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Public space systems: Designing for privacy?

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Abstract

Technological systems for use in public places need to be designed so people can use them efficiently, effectively, safely and with satisfaction. A component factor in satisfaction is perceived privacy. Current guidelines aimed at improving accessibility may impact users perceptions of privacy. The aim of this study was to explore whether different screen sizes affect users' perceptions of privacy. Also, if partitioning around screens influences privacy perceptions. An opportunity sample of 60 participants took part in the study. The results that revealed 12″ screens were perceived as more private by users than 15 and 17″ screens. Adding privacy partitions improved user's perceptions of privacy on the 12 and 15″ screens but not on the 17″. These findings provide evidence that slight changes in the physical design of systems can increase users' perceived levels of privacy and therefore satisfaction.

Keywords: Privacy; Technology use; Screen size; Public systems; Personal space; Accessibiligy

1. Introduction

Many people use interactive systems in public areas. Several accessibility guidelines exist for interfaces that are used in public areas such as colour and size. Gill (1997) states that the interface of systems used in public areas should be large, high contrast (white or yellow characters on a dark background) and illuminated (internally).

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Morris et al. (1995) suggest that interfaces should be no less than 17″ for systems used in public areas. This contrasts to the 10″ or 12″ screens generally used on systems that deal with financial information. These guidelines are aimed at improving accessibility and have not paid consideration to privacy issues. A larger screen may make it easy for the user to see the on-screen information; however, it also makes it easy for onlookers. Whilst the focus of this paper is mainly concerned with perceptions of privacy associated with screen size, consideration is given as to how physical space and privacy are implicated across technology use as a whole. Different contexts of technology use are constrained by time and place, e.g. the use of a laptop on a train, a computer in an open plan office, a health information kiosk located in a pharmacy or a mobile telephone on a city street. The amount of available space directly affects perceived levels of privacy and therefore impacts upon technology use.

The vast majority of design guidelines focus on physical accessibility (Feeney, 1999; CAN/CSA, 2000) and ignore psychological issues. However, in the changes proposed to the American Disability Act section on automated teller machines (ATMs), guidance is given that wheelchair users should be afforded the same privacy as non-wheelchair users and that if they cannot shield the screen with their bodies, they may prefer speech output. Therefore when considering human interaction with systems found in public areas consideration needs to be given to the user population, their characteristics, the environment, the location and the actual design of the system. Another important issue is the type of task or transaction the user will be using the system for. Many public systems require the user to enter personal and private information such as the personal identification number (PIN) needed to access an ATM. In public places other people in the immediate area can cause problems for users of technologies, for example, by standing too close or watching the user, i.e. shoulder-surfing (Morris et al., 1995). Generally, users do not like being observed by other people therefore this type of problem reduces the users perceived levels of privacy, personal space and safety. To alleviate the problem of shoulder-surfing suggestions have been made that if a system is used to access private information design specifications should afford the users body to conceal their interaction from others (Maguire, 1999). Therefore designers of public space systems need to design for privacy to protect leakage of information in the virtual as well as the physical world.

When considering screen size and the associated task it seems apparent that the larger the interface for a public transaction, the less privacy users will have or perceive themselves to have. There is no universal definition of privacy, the concept is highly complex and involves different perspectives and dimensions. The need and desire for privacy varies between individuals, cultures, social and physical environmental factors (Kaya and Weber, 2003). In western cultures definitions of privacy tend to involve management of personal information. Chan (2000) proposed that "privacy is a subjective response which varies according to individual preference and various social settings". Privacy does not always refer to social isolation—for example, when people use public technologies to access financial information, as with an ATM, people do not want total isolation, as this may be considered unsafe. Generally, physical privacy and safety are interrelated. Space is known to be a mechanism used to regulate privacy and safety. When interacting with technology in

public places the need for different levels of privacy, space and safety is variable at any given moment in time. However, people do desire a certain level of privacy and control over what information, if any, is made available to others.

1.1. Social influences on behaviour

The presence of others can influence an individual's behaviour in many ways. Their actions and expectations can exert a strong control over how an individual reacts to any situation. Social norms are powerful, invisible forces that make individuals comply to perform a behaviour in an accepted way. Zimmermann and Bridger (2000) found that users of ATMs felt under time and social pressure from others waiting, in particular when in unfamiliar environments.

