

Successful transfer to the real world of skills practised in a virtual environment by students with severe learning difficulties

J.J. Cromby, P.J. Standen, J. Newman & H. Tasker

Department of Learning Disabilities,
University of Nottingham Medical School
Queens Medical Centre, Nottingham NG7 2UH

John.Cromby@nottingham.ac.uk

ABSTRACT

Nineteen students with severe learning difficulties aged between 14 and 19 years completed a shopping task in a real supermarket before 9 students, the experimental group, had twice-weekly sessions carrying out a similar task in a virtual supermarket. The remaining 10 students formed the control group, matched with the experimental group for ability, age and sex. They had the same number of sessions using other virtual environments. Although there was no difference between the two groups at baseline, on repeating the task in the real supermarket the experimental group were significantly faster and more accurate than the control group.

Keywords: transfer, generalisation, training for independent living

1. INTRODUCTION

1.1 Overview

Before virtual environments can be widely used as an educational medium it must be demonstrated that skills practised in them can transfer successfully to the real world. This is a particular issue when the intended users are students with severe learning difficulties (in other countries, mental handicap or mental retardation), for whom generalisation of skills from training situations to the real world is notoriously difficult. This paper describes a pilot study showing successful transfer to the real world of shopping skills practised in a virtual supermarket by a group of students with severe learning difficulties.

1.2 Background

With the continuing expansion of “care in the community” there is an urgent need to train young people with learning difficulties in the skills required for independent living, yet the training methods currently in common use are problematic. On the one hand, if skills are taught in a training situation initial learning may not transfer easily to novel situations (Miller 1992). Assessment of social skills training programmes for people with learning disabilities shows that skills and knowledge learnt in training are unlikely to generalise beyond the teaching situation and that even when they do they are rarely maintained for very long after training has ceased (Robertson et al, 1984; Davies & Rogers, 1985). This failure to generalise has been attributed to both the design of the intervention (Stokes & Baer, 1977; Ward & Gow, 1982) and to the individual’s perceived status within the group varying from setting to setting (Selman & Jaquette, 1977).

Alternatively, training can be attempted in situ. However, this is both time consuming and staff intensive and hence prohibitively expensive. It also involves an element of risk, and in some instances the consequences of making a mistake may be so great that training in the real world is simply not an option. For example, use of a light industrial workshop by people with learning disabilities would require a grasp of basic health and safety principles before any in situ training could even be attempted.

Virtual environments may provide a solution to this problem. With a combination of careful design and programmatic use directed at clear and obtainable learning objectives they can be made to mimic closely the salient or critical features of the real world, making it more likely that skills will be transferred successfully. Where risk is a factor they permit the user to learn by making mistakes without suffering the real consequences of their errors. They may also have a particular pertinence in the training of people with learning disabilities because they promote self-

directed activity, decrease reliance on language or other abstract symbol systems, and minimise the effects of physical impairments (Cromby et al, in press).

For virtual environments to be of any use in training, learning obviously has to generalise to similar experiences in physical reality (Bricken, 1991). An unsuccessful attempt to demonstrate the generalisation of skills learnt in a virtual environment (Kozak et al., 1993) attributed the failure to the lack of veridicity of the virtual environment and the over-simplistic task (moving cans to target locations). However, Wilson (1993) describes successful attempts to teach children with physical disabilities the location of fire exits and appliances using a virtual model of the real building in which they were tested.

The present study examined whether shopping skills practised in a virtual supermarket by students with severe learning difficulties would transfer to a shopping task in a real supermarket. This task was chosen because of its high ecological validity and the relative ease with which it could be quantified. Using a supermarket is precisely the kind of activity which people with learning disabilities must be able to accomplish if they are ever to acquire any meaningful degree of independence.

2. METHOD

2.1 Selection of participants

The research took place at a school for students with severe mental retardation aged between three and 19 years. School staff nominated students to take part in the research if they met the following criteria:

1. They had sufficient motor skills and visual ability to be able to use the computer terminal and joystick
2. They were sufficiently able to carry out a real shopping trip with minimal staff support
3. They had used virtual environments on at least three previous occasions
4. The parents or carers gave consent for their child to take part in the research.

