Effective strategies of tutors teaching adults with learning disabilities to use virtual environments

P J Standen[1], D Brown[2], R Blake[3] and T Proctor[4]

[1,3,4]Division of Rehabilitation and Ageing, University of Nottingham, United Kingdom
[2]Computer Science, Nottingham Trent University, Nottingham, United Kingdom

[1]*p.standen@nottingham.ac.uk*, [2]*david.brown@ntu.ac.uk*, [4]*tracey@pippy.freeserve.co.uk*

ABSTRACT

Nine adults with learning disabilities spent up to twelve sessions with a non-disabled tutor learning to use desktop virtual environments designed to teach independent living skills. Sessions were recorded on videotape and analysed for frequency of tutor behaviours and goals achieved by learners. Before goals could be achieved, the learner had first to master the interaction devices and then learn to navigate around the environment. Preliminary analysis suggests that goal achievement maintains a constant level while instruction about the input devices and specific information about the environment decrease. Behaviours that maintain attention and motivation increase while positive feedback remains constantly high.

1. INTRODUCTION

Following an increase in its role in mainstream education, computer delivered instruction has started to make a contribution to the education of children with learning disabilities (Goldenberg 1979; Dube, Moniz & Gomes 1995; Chen & Bernard-Opitz, 1993). Interactive software encourages active involvement in learning and gives the user the experience of control over the learning process (Pantelidis, 1993). This is especially important for people with learning disabilities who have a tendency to passive behaviour (Sims, 1994). The learner can work at their own pace (Hawkridge and Vincent, 1992). They can make as many mistakes as they like without irritating others and the computer will not tire of the learner attempting the same task over and over again, nor get impatient because they are slow or engrossed in particular details (Salem-Darrow, 1995).

As an example of interactive software, virtual environments have a contribution to make to the education and training of students with learning disabilities (Cromby, Standen and Brown, 1996). Cromby et al (1996) draw attention to three characteristics in addition to those shared with other forms of computer delivered education which make them particularly appropriate for people with learning disabilities. First, virtual environments create the opportunity for people with learning disabilities to learn by making mistakes but without suffering the real humiliating or dangerous consequences of their errors. Secondly, virtual worlds can be manipulated in ways the real world cannot be. A simple world can be constructed within which the task could be performed and as the user becomes more familiar with the task the world can become more complex. Features to which the learner needs to pay attention can be made more prominent (McLellan, 1991).

Thirdly, in virtual environments rules and abstract concepts can be conveyed without the use of language or other symbol systems. Virtual environments have their own "natural semantics" (Bricken, 1991): the qualities of objects can be discovered by direct interaction with them. They can thus be used to facilitate concept attainment through practical activity, by-passing the need for disembedded thinking (Donaldson, 1978) which people with learning disabilities often find difficult to acquire and use.

Initial work suggests that virtual environments are effective in facilitating the acquisition of living skills for example shopping and navigating new environments (Standen, Cromby & Brown, 1997, 1998; Standen and Cromby, 1997) and Makaton sign language (Standen and Low, 1996) by children with severe learning disabilities. With the wider availability of computers in both primary and secondary schools for mainstream and special education (Light, 1997) there is a need to investigate a range of questions about this new aid to learning. However at the same time, there are adults with learning disabilities who may have had little or no computer experience at school but whose continuing educational needs have been recognised by the Tomlinson Report (1997).

Around 20 people in every thousand have mild or moderate learning disabilities and about three or four per

thousand have severe learning disabilities. They are unlikely to enter employment when they leave school or to achieve the level of independence expected by the rest of society. Adults with learning disabilities will have the option to attend some form of college or day centre, the role of which is to provide training programmes relating to the development of daily living, social and educational skills. As in special education, VE have a role to play in this. Brown et al (1999) have developed a virtual city for people with learning disabilities to facilitate the learning of skills like catching a bus, road crossing and buying food in a café

Rostron and Sewell (1984) see computers as just "one more useful facility in the general remedial framework that is available" (p9) but advise that they are not there to replace human teachers, just to provide them with additional teaching aids. Computers are highly motivating but Rutkowska and Crook (1987) caution against the naïve belief that unguided interaction can effectively exploit their educational potential (p91). There are two ways that interaction can be guided in this form of learning. The first is through the involvement of a human tutor. The work described above using virtual environments was carried out utilising desk top systems where the public nature of the display allows interactions between the learner and a tutor. A study by Standen & Low (1996) examined the strategies employed by teachers who were encouraging school aged students with severe learning difficulties to use a virtual environment to learn Makaton sign language. They found that teachers contributed significantly less as sessions progressed selectively dropping the more didactic and controlling behaviours in their repertoire.