Many variables need to be considered when trying to understand the need for privacy when an individual interacts with a technological system in a public area. Users of static systems maybe influenced by different environmental and social variables compared to users of mobile systems. For example, generally users of ATMs are dealing with very private and personal information in a public place. Therefore the amount of privacy they need from the system and environment maybe higher than someone browsing general information on a kiosk. Negative influences on users of static systems may also be greater as the device is not a personal one. Also, users may feel under more pressure from others who may be waiting to use the device. Therefore designers of public systems should consider the users need for privacy and space.

Space creates settings for appropriate behaviour, enable/disables privacy and facilitates/inhibits interaction from others. Aiello and Thompson (1980) state that the two primary functions of personal space are regulation or control and communication. Personal space protects against the possible uncomfortable psychological or physical encounters by regulating and controlling the amount and quality of sensory stimulation. Personal space communicates to others information about the relationship, the formality of the interaction by the use of cues to the preferred chosen distance. Public space systems must be designed so the user can undertake a transaction without having to pay too much attention to other people around at that particular time.

Kaya and Erkip (1999) studied the effects of short-term crowding on the invasion of personal space at an ATM in America. They found that people feel uncomfortable if approached at a distance they consider to be to close and in high-density conditions people are more disturbed by the presence of others than in low-density due to the invasion of their personal space. They also found people in high density perceive there to be less available space and withdrawal behaviours to increase. This type of research highlights how space and privacy are important issues that should be placed at the heart of the design process.

1.2. Privacy and HCI

The majority of HCI literature on privacy tends to focus on exchange and control of information over the Internet (e.g. Jackson et al., 2003; Cranor et al., 1999). Also,

the actual term "privacy" is generally used by computer scientists and security specialists to refer to the security of data against various risks or during transmission (Clarke, 1999). However, control of personal information is very important no matter where or what type of device is used. Individuals have a right to control and protect their personal information in both virtual and physical worlds (Nguyen and Truong, 2003).

Future systems will enable more freedom and reduce the physical constraints of time and place. According to Lester (2001), technological developments are considered to be the main culprit in increasing concern over the protection of privacy. As new forms of technology are introduced personal information maybe accessed using a variety of different systems. For example, one individual may prefer to access details of their bank account using their interactive television set compared to another individual whose preference would be their wireless free mobile telephone. Whichever types of system people use to access personal information the concept of privacy is of crucial concern in both the informational and physical worlds.

When considering human interaction with technology in public places physical privacy is a very important issue. Keizer (2005) highlights loss of information in public places when using technology can happen in low-tech ways such as someone peeking over the users shoulder. Companies such as Boeing have concentrated on the technical security of their on-board Wi-Fi system whilst only paying small attention to physical privacy, e.g. when a passenger might be using a laptop computer in a cramped condition (Hallett, 2003). Finding how privacy perceptions affect technology use will not only help to understand current but also future use. Little et al. (2003) discussed how levels of perceived privacy can be increased or decreased dependent upon the task and the physical environment. Their research found that privacy perceptions directly affected user intentions to use an ATM.

1.2.1. Privacy—the human need

Privacy is a topic receiving considerable attention, widely discussed by academics and practitioners alike (Kozlov, 2004). To design for privacy we need to understand what the concept actually is, how people control and regulate it. Guidelines for design of public space systems should include both physical and psychological aspects of privacy. Understanding the need to design for physical privacy is often intuitive. However, privacy from a psychological perspective is often ignored.

Research into privacy tends to take an individualist approach and use North American or Northern European perspectives (Margulis, 2003). This research uses the individualist approach to privacy adopted by the western world. Generally, models emphasize the individuals control and choice, and social relationships as either voluntary or as barriers to independence (Fiske et al., 1998). In the western world privacy definitions tend to involve management of personal information and space. According to Chan (2000) the ability to manipulate space is the primary way individuals achieve privacy.

