User Reactions to Videoconferencing: Which Students Cope Best?

Steve Wheeler, *Plymouth, UK*

Abstracts

English: This article reviews a study conducted to establish the psychological basis for user responses to digital videoconferencing. Left and right brain laterality and the demographic factors of age and gender were examined as possible predictors of user response. Behavioural and affective responses were measured in a small group of distance learners (n=60). Affective measure 'A' concerned user perception of equipment functionality and usefulness, and the intention to repeat the experience, whilst behavioural measure 'B' examined anxiety level and self-consciousness. Significant differences were observed between age groups with older participants expressing greater satisfaction with functionality and less anxiety overall. A lesser effect was observed between males and females with the latter reporting higher satisfaction levels and lower anxiety with the technology. No significant difference between left and right brain lateralities was observed.

Français: Cet article rend compte d'une étude conduite pour établir la base psychologique pour les résponses des étudiants à la vidéoconférence digitale. On a pris en compte la latéralité gauche et droite du cerveau et les facteurs démographiques d'âge et de sexe afin d'essayer de mieux prévoir les réactions des usageurs. Les réponses concerenant les attitudes et les réactions affectives ont été mesurées chez un group limité d'étudiants à distance (n = 60). La mesure affective 'A' concernait la perception de la fonctionalité de l'équipement et de son utlité, ainsi que l'intention de répéter l'expérience, tandis que les mesures d'attitude 'B' examinait le niveau d'anxieté et de conscience de soi. Des différences significatives ont été observées entre les groupes d'âge, les participants plus âgés exprimant davantage leur satisfaction de l'équipement et faisant preuve de moins d'anxiété en général. Un effet moindre a été observé entre les hommes et les fammes, ces dernières étant plus satisfaites et étant moins anxieuses devant la technologie. Aucune différence significative entre les latéralités droite et gauche n'a été observée

Deutsch: In diesem beitrag wird über eine studie berichtet, die zur herstellung einer psychologischen basis für nutzerreaktionen auf digitales videoconferencing diente. Linke und rechte hirnhälften und der demographische faktor bezüglich alter und geschlecht wurden als mögliche voreinstellungen für das nutzerverhalten untersucht. Das verhalten und affektive reaktionen wurden in kleinen gruppen (N=60) von distance-lernern gemessen: die affektive messung 'A' bezog sich auf nutzereinsicht in die ausstattungsfunktionalität und – nützlichkeit sowie die einstellung zu einer wiederholung des experiments, während die verhaltensmessung 'B' angstlevel und selbstbewußtsein untersuchte. Signifikante unterschiede wurden festgestellt bei gruppen mit älteren teilnehmern mit höherer zufriedenheitsrate bei der funktionalität und weniger angstüberschuß. Ein geringerer effekt wurde zwischen frauen und männern beobachtet, wobei die ersteren über höhere zufriedenheit und geringerer technologieangst berichteten. Kein signifikanter unterschied wurde zwischen der linken und der rechten gehirnhälfte beobachtet.

Introduction

The University of Plymouth is located in the south west peninsula of England and operates from six main campuses spanning a predominantly rural range of approximately 150 miles (230 kilometres). It is the fifth largest university in the UK, with over 20000 full time students and more than 2000 full time staff. As a regional academic institution, the University of Plymouth must deliver high quality education and training courses. Many students are recruited from within the region and a high proportion of these live in small communities in the surrounding countryside, often in remote rural areas. This can be problematic as they must regularly travel to the main campus to attend lectures, tutorials and seminars. Often, particularly with part-time postgraduate students who have work and family commitments, this can be extremely difficult, expensive and time consuming. The south west of England does not have a good transport infrastructure and travelling conditions are variable due to the seasonal tourist trade and geographical remoteness of many communities. Furthermore, teaching staff are often expected to travel great distances to reach these distributed student groups, for teaching practice observations and tutorials, and costs of transport and subsistence continue to rise.