This resulted in a sample of 21 students aged between 14 and 19 years whose teachers then completed the classroom version of the Vineland Adaptive Behaviour Scale (VABS). The students were then assigned to either the experimental or control group so that the two groups were matched on age, gender and Vineland score. Their parents were asked to complete a short questionnaire detailing how much their child accompanies them and helps them with shopping. There were no differences between the two groups on these measures.

2.2 Design

Students' baseline performance on a shopping task in a real supermarket was compared with their performance after an eleven week interval during which the experimental group had twice-weekly sessions using a virtual supermarket while the control group spent this time using other virtual environments.

2.3 Procedure

2.3.1 The Real Shopping Task. Students were taken to the local supermarket and individually given a shopping list of four items which they were to find, put in their trolley and take to the checkout. The list was one of six made from both miniaturised colour reproductions of packets of commonly available consumer goods such as washing powder and breakfast cereal and actual labels cut from other items such as tinned goods, which were then mounted under clear film onto pieces of A4-sized card.

Their performance was monitored by the accompanying adult who maintained a distance from the student and recorded the following measures:

1. Total time: Time taken from passing through the turnstile into the shopping area until stopping at the checkout with their shopping.
2. Total number of items: All items placed in the trolley even if they were later put back onto the shelves before reaching the checkout.
3. Total items at end: Number of items in the trolley on arrival at checkout.
4. Total items correct: Number of items from the shopping list in the trolley on arrival at the checkout.

2.3.2 The Virtual Shopping Task. This consisted of a two-aisle store viewed on the monitor of an IBM compatible computer with movement through the store achieved by use of a joystick and selection of items by a mouse. Shelves

were filled with a representative selection of goods found in the local supermarket. There were five different lay-outs of goods on the shelves which the students were presented with at random each time they started a session. Students were given a list as described above and faced with the same task. Each session was initiated by entering the student's identifying number and the number of the shopping list used. The same set of measures that the staff collected on the real shopping trip were then obtained from the computer's record or by a researcher. In addition the researcher recorded the amount of time the students spent looking at the screen as a proportion of the total time spent in the virtual supermarket.

2.3.3 Other Virtual Environments. While the experimental group used the virtual supermarket the control group were free to use any of the other virtual worlds which included a virtual city, a virtual house and a ski-slope. In the days before the final assessment the control group also played a game with the shopping lists to ensure that they were not disadvantaged in familiarity with them when they returned for the second real shopping trip.

3. RESULTS

3.1 Participants

Two students in the experimental group spent very little time looking at the screen and there was no improvement in the time it took them to complete the virtual shopping task. They were therefore excluded from further analyses. The characteristics of the students who completed the trial are shown in Table I below.

Table 1. *Characteristics of participants*

	Mean Age	Gender	Mean VABS
Experimental Group	15.84	5M / 4F	5.40 (SD 1.66)
Control Group	15.67	6M / 4F	5.48 (SD 1.72)

3.2 Analysis

Data were analysed using SPSS for Windows.

3.2.1 Total Time to complete the task. Mean times taken to complete the real world shopping task for both real shopping trips are shown in Table 2 below. Neither group showed an improvement on this measure because the task had become more difficult at the second visit. The store had prepared for Christmas by changing their lay-out and increasing their stock. However, using an analysis of covariance with baseline time as a co-variate, the experimental group were significantly ($F = 7.173$, $df = 1,18$, $p < 0.02$) faster than the control group at the second visit.

Table 2. *Mean Times to Complete Real Shopping Tasks*

	First Visit	Second Visit
Experimental Group	11.97 (SD 5.7)	11.59 (SD 3.1)
Control Group	11.21 (SD 6.9)	16.92 (SD 5.8)

3.2.2 Number of Items Correct. Using a Mann-Whitney U Test there was no difference between the two groups at baseline but at the second visit the experimental group had significantly ($p < 0.05$) more correct items than did the control group. On the second visit there was no difference between the two groups in the number of items picked up whether correct or not (total number of items) and the experimental group had significantly ($p < 0.05$) fewer items in the trolley at the checkout (total items at end).

3.2.3 Other Shopping Experience. A two way ANOVA showed that whether students accompanied their parents shopping was significantly related to final shopping time ($F = 4.70$, $df = 1,18$, $p < 0.05$). However, the interaction with group was not significant, i.e. the experience of accompanying parents did not differentially benefit either the experimental or the control group.