Privacy is classified as a human boundary control process that allows access by others according to one's own needs and situational factors. Privacy does not always

refer to total isolation from others. Too much privacy can lead to alienation and too little as an invasion of privacy (Pedersen, 1999). Crowding and isolation are examples of where privacy regulation has gone wrong. Consideration must also be made to situational factors which can be either social (interaction from others) or physical (location, layout). For example, in public places individuals often co-exist in a space with others they do not want to interact with.

1.2.2. Western models of privacy

Two western models that have been very influential in privacy research in the discipline of psychology are the ones developed by Altman in 1975 and Westin in 1967. Both theories are examples of a limited-access approach to privacy (Margulis, 2003). Both theories describe privacy in terms of the need and desire to control and regulate access to oneself. They also acknowledge that privacy is a continuous dynamic regulation process that changes due to internal/external conditions, sometimes regulation can be unsuccessful, different types of privacy exist and privacy is culturally specific.

Altman (1975) described privacy as an ideal, desired state or as an achieved end state. If the desired state matches the achieved state then an optimal level of privacy is obtained. Privacy is obtained by selective control of access to the self. Altman suggested social interaction is at the heart of understanding privacy and the environment provides mechanisms for regulation. Altman proposed four mechanisms to achieve privacy: verbal (e.g. what is said, tone of voice), non-verbal behaviour (e.g. eye contact in communicating attitudes or intentions), environmental (e.g. personal space, physical aspects of the environment) and culture (e.g. norms, beliefs).

Westin (1967) suggested individuals use a limited-access approach to protect their privacy. He defined privacy as a dynamic process of regulation and one that is non-monotonic, i.e. an individual can have too much or too little. Westin proposed four types of privacy: solitude (being free from observation by others), intimacy (small group seclusion), anonymity (freedom from surveillance in public places) and reserve (limited disclosure of information to others). The four types serve various functions: personal autonomy (desire to avoid manipulation), emotional release (ability to release tensions from the social world), self-evaluation (ability to contemplate, reflect), limit (set boundaries) and protect communication (share information with trusted others). Westin's model has been extended several times to include other dimensions (e.g. seclusion, not neighbouring Marshall, 1970). Previous research that highlights the importance of additional dimensions shows how aspects of privacy can be context-specific.

Pedersen (1999, 1997, 1979) further developed Westin's model and categorised privacy into six main types: solitude (freedom from observation by others), reserve (not revealing personal information about one's self to others), isolation (being geographically removed from and free from others observation), intimacy with family (being alone with family), intimacy with friends (being alone with friends) and anonymity (being seen but not identified or identifiable by others). Pedersen suggests that the six types of privacy "represent the basic approaches people use to satisfy their privacy needs".

Although speculative, Burgoon (1982) suggested four dimensions of privacy: physical, psychological, social and informational. The physical dimension relates to how physically accessible a person is to others and can be linked to such aspects as environmental design. The psychological dimension refers to a person's right to decide with whom they share personal information and the control of cognitive/affective inputs/outputs such as non-verbal communication. The social dimension is the ability to control social interactions by controlling distance between people. The informational privacy dimension relates to a person's right to reveal personal information to others, which is not always under a person's control.

1.2.3. The use of space to regulate privacy

Control of information can be regulated in different ways, e.g. through the implementation of legal statutes. However, in the context of this research the focus is on the physical and psychological aspects of privacy regulation. The regulation of privacy is complicated due to the range of functions it maintains and protects. Levels of perceived privacy can be increased or decreased dependent upon an individuals experience, expectation, other people in the area, the task and the physical environment. Regulation is considered as a dynamic process with variable boundaries that are under continuous negotiation and management, continuously refined according to circumstance (Palen and Dourish, 2003). Generally, individuals rely on features of their spatial world and the immediate environment. Regulation and control can also be attained by the use of verbal and non-verbal behaviour.

Demirbas and Demirkan (2000) investigated privacy regulations used by people in a design studio taking into account spatial characteristics such as the amount of personal space and the effect these factors have on preference for an environment. The studio was open plan although certain physical features such as columns gave the users the opportunity to be by himself/herself and to create private corners within the studio. Therefore the studio afforded both the possibility of both social interaction and avoiding social interaction. Demirbas and Demirkan suggested that physical barriers such as strategically placed partitions can affect levels of satisfaction. This supports research by Oldham (1988) who argued that effective use of partitions can increase perceived privacy and satisfaction.