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The University of Plymouth has therefore focused for several years on developing telematics solutions to enable students to study substantially at a distance, whilst retaining close communications links with both their tutors and peers. This approach has led to many prestigious projects and awards, including Rural Area Training and Information Opportunities (RATIO), ADAPT through RATIO (Wheeler, 1997), and WIRE Media Space (Vranch *et al.*, 1997; Patel 1997). Since 1989, the University has also enjoyed privileged access to TDS-4, a V-SAT uplink facility on long-term loan from the European Space Agency. Using this facility, the University and its partner organizations can transmit signals to a range of communications satellite, with footprints covering most of Europe. Live television and data have thus been broadcast regularly to deliver training and information to remote areas. More recently, MPEG2 digital codec technology has been employed to improve quality, reduce transponder bandwidth space and thereby reduce costs.

Study centres have been set up across the region offering students access to internet and e-mail facilities, digital videoconferencing links and access to the digital satellite TV broadcasts. Centres also stock a wide range of learning materials including paper based, CD-ROM and videotape resources. These include materials to support the delivery of courses in computing, languages, business, nursing, midwifery, medical and probationary officer training

One of the most effective ways to support learning at a distance has been to offer tutorials using desktop ISDN videoconferencing. Students work through materials at their own pace, and spend as little or as much time as they need in the telematics centre. When they wish to communicate with their tutor, they use either the e-mail facility, or increasingly, the videoconference link on a nearby personal computer. They are then able to enjoy 'face-to-face at a distance' conversations with subject experts, and also share files and send assignments for guidance and assessment of learning (Winders, 1993). Students who study in this manner can eliminate a great deal of the costs associated with travel, accommodation and time spent on the road. By using telematics technologies, a cost effective link between tutor and student can be maintained without sacrificing interactivity and dynamism. Videoconferencing has also been used successfully on many occasions to enable remote students to ask questions of studio guests during live TV transmissions.

Videoconferencing is therefore becoming an important strategic component in distance learning, and it is vital that research is conducted into ascertaining the effects, both pedagogically and psychologically on users. Several researchers have reported that technophobia and other associated problems arise when students are exposed to computing and communications technologies (Brosnan, 1998; Gibson, 1996; Wheeler, 1993). Furthermore, students learning at a distance from their tutors can often experience feelings of isolation due to lack of social support and physical remoteness. This 'transactional distance' between tutors and students often creates a psychological 'gap' which has the potential to create misunderstandings between the two (Moore, 1991; Willis, 1993; Marsden, 1996). If it is not effectively bridged at an early stage, this psychological gap tends to become a chasm, with differentials between expectations and intentions on both parts resulting in confusion, frustration, feelings of isolation, demotivation and, ultimately, increased student attrition rates.

There is still a dearth of research into how visual based communication systems impact upon individuals as they study at a distance. Rowntree (1982) pointed out a lack of research to relate multi-media presentations to individual characteristics of learners. Jones *et al.* (1997) echoed these sentiments by calling for guidelines to match delivery modes to the individual learning needs of students. Ehrmann (1990) has also indicated an urgency for research into individual factors in distance education students. This paper reports on a pilot study conducted to lay the groundwork for research into these areas.

Theoretical framework

A good starting point for research into the psychological dimensions of user responses to new technology is at the level of the individual. If we are serious about student centred learning, we should be examining the impact of new technologies upon individuals before we study group effects. Individual differences such as cognitive style and preferred approaches to study have yielded fruitful results in increasing our understanding of student motivation (Entwhistle, *et al.*, 1987), levels of processing (Entwhistle and Waterston, 1988) and the design of course materials (Hayes and Allinson, 1993; Sadler-Smith, 1996). At the deepest level of individual difference study is brain laterality.

Neuro-psychological studies into split-brain individuals by Sperry (1968) and Gazzaniga (1970) established that the two hemispheres of the human brain operate as distinctly separate yet integrated organisms. Studies into cognitive style suggest that the left hemisphere is generally used by the majority of people to process language and logic operations, whereas the right hemisphere is used to represent images and intuitive thought processes (Ornstein, 1972). Cognitive style can be described as a consistent approach to organizing and processing

information (Tennant, 1988). Work by Paivio (1971) showed that when an individual processes information, a dual processing occurs, whereby imagens (pictures and visuo-spatial information) are processed separately from logogens (verbal and textual information).

