An evaluation of the use of virtual environments in improving choice reaction time in people with severe intellectual disabilities

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ABSTRACT

People with intellectual disabilities are often described as being unable to make choices or decisions. This study set out to test whether choice making or selection from options in a virtual environment would improve the ability of people with severe intellectual disabilities to make decisions or choices in other situations. Volunteers attending an adult training centre were randomly assigned to one of two groups matched on age, sex and ability. The active group (n = 9) received six twice-weekly sessions using the virtual environments while their passive partner (n = 7) sat next to them watching the computer monitor. Before the intervention all participants completed three tests of choice reaction time which were repeated after the intervention. The active group significantly reduced their choice reaction time on two out of the three tests. There was also a decrease in choice reaction time on the third test however this did not reach significance. In comparison, the passive group showed a non-significant decrease in choice reaction time for only one of the tests. Although these results are encouraging, the study needs to be repeated with a larger group and the collection of additional data.

1. INTRODUCTION

A common perception of people with intellectual disabilities is that they are unable to make choices or decisions. This inability prevents them from playing a fuller role in society and maintains their dependence on staff or other care givers (Cooper and Browder, 2001) and has been cited as a barrier to making informed decisions about the health care they wish to receive (Welsh Health Planning Forum, 1992) and their ability to give eye witness testimony (Clare and Gudjonnsen, 1995). Cooper and Browder (2001) see this characteristic as resulting from a constant denial of choice which underlies their inability to respond to stimuli in the community and as a result they may never acquire skills that lead to enhancing their independence. Additionally, they believe limited opportunities to make choices may result in the expression of frustration in the form of aggressive behaviour or withdrawal. Reduced intellectual capacity need not necessarily lead to the inability to make choices as even people with severe and complex disabilities can express stable preferences when provided with choices (Lancioni, O'Reilly and Emerson, 1996).

The rationale for replacing traditional forms of institutional provision with small community based residential support, as well as being financial, included a belief that this move would facilitate both inclusion and self-determination (Robertson et al (2001). However, while there is considerable evidence to suggest that people in smaller community based residential settings may experience greater choice than people in larger more institutional settings, opportunities are still highly restricted (Robertson et al, 2001).

Cooper and Browder (2001) demonstrated how embedding choice opportunities in a trip to a fast food outlet can enhance choice making. They set out to increase the opportunities for choice making in a group of eight people with severe intellectual disabilities with a staff training package. Equating choice making with the selection of options, they trained staff to offer a series of two options (eg which of two doors through which to enter; two photos of food or drink options) when using fast food restaurants. Compared with baseline, the people with intellectual disabilities increased the number of choice responses they made both

prompted and independent. They also required a much lower level of prompting to make these choices after the intervention.

The implications of this study are that carers of those with intellectual disabilities need to present them with options on as many occasions as possible. However, what is the best way to increase the number of times options are presented? Options presented by staff and carers in day to day activities may well be the most ecologically valid way of increasing the opportunities for choice-making. However, staff are often pressed for time, wary of letting their charges take risks and may also find it difficult to suppress their natural inclination to take over before allowing the person sufficient prompts for them to perform the selection independently. Pantelidis (1993), talking about their role in education, claimed that virtual environments encourage active involvement: if the user remains passive nothing will happen. In common with other interactive software the user is constantly faced with making choices or decisions about what action to take next eg whether to move or remain stationary, which direction to go, which object to select. Standen and Low (1996) found that in initial sessions school aged students with severe and profound intellectual disabilities needed much assistance and prompting from a tutor to use desk top virtual environments. After repeated sessions, however, the amount of self directed interaction with the computer increased and the amount of help they required from the tutor decreased. If this self-directed activity in a virtual environment takes the form of making choices or selection from options, would this improve the ability of people with severe intellectual disabilities to make decisions or choices in other situations? The present study set out to answer this question.

2. METHODS

2.1 Participants

Twenty-five people with severe intellectual disabilities were invited to take part. They attended the adult training centre where the research was taking place. The criteria for approaching them was that they had not taken part in any of our earlier studies using virtual environments and that they had sufficient motor and visual ability to use the monitor and controls. Two refused the invitation because of their dislike of computers and one had behavioural problems that led his keyworker to advise that activities that were unsupervised by a member of staff from the day centre would be unwise. In order to match the groups as closely as possible, the remaining twenty-two were grouped into 11 pairs matched on age, sex, British Picture Vocabulary (a measure of verbal ability) and Raven's Matrices (a measure of non-verbal ability) scores and presence of additional physical disabilities. Members of each pair were then randomly assigned to either an active or passive group. Following matching six participants dropped out. Two decided they would not like to continue, two had clashing commitments, one moved from the area and one was found to have taken part in an earlier study. This meant that two individuals from the active group were without a matched partner. Details of the participants are shown in Table 1.