As privacy is an important human need and in particular when it is related to certain tasks such as using public technologies to access personal information it appears an important area for research. It is important for designers of the product hardware, software and the surrounding area to understand the impact of the design on perceptions of privacy. This study measured users' perceptions of privacy, clarity of information and attitude towards three different screen sizes (12″, 15″ and 17″). Side partitions were also added to each screen to see if this had any effect on the user's perceived levels of privacy. It was hypothesized that the smaller the screen, the users would perceive higher levels of privacy and this would further increase when side partitions were attached.

2. Method

2.1. Design

A 3×2 factorial repeated measures design was used in this study. Factor one screen size included three levels: 12″ screen, 15″ screen and 17″ screen. Factor two included two levels whether the different size screens had partitions attached or not. The dependent variables were participant's subjective ratings of: perceived levels of privacy, clarity of on-screen information and attitude towards screen type.

2.2. Participants

An opportunity sample was used in this study, 60 participants were recruited from the Newcastle upon Tyne area of England, 29 males and 31 females. The age range was from 16 to 65 years (mean 28.85 years). Participants took part in all six conditions; random allocation to each of the six conditions was used as a control factor in this study. All participants had either normal of corrected vision (e.g. glasses, contact lenses). Participants were not screened for visual impairments.

2.3. Apparatus and materials

NCR Financial Solutions LTD., Dundee, UK, supplied three flat computer screens: 12″, 15″, and 17″. Each of the three screens was independently enclosed in white cardboard surrounds and cardboard partitions were added or removed on both sides of each screen dependent upon the condition (see Fig. 1). All screens were set at a standard height distance that measured 900 mm from the floor to the bottom of the screen. All three screens were linked to separate computers. For recording purposes each screen type was allocated a number: **1**–*12″ screen without partitions*, **2**–*15″ screen without partitions*, **3**–*17″ screen without partitions*, **4**–*12″ screen with partitions*, **5**–*15″ screen with partitions*, **6**–*17″ screen with partitions.*

A software program was developed for use in this study consisting of 12 statements that appeared on all screens. In this study, guidelines for the appearance

Fig. 1. Example of screen with and without partitions.

of information on-screen were followed. A dark blue background was used with high contrast yellow characters (font size 18, Times New Roman); this is in accordance with suggestions by Gill (1997). Participants responded to each statement using a bipolar scale of 1–7, where 1 was very likely or I agree with this statement to 7 very unlikely or I do not agree with this statement. Statements appeared in the same order on every trial and on each screen type. The program automatically recorded the participant's response to each statement.

Statements were linked explicitly to previous research where possible. Privacy and attitude statements were developed from previous research, e.g. *Other people would be able to see my personal information on this screen* (Pedersen, 1999; Little et al., 2003). The statements related to clarity of on-screen information were based on the IBM Computer Usability Satisfaction Questionnaire (Lewis, 1995). Five of the statements related to levels of perceived privacy. Five of the statements related to clarity and presentation of on-screen information. Two statements related to the participants attitude regarding their overall opinion of each screen type. The statements are listed below in their respective category:

Privacy statements: When I use this screen other people can see what I'm doing.

Other people would be able to see my personal information on this screen.

When using this screen the only time I believe I would have enough privacy is when no one else is around.

I would feel uncomfortable using this screen if there was someone queuing behind me.

My privacy would be at risk using this screen.

Clarity of screen information statements: This screen is just the right size for dealing with personal information.

This screen size makes use easier.

This screen size enables me to complete my task quickly.

This screen size makes the information clear and precise.

I do not feel comfortable with this screen size.

Attitude statements: All things considered I do not like this screen.

All things considered, I find this screen pleasant.