The aim of this reported study was to establish whether left brain or right brain individuals showed a greater satisfaction and general ease with using videoconferencing. It was predicted that right brain users would exhibit significantly less anxiety and more general satisfaction with videoconferencing than left brain users due to the visual nature of the medium.

The demographic dimension was also considered to be of interest in the reported study. In particular age and gender were thought to be possible predictors of user response to new technologies. The second research hypothesis therefore predicted that older participants would report greater anxiety than younger participants due to less familiarity with the technology.

The third hypothesis predicted that males would report greater satisfaction and show less anxiety and self-consciousness when using videoconferencing than females. This last hypothesis was based on the premise that males generally demonstrate better visual-spatial abilities than females. It is also generally accepted that females demonstrate better verbal skills (Maccoby and Jacklin, 1974; Linn and Petersen, 1986; Lips, 1988)

Method

Participants

A number of remotely based 'naïve users' of videoconference (those who had never experienced use of the system prior to participation) were recruited for the pilot study (n=60). There were 28 females and 32 males in the sample with a mean age of 35.6 years (16–63 years). Twelve were schoolchildren aged 16–18 at Hautlieu School in Jersey. The remainder was constituted of either business (small and medium enterprise) and education (student teacher) users.

Procedure

All participants were invited to take part in small groups of between 2 and 4. Participants were asked to complete a short questionnaire – Style of Learning and Thinking Inventory (Torrance *et al.*, 1977) – measuring brain laterality on a scale of +12 to –12. Each small group then used the videoconference link to contact a remotely sited individual whom they had not previously met, and converse for approximately 5 minutes. Finally, after breaking the link, each participant was then asked to complete a short satisfaction questionnaire.

Measures

The questions were presented as statements in a five point Likert scale format and measured four subsets of data: self consciousness and anxiety level (SC), intention to repeat the experience (IR), assessment of equipment functionality (EF) and social facilitation (SF). A Pearson product moment correlation was performed on the four subsets to check for internal validity of the questions. Strong association was observed between the questions related to assessment of equipment functionality, perception of social facilitation and intention to repeat the experience. These questions were grouped together under the affective measure 'A'. Strong association was also observed between the anxiety and self-consciousness questions, so these were assigned as the behavioural measure 'B'.

Equipment/apparatus

Desktop Pentium 230 personal computers were used for the study, each equipped with PictureTel Live 200 videoconference systems and external speakers to facilitate group conferencing.

Results

Table 1 presents scores as mean averages with standard deviations in parentheses. On the scale, higher scores indicate higher anxiety and higher aversion (lower preference). Preliminary data indicate that left-brained verbalizers reported less affinity with videoconferencing than right-brained imagers. However, one way analysis of variance (ANOVA) revealed a no significant variance between the left and right lateral groups.

Table 1 *Brain laterality mean scores and standard deviations (n=60)*

	Left lateral (n=29)	Right lateral (n=25)	Zero lateral (n=6)
Affective (satisfaction)	7.34 (3.36)	7.12 (3.12)	6.50 (3.88)
Behavioural (anxiety)	5.59 (2.21)	5.16 (2.56)	4.83 (4.62)
Total	12.90	12.28	11.33

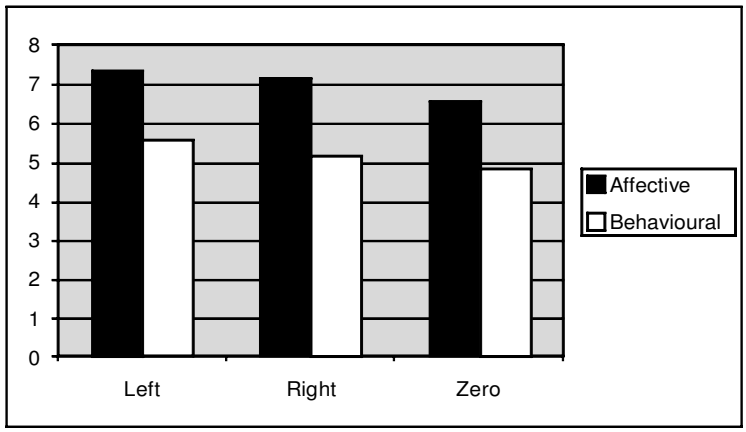

Figure 1 *Analysis of behavioural and affective responses: left, right and zero lateralities (n=60)*