4. DISCUSSION

In this study performance on a real shopping task benefitted from the experience of shopping in a virtual supermarket. Neither group showed an improvement from baseline, but on the second visit just two weeks before Christmas the task was significantly harder. The supermarket had increased their stock from around 5,000 to around 7,500 lines, and distracting displays of attractive toys, gifts and decorations were placed prominently at the junctions of aisles. Faced with this more difficult shopping task on the second occasion the experimental group completed the task in less time than did the control group.

Students in the experimental group also selected more correct items than did the control group. This cannot be explained in terms of the students improving their chances of a correct choice by simply picking up more items since the experimental group had significantly fewer items in their trollies on arrival at the checkout.

These results were achieved using a very simple virtual environment bearing a limited resemblance to the real supermarket. It is likely that in its simplicity the virtual environment successfully abstracted the essential features of supermarkets (packaging, aisles, shelves, checkout desk) enabling the students to recognise them in the real supermarket. The question remains of how much detail should be built into virtual environments to increase the likelihood that learning will generalise to other settings. The virtual environment needs to have sufficient detail for the learner to be able to practice skills needed in the real world (visual search, navigation) and to be recognisable as a representation of the real world. On the other hand too much detail may prevent the learner from extracting the salient features necessary for the task to be learnt. Further research may be able to identify the optimal levels of detail to facilitate both successful skill acquisition and generalisation.

Shopping in a supermarket involves a variety of skills: memorising items from the list, visually searching for them, remembering the route taken so far and the locations of items already passed. This is all made easier if the shopper has some understanding of the categorisation of goods such that finding coffee on the shelves makes it more likely that tea bags will be located nearby. In this study it is possible that the advantage that the experimental group had over the control group was mediated by a more general increase in familiarity with the task, or the fact that their sessions with the virtual supermarket were more structured than those on the other virtual environments. Research into changes in the specific sub-skills of shopping is currently underway, but measures need to be developed to assess any change in more generalised skills such as autonomy and decision making which may be produced by the experience of learning in virtual environments.

Finally, there is the the question of maintenance: ideally, skills must not only transfer to the real world but should also endure for some significant period. This raises many other issues, since regardless of the quality of the training method skills will only be maintained if there are real opportunities to practice them. A more interesting question may be how much learning experience in a virtual environment is necessary before the learner can move into the real world and begin learning there? Future research must identify critical features of appropriate educational virtual environments for students with learning difficulties, and also develop appropriate guidelines for their successful integration into the classroom.

5. REFERENCES

- Bricken, W. (1991) Training in virtual reality, Proceedings of the 1st International Conference on Virtual Reality, London, pp 46-48
- Cromby, J.J., Standen, P.J. & Brown, D.J. The potentials of virtual environments in the education and training of people with learning disabilities, in press, J. Intellectual Disab. Rsch
- Davies, R. R. & Rogers, E. S. (1985) Social skills training with persons who are mentally retarded, *Mental Retardation*, 23,(4), pp. 186-196
- Kozak, J. J., Hancock, P. A., Arthur, E. J. & Chrysler, S. T. (1993) Transfer of training from virtual reality, *Ergonomics*, 36, pp. 777-784.
- Miller, E.C. (1992) Special experiences for exceptional students: integrating virtual reality into special education classrooms, "Art, Science and Visual Literacy: selected readings from the 24th Annual Conference of the International Visual Literacy Association" Pittsburgh PA, pp326-334
- Robertson, I., Richardson, A. M. & Youngson, S. C. (1984) Social skills training with mentally handicapped people: a review, *Br. J. Clin. Psychol.*, 23, 241-264.
- Selman, R. L. & Jaquette, D. (1977) Stability and oscillation in interpersonal awareness: a clinical-developmental analysis. In C. B. Keasey (Ed.), *Nebraska Symposium on Motivation*, 25, pp. 261-304
- Stokes, T. F. & Baer, D. (1977) An implicit technology of generalisation. *J. App. Beh. Anal.*, 10, 349-367.

- Ward, J. & Gow, L. P. (1982) Programming generalisation: a central problem area in clinical psychology, *Educ. Psychol.*, 2, 231-248.
- Wilson, P. (1993) Nearly There, *Special Children*, Sept., 28-30.