2.4. Procedure

The experiment was counterbalanced and a random procedure used, all participants took part in all six conditions and were tested individually. Each participant was randomly allocated to one of the conditions at the beginning of each experimental trial. All participants were instructed on how to carry out the task. The task was simply to respond to the statements about privacy, screen clarity and general acceptance. This neutral task was used to ensure that the response was based on the design of the system rather than privacy concerns about the information being presented. Before each participant began his or her participant number and screen type were entered onto each of the individual screens. Each participant approached one of the six screens; they then answered all the questions related to privacy, clarity of screen information and attitude towards that particular screen type. Participant's

response to each statement was recorded using the mouse to click the number on the scale that best applied to their opinion of that particular statement. When participants finished rating each set of statements on one screen they moved onto the next screen and so on until they had completed the task on all six screen types. While participants were completing one trial, privacy partitions were either removed or added to one of the other screens dependent upon condition.

Testing took approximately 10 min. Once each participant had completed the screen tasks they were thanked and debriefed. After all 60 participants had completed all six conditions data were recorded. Means were calculated and totalled for all participants' responses. This resulted in mean scores for levels of perceived privacy, clarity of information scores and attitude towards each screen type. The data from the screens were then analysed using a two way repeated measure ANOVA.

3. Results

All data were screened for normality using SPSS. A 3×2 repeated measures ANOVA was applied to the screen data.

Cronbach alphas were applied to the subscales to check reliability and validity. Each of the subscales showed an overall high level of internal consistency, with coefficient alphas in the range of 0.73–0.94, mean alpha = 0.91. The alpha coefficients related to each subscale were: privacy (0.94), clarity of information (0.73) and attitude (0.86).

3.1. Screen data-privacy

Comparison of the means for the six screen types revealed that the 12″ screen with partitions attached (mean 3.95) and the 12″ screen without a partition (mean 3.53) were rated higher for levels of perceived privacy compared to all of the other screen types. The 17″ screen without partitions (mean 1.71), the 17″ screen with partitions (mean 2.08) and the 15″ screen without partitions (mean 2.13) were rated the lowest for levels of perceived privacy (see Table 1).

The ANOVA revealed a significant effect on levels of privacy between the different screens with partitions and screens without partitions; $F(1, 59) = 33.487$, $p < 0.001$. The ANOVA revealed a significant effect on levels of privacy between the different sizes of screens, i.e. 12″, 15″ and 17″; $F(2, 118) = 79.703$, $p < 0.001$. There was no significant interaction effect between screen size and partitions or no partitions, $F(2, 118) = 1.663$, $p = 0.194$.

Although the interaction was not significant, there did seem to be differences between mean ratings across different screen sizes and partition/no partition conditions. Thus sets of post hoc analyses were applied to the data to explore this further.

Table 1
Mean rating for levels of perceived privacy for each screen type

$N = 60$	Mean privacy	S.D.
12″ screen/no partitions	3.53	1.53
15″ screen/no partitions	2.13	1.04
17″ screen/no partitions	1.71	1.02
12″ screen/partitions	3.95	1.54
15″ screen/partitions	2.97	1.87
17″ screen/partitions	2.08	1.21

3.2. Post hoc comparisons

Post hoc comparisons were carried out using the Scheffé method to find where the difference between screens occurred. Analysis revealed that the 12″ screen with partitions was rated significantly higher for levels of perceived privacy (at the 0.01 level) compared to the 15″screen with/without partitions and the 17″ screen with/without partitions. The 12″ screen with partitions was rated significantly higher for levels of perceived privacy (at the 0.05 level) compared to the 12″ screen without partitions.

The 12″ screen without partitions was rated significantly higher for levels of perceived privacy (at the 0.01 level) than the 15″ without partitions and both the 17″ with/without partitions. The 12″ screen without partitions was rated significantly higher for levels of perceived privacy (at the 0.05 level) compared to the 15″ screen with partitions.

The 15″ screen with partitions was rated significantly higher for levels of perceived privacy (at the 0.01 level) than the 17″ without partitions. The 15″ screen with partitions was rated significantly higher for levels of perceived privacy (at the 0.05 level) compared to the 15″ screen without partitions.

No other significant differences were found between any of the other screen types.

3.3. Clarity of screen information

Comparison of the means and standard deviations for clarity of information presented on the screens revealed only a slight variation between the different screen types (see Table 2).