Analyses of the left-right laterality group means showed variance in the expected direction with right dominant participants reporting less anxiety in measure 'B' left brain dominant participants scored slightly higher, indicating a higher level of anxiety and self-consciousness than right brain dominant participants. Affective measure 'A' also showed higher scores for left brain dominant participants, indicating that overall right brain dominant participants generally reported less anxiety and greater preference for videoconferencing than left brain dominant users. Generally, zero lateral participants fared the best, although uneven sample sizes prevent any concrete conclusions from being drawn. This is shown in table 1. These data are represented in graphical form in figure 1 (throughout this paper higher scores indicate lower preferences).

Gender differences

A gender analysis was also performed to establish if there was any significant variance between male and female scores. Mean scores indicated that females reported greater satisfaction and less anxiety and self-consciousness throughout the experience. Males reported greater reluctance to repeat the experience than females and also viewed the functionality of the equipment slightly less favourable than female users. However, one-way ANOVA revealed that responses on individual measures were statistically no-significant. A significant variance was observed between the total mean scores of males and females, at $F(3,55) = 2.96$, $p < 0.04$ (table 2 and figure 2).

Table 2 *Mean scores between sexes and standard deviations (n=60)*

	Male (n=32)	Female (n=28)
Affective (satisfaction)	7.53 (3.40)	6.57 (3.19)
Behavioural (anxiety)	5.50 (2.84)	5.04 (2.55)
Total	13.03	11.61

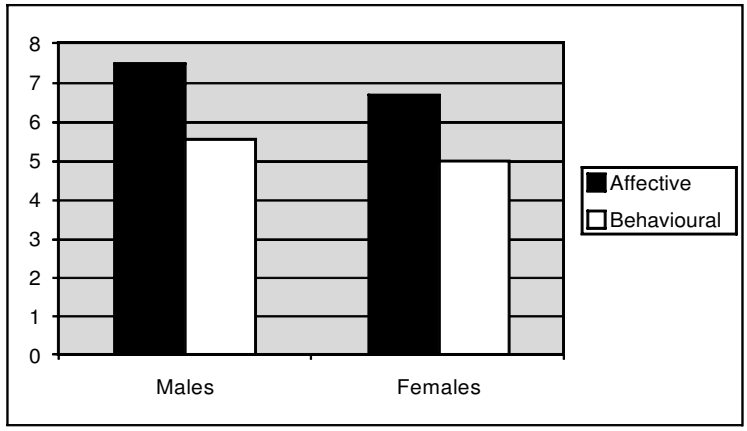

Figure 2 *Male/female differences (n=60)*

Age differences

Finally, the variance between age groups was analysed. Participants were designated as belonging to one of four age groups: 16–25 years (n = 14, mean = 16.93, sd = 0.73); 26–34 years (n = 14, mean = 30.5, sd = 2.13); 35–44 years (n = 14, mean = 39, sd = 2.6) and over 44 years old (n = 17, mean = 52.5, sd = 5.32). One participant declined to give an age and was therefore dropped from this part of the analysis (n=59). Initial analysis of sample means revealed that the youngest age group was the most anxious and self-conscious when using the video link and reported the least preference. They indicated more reluctance to repeat the experience and expressed a markedly less favourable attitude to the functionality of the equipment than the older age groups. Generally this population split produced the largest variance of scores in both measures as well as between total mean scores. The 35–44 year old age group seemed a great deal more at ease with using video conferencing to communicate at a distance than any other age group. ANOVA revealed a statistically significant result at $F(24,18) = 2.98$, $p < 0.04$, between the total scores of all age groups. ANOVA also revealed significant variance between the total scores of the 16–25 year old and 35–44 year old age groups at $F(1,26) = 10.39$, $p < 0.03$, and between the 16–25 year old and over 45 year old age groups at $F(1,29) = 5.78$, $p < 0.02$. Significant variance was also observed between the 16–25 year old age group and the 35–44 year old age group on both the affective measure 'A' at $F(1,26) = 6.26$, $p < 0.01$, and the behavioural measure 'B' at $F(1,26) = 5.67$, $p < 0.025$. Multivariate analysis revealed no significant interaction between any of the aforementioned factors (table 3 and figure 3).