For both children and adults with learning disabilities it is important to learn with a tutor but staff are responsible for too many students to be able to give one-to-one tuition on a regular basis and when they are able to provide this function need guidance on effective strategies. According to Hawkridge and Vincent (1992) teachers need help and encouragement to build their confidence and skills in using computers and deserve proper training opportunities. Resolution of this situation involves a consideration of the functions of the tutor. One of the primary functions of tutoring according to Wood, Bruner and Ross (1976) is to allow the learner to make progress by initially providing scaffolding, for example by controlling those elements of the task that are initially beyond the beginner's capability. As the beginner becomes more familiar with elements of the task and develops the ability to carry it out independently the tutor intervenes less. Another is to maintain the learner's interest and motivation, marking relevant features of the task and interpreting discrepancies between the learner's productions and correct solutions. As proposed by Slator et al (1999) the first of these functions could be incorporated into the software. This would be either in the form of unintrusive tutoring (giving advice but not preventing actions) or intelligent software tutoring (providing feedback based on the tutoring agent's experience of the task and the learner's behaviour). Such a software tutor would enable a less experienced person, even a peer to carry out the function of maintaining the learner's interest and motivation.

In order to inform the design of the software tutor we set out to investigate what strategies human tutors used when working with adults who were learning to use virtual environments and how effective these strategies were.

2. METHOD

2.1 Participants

So far data are available on 9 people attending a social services adult training centre for people with learning disabilities. They would all be described as having moderate to severe learning disabilities but staff have yet to score them on the AAMR Adaptive Behaviour Scale (Nihira et al 1998).

2.2 Design

Each participant completes up to 12 sessions and changes from baseline and over time are examined

2.3 Virtual environments

The virtual environments shown in Figure 1 have been developed as part of the Virtual City project sponsored by the National Lottery Charities Board. The project consortium consisted of The University of Nottingham, The Shepherd School and The Metropolitan Housing Trust (Brown et al, 1999). All of these environments were displayed on Pentium II with 17" monitor, operated using a standard 3 button mouse or trackball.

2.4 Procedure

Service users who wished to take part spent a session using a 2 dimensional routine to learn how to use the mouse. Once this had been mastered they moved on to the other environments in the same order (road crossing, café, supermarket, factory) only progressing to the next once a defined level of mastery had been achieved. Sessions were scheduled as close as possible to twice a week and lasted approximately 30 minutes. They were recorded on videotape, the camera positioned to view both the learner and the tutor sitting next to them.

Virtual Supermarket

The Virtual Supermarket was based on a real supermarket in Nottingham and aimed to promote basic shopping skills. The Virtual Supermarket is illustrated here and the learning objectives identified for this environment are as follows:

- Creating an icon-based shopping list
- Selecting items from the shelves
- Finding all the items from the shopping list
- Paying for goods at the checkout

Virtual Café

The contents and layout of the virtual café were based upon the University of Nottingham's Art Centre Café. The Virtual Café is illustrated here and the learning objectives identified for this environment are as follows:

- Making choices and decisions – ordering drinks from a list for self and others.
- Social skills when ordering
- Communication with staff and public
- Money handling - paying for drinks
- Appropriate behaviour - table manners, etiquette
- Appropriate dress
- Toilet use in public situation
- Dealing with alcohol - what drinks you can order at what ages, and the affects these drinks may have on you

Virtual Transport

The Virtual Transport system was designed as a way of physically linking the other three VEs. Thus, the user could take the bus from the house to the supermarket, or to the café, etc. The bus route was not modelled on any actual location but the buses themselves were made to resemble Nottingham City buses which the users would be using. The Virtual Transport environment is illustrated here and learning objectives identified for this VE are as follows:

- Select the correct coins for the bus
- Leave the house with enough time to catch the bus
- Cross the road safely
- Catch the correct bus
- Pay the bus driver and collect your ticket
- Get off the bus at the correct stop

Virtual Factory

The Virtual Factory was designed in collaboration with the Health Authority to teach health and safety skills to people with learning disabilities entering sheltered employment. The learning objectives identified for this VE are:

- Selecting correct clothing before entering the factory
- The dangers of entering black and yellow lines
- Storage of chemicals
- Fire safety drills
- Collection of COSSH forms
- Hygiene within the factory

Figure 1. *Virtual Environments.*

3. RESULTS

3.1 Coding of videotapes

The coding system was developed with the help of RB who had previously carried out a pilot study on 9 service users. The system went through 3 different phases before a satisfactory level of repeat reliability (between 75 and 80%) could be established.