Table 1. *Characteristics of participants and dropouts*

	All participants n = 16	Active group n = 9	Passive group n = 7	Drop out n = 6
Mean age (median)	43.1 (46.5)	41.6 (44.0)	45.0 (52.0)	Unavailable
Sex ratio m:f	9:7	5:4	4:3	1:5
Mean (median) BPVS score	59.0 (55.0)	65.2 (56.0)	51.0 (54.0)	54.2 (69.5)
Mean (median) Ravens Matrices score	8.5 (7.0)	10.4 (13.0)	6.0 (6.0)	12.7 (12.0)
Presence of physical disabilities	4	1	3	0

As the data were skewed, the groups were compared for age, BPVS and Ravens Matrices scores using the Mann Whitney U test. In spite of the passive group having a higher median age and lower median scores on the Ravens Matrices, no significant differences were found.

2.2 Design

The experimental group interacted with virtual environments while their matched controls sat at their side and watched. The groups were then compared on change from baseline performance on two choice making tasks.

2.3 Measures

2.3.1 Card game. This contains ten cards each depicting a familiar object (eg apple, fish) and the participant's recognition of the objects is first ascertained. Each of the ten cards has a common pattern on the other side. A trial involves the cards being placed face down displaying the common pattern and this activity is screened from the participant so they cannot see the identity of the cards or their location. The participant is then asked to guess where one of the objects is. Time to touch the card that is chosen is recorded in seconds and the card is then turned over so that the object on the other side is visible. If it is not the target object and the person wishes to have another attempt they can do so but this attempt is not timed. This process is repeated for each of the ten objects. After each trial the cards are reshuffled. The times for the ten trials are averaged for each participant producing a single score for this test.

2.3.2 Shopping list. This is a computer based shopping list with ten categories of items (eg vegetables, drinks) pictorially represented. A trial involves the participant being shown one of the lists before being asked to choose two items by pointing at them on the screen. The time taken to choose the second item is recorded. This process is repeated for each of the ten shopping lists and the times for the ten trials are averaged for each participant. To avoid habitual responses, on three trials, after the time for the second choice has been recorded, participants are told that one of the items is no longer available and they have to choose something else. The time taken to make the alternative choice in seconds is recorded and the three times are averaged for each participant. This task therefore yields two scores: one for the initial choice (an average of ten) and one for the alternative choice (an average of three).

2.4 Virtual Environments

Participants used the café, supermarket and factory from the Virtual City (Brown, Neale and Cobb, 1999). These were developed as part of a project sponsored by the National Lottery Charities Board. Participants navigated through the environments using a joystick and interacted with objects using a standard two button mouse. In the Café the participants had to choose where to sit and order drinks and snacks from a pictorial menu. In the Supermarket they had to select items from the shelves, put them in the trolley and take them to the checkout. In the Factory they had to select the correct clothing from a wardrobe before entering the two storey factory where they had to find a number of COSSH (health and safety) forms and identify a series of hazards while avoiding a trolley that moved back and forth between clearly marked hazard lines.

2.5 Procedure

All participants were assessed at baseline on the two tasks to assess choice making: the card game and the shopping list. The active group then had six 20 to 30 minute sessions over the next three weeks using the Virtual City. Initially they needed help from the researcher (DI) to use the environments but in later sessions they were able to use them with minimal help. For seven participants in this group their matched pair from the control group sat alongside them during these sessions to control for the amount of time the participants spent doing something different from their usual activity and in the presence of the researcher. After the last session was completed, all participants repeated the card game and the shopping list.

3. RESULTS

As data were normally distributed, unpaired t-tests were used to compare the scores of the active group with those of the control group. Baseline scores were compared with post intervention scores using paired t-tests. Results from all 16 participants are presented.

3.1 Card game

For the card game there was no difference between the two groups at baseline or post intervention. However only the active group significantly ($t = 4.12$, $df = 8$, $p<0.003$) reduced their time to make a choice from baseline (see Table 2.).

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Table 2. *Mean times in seconds for the active and passive groups on the card game.*

	Active n = 9	Passive n = 7
Mean time for baseline (SD)	3.76 (1.11)	4.59 (2.03)
Mean time for post intervention (SD)	2.43 (0.72)	3.46 (2.51)

3.2 Shopping List

For the initial choices of the shopping list the active group was significantly (t = 3.66, df = 14, p<0.003) slower than the passive group. However, again only the active group significantly (t = 4.19, df = 8, p<0.003) reduced their choice reaction time from baseline to post intervention.