Table 3 *Age split mean scores and standard deviations*

	16–25 years (n=14)	**26–34 years (n=14)**	**35–44 years (n=14)**	**>44 years (n=17)**
Affective (satisfaction)	8.50 (2.85)	7.86 (3.25)	5.86 (2.77)	6.71 (3.50)
Behavioural (anxiety)	6.50 (1.95)	5.29 (2.81)	4.71 (2.02)	5.06 (3.25)
Total	15.00	13.14	10.57	11.76

Discussion

Results of the data analysis suggest that the main factor generally influencing user satisfaction within this sample population, at least in terms of anxiety and self consciousness, is age (and therefore experience). Brain dominance and other laterality traits are notoriously difficult to measure accurately and this may have been a factor in the distinct lack of significant results within this predicted dimension. Significantly, the direction predicted for gender was reversed, with females expressing greater preference and lower negative responses to the technology. We shall return to the discussion of these factors later in this atricle. Firstly, age – the most significant factor influencing user responses – will be examined.

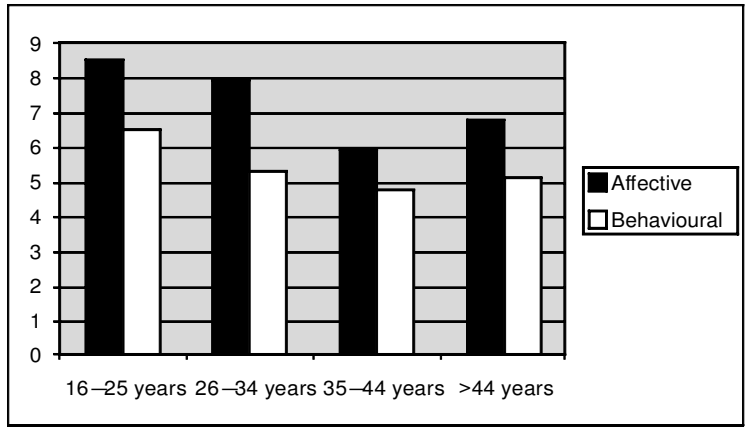

Figure 3 *Age differences*

It may be argued that in the age variances observed, older participants had had more experience of social interaction within novel situations and therefore were more at ease communicating using the new technology. This does not explain the responses of the oldest group, however, who although generally more comfortable than the two youngest groups, expressed less satisfaction than the 35–44 year old age group. Younger participants, conversely, may perhaps have been more self-conscious and anxious due to a lack of practice in communicating to others in novel situations. This may have been a case of the 'media' having more of an impact that the 'message'. Another factor possibly influencing the youngest groups' responses within measure 'B' may have been peer group and 'authoritarian' influence, as all those in the 16–18 year old age band took part in groups of four within a classroom setting, with a teacher present. This does not explain the total overall effect however, as other members of this age group participated outside of a typical school setting.

Females fared generally better than males in self-reported responses to both measures, expressing less anxiety and self-consciousness, and reporting more favourable attitudes towards the functionality and usefulness of the equipment. One explanation for this result is that females may 'see through' the technology more successfully than males, perceiving the videoconference equipment as a means to an end, that is, social interaction. Studies have shown that females have greater verbal ability (Maccoby and Jacklin, 1974; Halpern, 1989) and this factor may be more important in videoconferencing than the greater visual-spatial abilities that males tend to demonstrate. In industrialized nations, males are generally more technologically sophisticated due to well documented socialization and schooling influences (Naffzinger and Naffzinger, 1974; Sharpe, 1976; Clarricoates, 1980; Brosnan, 1998) and this may prove to be a pitfall. Males may concentrate more on the effects of the technology rather than the reason for the technology and this may create a psychological barrier to good communication, by raising arousal levels. Generally speaking, it appears that cognitive abilities such as visual-spatial skills are less important contributors to performance than the perception of the functionality of the technology being used. This finding supports the work undertaken by Reid *et al.* (1997) who studied group discussion and decision making via computer mediated conferencing (CMC). Reid *et al.* concluded that obtaining an understanding of the psychological impact of CMC will come from an examination of the social meaning of goal directed tasks, rather than the static properties of the technology.