Tutor behaviour was coded into 5 categories

- *Specific information* given to learner about achieving a goal and was further categorised as being about the mouse, the joystick or the environment (e.g. "go over to the bar now).
- *Non-specific information* did not provide the help a learner needed to achieve a goal but made the learner aware of possibilities and was similarly categorised as concerning the mouse (e.g. "where are you going to click then?"), the joystick or the environment.
- *Gesture* covered any movement made by the tutor for example pointing to direct attention to the screen or to instruct movement of the arrow on the screen or to direct movement through the environment.
- *Touching* controls included the tutor putting their hand over the learner's or taking over the input device to demonstrate and was further categorised as concerning either the mouse or the joystick.
- *Feedback* could be either positive such as praise or reassurance (e.g. "well done", "that's good") or negative ("no, not like that").

Learner behaviour was categorised in terms of the number of goals they achieved in an environment and could be either positive (finding an item on the shopping list) or negative (stepping into the road before the light has turned to green).

3.2 Analysis

Sessions were divided into 10 second intervals and whether or not a particular behaviour started during this interval gave it a score of 1. Therefore the maximum score for a behaviour for any one session could not be greater than the number of 10 seond intervals in that session. The score was converted to rate per minute to take account of differences in duration of sessions.

3.3 Use of input devices

One of the tasks of the tutor was to assist with mastery of the input devices but specific information about them was always given at a lower rate than about the environment itself. Both touching and specific information about the mouse (see Fig. 1) and the joystick (see Fig. 2) did decrease over repeated sessions. Unsurprisingly there were very low levels of non-specific information throughout.

3.4 Learners' achievement of goals

Environments differed in the number of goals there were to achieve and on the early attempts at each environment not all goals were attempted. Figure 3 shows the rate per minute at which goals were achieved irrespective of which environment the learner was working on. To give context to the activity of the tutor, it appears that learners were achieving goals at a steady rate. However, to give a true picture of achievement, rates need to be adjusted to take account of the total possible number of goals that could be achieved in each particular environment and also whether the learner had just progressed to that environment.

3.5 Tutors' strategies

Although learners' goal achievement was remaining at a steady level, tutors provided less and less specific information as sessions progressed while giving increasingly more non-specific information (see Fig. 4). Negative feedback was always very low while positive feedback remained at a high level. Closer analysis might illustrate whether this was needed to maintain learners' motivation or because it was a default level for the tutor and insensitive to behaviour on the part of the learner.

4. DISCUSSION

Although we had established a method of coding in an earlier study a new scheme had to be adopted for this study because the participants were much more able and verbal. However, this new system retained the distinction between help with input devices and help with negotiating the environment. The amount of help given with the mouse was much lower than that given with the joystick because specific training was given with the mouse prior to starting on the first virtual environment. Similar training with the joystick would have been helpful as well as a user friendly method for determining individual settings for the controls. The distinction between

specific and non-specific information follows work on children's learning (Wood et al, 1976) where different levels of control exerted by the tutor were distinguished. Changes over time in the present study suggest that this distinction is worth maintaining. The tutors appear to be following the expected pattern of intervening or controlling less thus allowing more time for the behaviours which maintain the learner's interest and motivation and function to interpret the learner's activity. This distinction might also correspond to that between tasks which can be written into the software tutor (specific information) and those that need the presence of a human tutor. Although preliminary analysis of data shows interesting changes over time, the true value of the effectiveness of the strategies can only be determined by further, closer analysis.

