment:

- aware of the entrance, but was not consider to be an average door in the traditional sense
- participants felt the size of the door was difficult to ascertain since it was a computer simulation, but remarked that it seemed visually correct
- others were more aware of the surface textures.

## Revolving doors

### Impressions of the commercial setting:

- likely to be seen in supermarkets outside of Leicester
- may not be practical considering children's use of them
- other respondents compared the rotation to that of a turnstile similar to Leicester City Football Club.

## Impressions of the simulated 4D environment:

- most respondents liked the pace of the rotation
- it seemed spacious and less restricting in the first environment than in the second.

However, the participants who took part in the 4D Emotional Design Survey felt that:

- the shape of the environment was interesting

- the separate environments with different colours and lighting techniques were looked upon favourably
- most agreed that the walls and fixtures steered the user through the interiors
- the first environment gave the impression of looking into the clouds compared to the moodiness of the second environment
- most users felt that the combination of blues and beige browns in the first environment, compliment each other

in the second environment the dark reds and purples seemed slightly restrictive.

## Conclusions

The conclusions drawn from this study redefines and highlights the need for research which links topics concerning the human emotions, the commercial environment and computer technology which is currently missing in research. Our senses are forever being utilised in commercial environments. To some degree, technology is often used to trigger or used to produce the desired effect. This study shows that:

- It is possible to use the '4D Emotional Design' technology to monitor an emotional effect on humans from elements in the built environment.
- It is possible to create a design simulation that could achieve an emotive response similar to those in the commercial environment.
- Experimenting with the Silicon Graphics computer software achieved the desired effect that was needed for the design simulation. It provided the stimulus to obtain the desired sensory effects that made the research project viable.
- By simulating an animated computer environment, a reaction can be observed as a result of an emotional response to that simulation. This implies that the subjective 'reactionary stimulus' has the capabilities, to be measured objectively.
- That creative thinking for the 21st Century will only be enhanced if multidisciplinary skills and concepts are utilised for some research topics or projects. This concurs with most of the recommendations agreed on the future role of interior design research, by Ashcroft, Anjum and Paul (1996).
- Designers are now using **computer-generated environments** since on a conscious or subconscious level, the power of the computer in producing visuals which leaves a definite impact in



the minds of most people. It is therefore not surprising that most companies, industries and educational institutions, are becoming dependent on computer facilities and capabilities.

- Most designers using these means might be able to subjectively measure their clients and users perceptions and reactions to their projects at the initial stages, and allow for modifications to be made.
- Society is developing at a faster rate to accommodate this new way of living and computer technology is fulfilling that void. Most companies will endeavour to employ people who have some ability or the enthusiasm to work with this technology, for the primary purpose of efficiency and satisfying their clients.

Studies in environmental psychology are constantly probing to understand, improve and utilise methods which will aid the users emotional response and a sense of wellbeing in physical settings.

By considering the opinions of the consumer and understanding certain variables such as social conditions and psychological expectations of the user, designers will be able to create effective designs in innovative ways. The door entry system was used to identify this point and show the diversity in a single design element.

The complexities of colour psychology, the senses and human emotions highlight the dynamics of these areas of studies. Individual's perspectives, perceptions and reactions are constantly changing, therefore it seems logical for research in these areas to be just as flexible in its approach.

Considering the changes and benefits that were made after the industrial revolution, the development of computer technology can only spiral. Western society is living in an era that will determine whether technology dominates the user or the contrary. Modern psychologists have adapted this technology to suit their purposes and may be it is time others in other disciplines did the same.

This study recommends the following:

- further analysis of the 4D Emotional Design Survey should be undertaken since the respondents comments were similar to those of the Leicester Door Survey, which was a confirmation at a basic level of the main hypothesis of this study
- further investigation of the commercial potential of using this model, as a means of identifying consumers' requirements



Figure 4:  
Revolving door.

- the 4D Emotional Design tool has the potential to enhance psychological and medical research in peoples emotional reactions to the environment in general, its adaptation has the potential to accommodate some current medical sciences which should be investigated
- further studies should be undertaken into the areas of emotional conditions of consumers, so that common variables can be identified, isolated and utilised effectively in the commercial environment
- to understand and dictate emotional reactions of the consumer, this model has implications for home shopping and should be further investigated
- future studies could incorporate the influences of cultural differences on individuals in the commercial environment
- further studies should be undertaken since this study has also highlighted that if door entry systems were not inviting, practical and were difficult to manage and maintain, then consumers would be less inclined to enter the stores
- The model can be developed to test future behavioural patterns of people who are likely to be constantly exposed to computers, in cyber cafés, amusement arcades and other environments.