The ANOVA revealed no significant effect on clarity of information that appeared on the screens between the screens with partitions and the screens without partitions $F(1, 59) = 0.196$, $p = 0.66$. The ANOVA revealed a significant effect on clarity of information that appeared on the screens between the 12″, 15″ and 17″ sizes, $F(2, 118) = 5.436$, $p < 0.05$. There was a significant interaction effect between screen size and whether partitions were added or not; $F(2, 118) = 9.515$, $p < 0.001$.

Post hoc comparisons were applied to the data using the Scheffé method. No significant differences were found. This finding reflects the stringent nature of the

Table 2
Mean rating for clarity of screen information for each screen type

$N = 60$	Mean clarity	s.d.
12″ screen/no partitions	3.51	0.93
15″ screen/no partitions	3.27	0.99
17″ screen/no partitions	3.74	1.32
12″ screen/partitions	3.90	1.06
15″ screen/partitions	3.23	0.93
17″ screen/partitions	3.93	1.13

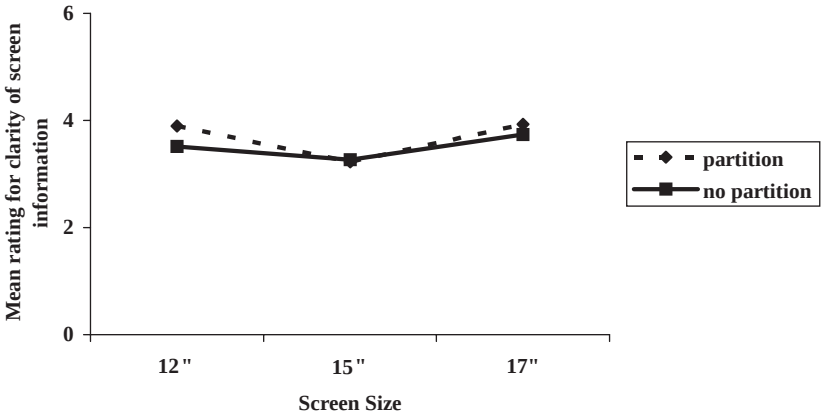

Fig. 2. Mean rating for clarity of information between the three screen sizes and with/without partitions.

Scheffé method and draws attention to the small differences between the mean values. Ignoring the significance found in the ANOVA reduces the chance of a Type I error. Observations for Table 2 and Fig. 2 show ratings for clarity of information on the three screen sizes and whether partitions were added or not. The 15″ screen is rated lower for clarity with and without partitions attached compared to the 12″ and 17″ screen with and without partitions attached. When partitions are attached to the 12″ and 17″ screens they are rated slightly higher for clarity of on-screen information compared to when partitions are not attached to these screens.

3.4. Attitude towards screen types

Comparison of the means for the six screen types revealed the 12″ screen with partitions attached (mean 3.96) was rated more positively for attitude towards that particular screen compared to all of the other screen types. The 15″ screen without partitions (mean 3.57) and the 12″ screen without partitions (mean 3.67) were rated the lowest for attitude towards the different screen types (see Table 3).

Table 3
Mean rating for attitude towards each screen type

$N = 60$	Mean-attitude	s.d.
12″ screen/no partitions	3.67	0.86
15″ screen/no partitions	3.57	0.96
17″ screen/no partitions	3.70	1.04
12″ screen/partitions	3.96	0.84
15″ screen/partitions	3.80	0.90
17″ screen/partitions	3.81	1.10

The ANOVA revealed a significant effect of attitude towards the screens with partitions and the screens without partitions; $F(1, 59) = 8.467$, $p < 0.005$. The ANOVA revealed no significant effect of attitude between the 12″, 15″ and 17″ sizes, $F(2, 118) = 0.566$, $p = 0.569$. There was no significant interaction effect between screen size and whether side partitions were added or not, $F(2, 118) = 0.349$, $p = 0.706$.

Post hoc comparisons were carried out using the Scheffé method to find where the difference between screens with and without partitions. Analysis revealed that only the 12″ screen with partitions was rated more positively (at the 0.05 level) with regard to attitude towards that particular screen compared to all of the other five screen types. No other comparisons were significant ($p > .05$ in all cases).