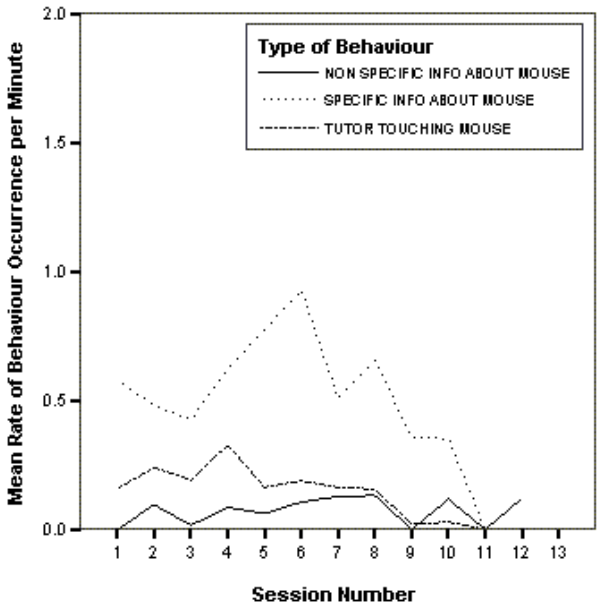

Figure 1. *Tutor behaviours relating to mouse.*

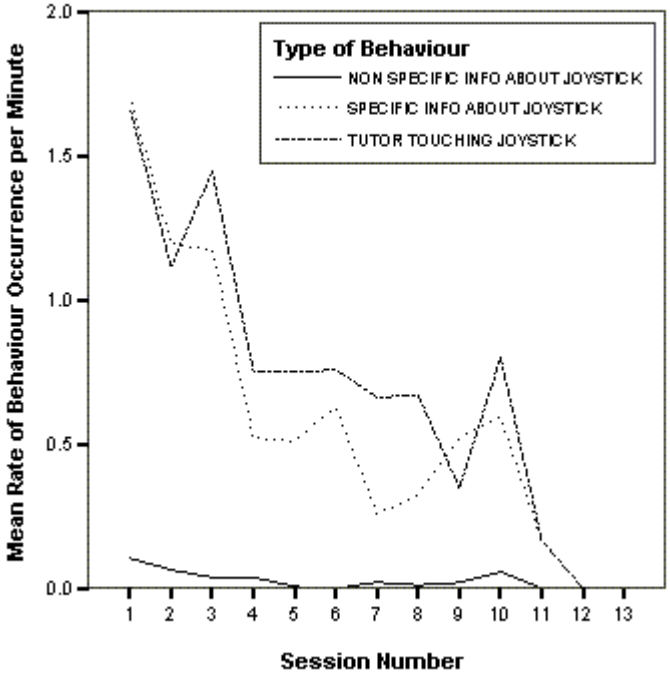

Figure 2. *Tutor behaviours relating to joystick.*

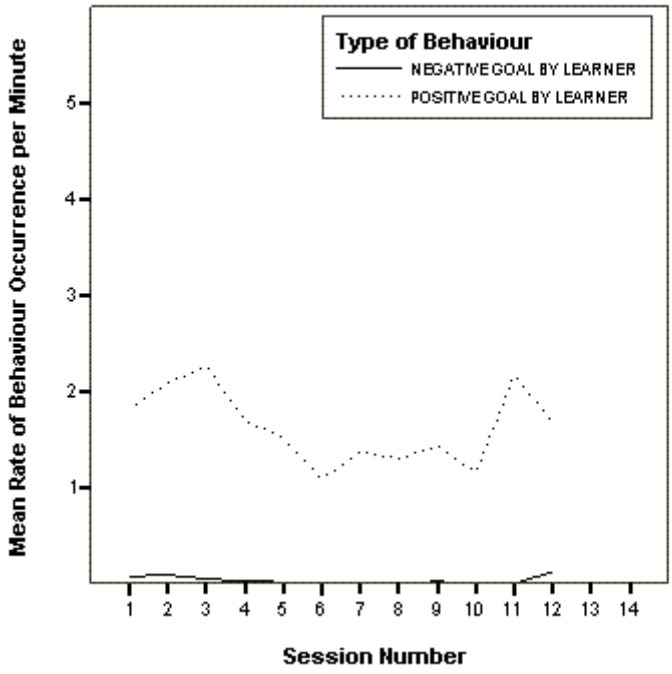

Figure 3. *Goals achieved by learner.*

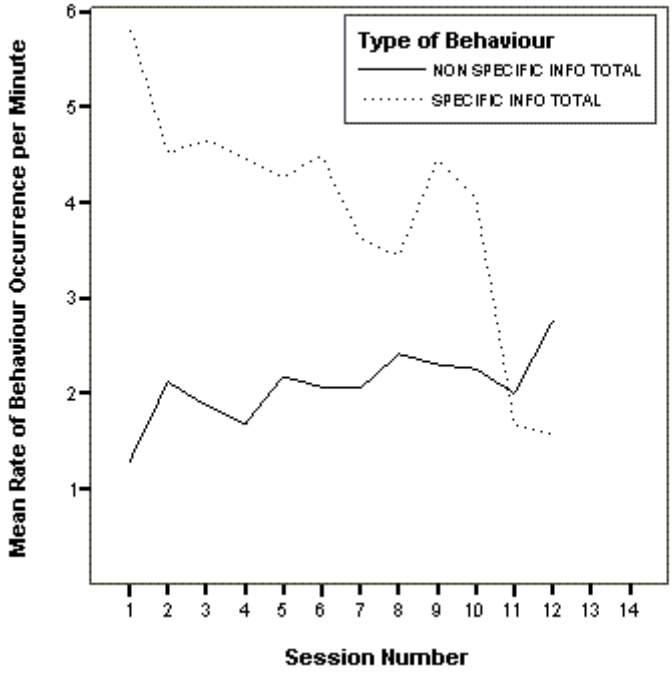

Figure 4. *Type of information given by tutor.*

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