Finally, a lesser, but possibly important factor impacting on the data may be that of left/right brain laterality. Further research is demanded in this area as statistical analysis of the data offered no support for the original hypothesis. One of two conclusions may be drawn from the results in this part of the study. Either the measures applied were ineffective, failing to measure an influence that may be present, or left and right brain differences in individuals have no significant predictive value over the responses and preferences of individuals who use new communications and information technologies.

Several potentially confounding variables and measurement errors may have influenced the results presented in this study. Firstly, most participants took part in the study in groups of threes and fours for reasons of economy and time constraint. Future studies of a similar nature should focus on individual rather than corporate use of the technology to eliminate this possible source of measurement error.

Secondly, because of geographical limitations different interviewers at remote sites were used, and thus the content and presentation style of each video-linked conversation varied slightly. Although this would in no way affect the data gathered in the first questionnaire, it may have influenced participants' completion the satisfaction questionnaire. Ideally, either a 'scripted' dialogue, or preferably continuity of presentation by one interviewer is desirable for future studies.

Thirdly, users participated from several remote sites, and it was therefore impossible to strictly control local environments to eliminate distractions or maintain a uniform setting for the study. Again, continuity of environment would be desirable to eliminate any extraneous factors of influence.

In conclusion, individual differences such as left/right brain dominance and gender appear to contribute to anxiety, satisfaction levels and preference for videoconferencing as a communication method. However, these results were inconclusive when analysed for statistical probability. More notably, the factor of age difference revealed significant variability across groups, with older participants generally responding better to the technology than younger participants. We can conclude therefore that age and possibly other individual difference factors might have a negative effect on performance and quality of learning outcomes for those engaged in distance learning activities using videoconference systems.

A desirable outcome for future research would be to design delivery and support systems and to develop appropriate training programmes to match the styles and preferences (and particularly age and experience) of open distance learning students, and so create the highest quality distributed learning environments. The author intends to develop this study further and extend it to include cognitive styles and learning preferences. It will be important to consider the dynamics of distributed groups also. Finally, there is also scope to extend this research to include the study of other forms of telematic delivery and support methods, including text based and audio based communication systems.

Glossary of terms

ADAPT: European structural fund.

Codec: coder decoder – the device that translates signals into a format fit for transmission.

Footprint: the beam coverage of a satellite.

Geosynchronous: stationary satellites used for communication are positioned at an orbital altitude enabling them to match the rotation of the earth and thus remain stationary in the sky. This eliminates the need for expensive tracking equipment.

ISDN: Integrated Services Digital Network.

MPEG2: Motion Picture Experts Group; a digital broadcast standard.

RATIO: Rural Area Training and Information Opportunities; a European funded telematics project based in South West England.

TDS-4: Test and Demonstration Site 4; The ESA uplink dish currently located at the University of Plymouth.

Transponder: part of a satellite; a broadcasting device, enabling signals to be transmitted back to earth.

Uplink: Term used to describe the transmission of signals up to a satellite.

V-SAT: Very Small Aperture Terminal; a specialized satellite dish used to send as well as receive transmissions.

Wire Media Space: a project aimed at the telematic delivery of multimedia courses to study centres across Europe.

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Biographical note

Steve Wheeler is currently Senior Lecturer in Distance Learning at the University of Plymouth, UK. He has responsibility for researching the effectiveness of telematic delivery systems in distributed learning and is in the final stages of writing up his PhD thesis into the psychological impacts of new technologies on distance learning. His work can be accessed on the web at: http://www.fae.plym.ac.uk/tele/tele.html

Address for correspondence

Steve Wheeler, Senior Lecturer, Graduate School of Arts and Education, Faculty of Arts and Education, University of Plymouth; e-mail: swheeler@plymouth.ac.uk