For the alternative choices for the shopping list there was no significant difference between the two groups either at baseline or post intervention. However, although the results did not reach significance their mean scores indicated that the active group improved from baseline (mean = 6.73 seconds) to follow up (mean = 3.98 seconds) while the passive group became slower with a mean of 4.42 seconds at baseline and 5.95 seconds at follow up. Mean times in seconds for both groups are shown in Table 3.

Table 3. *Mean times in seconds for the active and passive groups on the shopping list*

	Active n = 9	Passive n = 9
Mean time for baseline initial choice (SD)	16.58 (3.18)	11.02 (2.78)
Mean time for post intervention initial choice (SD)	12.46 (4.30)	11.08 (3.90)
Mean time for baseline alternative choice (SD)	6.73 (3.75)	4.42 (1.64)
Mean time for post intervention alternative choice	3.98 (2.18)	5.95 (3.18)

4. DISCUSSION

After several sessions interacting with the virtual environments participants significantly reduced their choice reaction time on both the card game and the initial choices on the shopping list. There was also a decrease in this measure for the alternative choice on the shopping list, however this did not reach significance. In comparison, the group who watched showed a decrease in choice reaction time for the card game which did not reach significance, no change on the initial choice reaction times and an increase in alternative choice reaction times on the shopping list.

This result was somewhat surprising as with the small sample size, short intervention time and non-standardised tests no significant differences were expected. Of the three tests, it was expected that the one where participants were forced to make an alternative choice would be the one most likely to show an effect if the active exposure to virtual environments were improving the participants' decision making. The other two tests could merely be a measure of simple reaction time rather than choice reaction time as their choice in both situations could be habitual. The improvement in the expected direction in the alternative choice on the shopping list may have failed to reach significance because of the small sample size or that the test was not measuring choice making. On the other hand it may be because the intervention failed to have an effect on choice making. If this is the case, how could the improvements on the other two measures in the active group be explained?

One possibility is that although the passive group was physically passive they may not have been psychologically passive. This distinction was utilised in a study by Wilson, Foreman, Gillett and Stanton (1997) who investigated the effect of exposure to a simulated environment on an orientation task in the same environment. Their participants worked in two types of pairs. In one pair one participant explored the simulated environment using the interaction devices (physically and psychologically active) while the other

participant watched passively (physically and psychologically passive). In the other type of pair one participant gave instructions (physically passive, psychologically active) to the other (physically active, psychologically passive) on what routes to take. In the present study, the passive partner was told to refrain from giving guidance or making suggestions to the active participant. Passive participants found no difficulty in following this instruction. However, in order to ensure their continuing participation, they had been promised sessions using the virtual environments after the active participant had finished the study. This may have led them to become psychologically active, mentally rehearsing some of the tasks they anticipated. Even though psychological activity could not have been eliminated, it is unlikely to have been an influential factor as choice reaction times for the passive group only decreased in the card game and this decrease did not reach significance. There was considerable variability in choice reaction times and for the passive group this variability often increased post intervention. It may therefore have been that for some individuals in this group their choice reaction times were decreasing post intervention and psychological activity may be responsible.

An explanation that cannot be ruled out is that as a result of their active involvement in the virtual environment, the active group became more confident in the testing situation. It is difficult to envisage what control activity would eliminate this possibility while still controlling for time in the test situation and exposure to the same visual information.

While these results are promising, they need to be confirmed in a future study with a much larger group of participants. Future studies would also benefit from collecting additional types of data. In many of our studies we utilise video recordings to measure how much help participants are receiving (Standen, Brown, Proctor and Horan, 2002) and current versions of the software collect data on the user's activity. Neither of these were available for the present study so that there was no precise information about how many choices each active participant was making while using the virtual environments nor whether this increased with repeated sessions. Analysis of this source of information would demonstrate whether some of the active participants were not really very active in terms of the number and the types of choices they were making in the virtual environment. For example, some choice making in the virtual environments was more similar to the tests of choice reaction time than were others. Ordering drinks and snacks in the café shared some similarities with the shopping list, while searching for forms in the factory focussed more on decisions about which direction to take. This information could then be linked to the change in their choice reaction times from baseline to post intervention.

Additional data from the tests of choice reaction time would also be informative. Recording time alone gives no information about the activity preceding the choice. No distinction can be made between a long reaction time due to a latency to initiate an arm movement and one where the participant's hand has hovered over several items before settling on a choice. For the shopping list no note was made of what items were chosen on the alternative choice and whether they bore any relation to the item that was "unavailable" (eg choosing another soft drink rather than coffee) or whether they were totally unrelated. Choosing unrelated items would suggest that choices were being made randomly rather than reflecting some type of strategy.

As a postscript, an attempt was made to repeat the study incorporating some of the changes in design mentioned above. This time it was impossible to persuade participants in the passive group to either continue with the study because they became despondent at not being able to use the computer or to refrain from intervening with their partner's performance.

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