4. Discussion

The findings from this study reveal a significant effect of screen size and type on participant's perceived levels of privacy and attitude towards them. Results show that the 12″ screen with partitions attached was rated significantly higher for perceived levels of privacy compared to all of the other screen sizes and types. The 12″ screen without partitions was rated significantly higher for perceived levels of privacy compared to all of the other screen sizes and types except the 12″ screen with partitions attached. The 15″ screen with partitions attached was rated significantly higher for perceived levels of privacy compared to the 15″ screen without partitions and the 17″ screen with or without partitions. Results revealed that participants' attitudes towards the different screen sizes and types was significantly more positive towards the 12″ screen with partitions compared to the other five screen types.

4.1. Designing for accessibility or privacy?

While researchers such as Morris et al. (1995) state that screen size of interfaces used in technology in public places should be no less that 17″, this is not sufficient to ensure accessibility. The requirement should be to have accessible screen design in terms of font and contrast rather than base it on an absolute screen size. The screen

should be large enough to display the information accessibly. This experiment shows that there was no difference in perception of the clarity of information displayed on the screens. In this study guidelines for the appearance of information on screen were followed. A dark blue background was used with high contrast yellow characters (font size 18, Times New Roman); this is in accordance with suggestions by Gill (1997). No differences were found between any of the screen sizes and types for clarity of on-screen information. This suggests that smaller screens such as 12″ can appear just as clear as 17″ screens providing too much information is not presented at once.

These larger screens also have a negative impact on perceptions of privacy and may not be appropriate for private transactions in a public environment. The findings from this study reveal that when dealing with personal information 12″ screens with added partitions are the most suitable type of interface for users of technology in public areas. Maguire (1999) states systems that are used to access personal information should be designed to allow the user's body to conceal their interaction from others. The findings in this study support this concept, as larger screens do not allow users to fully conceal the information that appears on-screen from other people who may be around in that particular area, and screens with partitions at the side are perceived as more private as they help the user to feel confident that the screen can be concealed.

All participants in this study had normal or corrected vision (e.g. wore glasses, contact lenses). One limitation of this study might be that participants were not tested for visual acuity and therefore results cannot be generalized to people with visual impairments. This would be an interesting area for further investigation into accessibility and perceptions of privacy.

4.2. Privacy perceptions

This study shows how design factors, e.g. screen size and partitions can dynamically change an individual's level of perceived privacy. The findings support previous research by Demirbas and Demirkan (2000) and Oldham (1988) in that adding partition in strategic places can increase individuals' levels of perceived privacy and satisfaction. The findings from this study show that by adding partitions to the side of a screen this can increase participant's perceived levels of privacy and result in a more positive attitude towards that particular screen type.

The privacy statements that appeared on screen were developed from previous research by Pedersen (1999) and Little et al. (2003). The findings support that dimensions of privacy proposed by Pedersen such as reserve (not revealing personal information about oneself to others), isolation (being geographically removed from and free from others observation) and solitude (freedom from observation by others) are important factors that can affect use of a system.

Interestingly, when participants were debriefed and given a full explanation of the experiment the majority commented they had not noticed that partitions had been either added or removed to any of the screens. This perhaps reveals how privacy can be subtly enhanced by changes to the design of systems used in public areas. There

appears a need to consider the actual task the system is used for and this should be reflected in the design. When dealing with personal information a user needs a certain level of privacy so they can interact with the system without concern for other people in the immediate environment. Therefore systems used in public areas need to be designed so that regulating and maintaining a desired level of privacy does not cause concern for the user. When dealing with personal information on public systems, e.g. entering PIN, invasion or violation of privacy can occur. If invasion or violation occurs privacy is lost and dependent upon the importance of the information, e.g. someone seeing his or her PIN or account balance, this will result in a negative effect on the user.

A core theme in HCI is to objectively design, construct and evaluate computer-based interactive systems so people can use them efficiently, effectively, safely and with satisfaction (Hartson, 1998). When considering systems used in public areas, in particular ones that are used to access personal information, size and type of interface need careful consideration. Privacy is an important factor that needs to be considered in the design process.

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