An Exploratory Study into the Accessibility of a Multi-User Virtual World for Young People with Aphasia

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This paper describes an exploratory study into the accessibility of the virtual world Second Life for two young people with aphasia. Aphasia is a communicative disorder most commonly caused by a stroke. It affects both written and spoken language, is frequently accompanied by right-sided paralysis and people with aphasia can experience isolation and social exclusion. Multi-user virtual worlds are a potential source of fun and contact with others, but how accessible are such worlds to those with communication issues?

We report an investigation into the accessibility and potential of Second Life for people with aphasia. This was accomplished through a critique and an empirical study involving two young people: Ann was in her mid twenties and Bob in his early thirties. They were selected because both were comfortable with computer technologies before their strokes and each continues to use them, albeit in a more limited capacity. We discuss implications of the results for people with aphasia interacting with multi-user virtual worlds.

Accessibility. Aphasia. Second Life. Multi-user virtual worlds.

1. INTRODUCTION

This paper reports a study into the accessibility of the virtual world Second Life (SL) for two young people with aphasia. Aphasia is a communicative disorder most commonly caused by a stroke and increasingly experienced by those under 55 (Bestic, 2013). It impairs the ways that people use language to communicate and can be an isolating and lonely condition.

Multi-user virtual worlds such as SL offer interesting, and sometimes unconventional, opportunities for people to engage with others and therefore have the potential to help mitigate against feelings of social isolation. Moreover, the visual nature of virtual worlds would suggest that they might be more accessible to people with language impairments than other text and menu-based applications. However, delve a little deeper and it becomes apparent that SL (and other virtual worlds) still rely heavily on written language, hierarchical menus and text-based methods of interaction. It was this contradiction that motivated the exploratory study reported here: we investigated the reality of the accessibility of SL for people with aphasia. We are not aware of any other published work addressing this issue.

We start by summarising existing guidance on how to design accessible digital technologies for people with aphasia, focusing on what this literature suggests about the accessibility of SL. We then report an empirical study in which we explored the reality of the accessibility of SL for two young people with aphasia. In reporting the results, we highlight an apparent contradiction between poor accessibility yet a positive user experience and briefly consider implications of our results for the design of multi-user virtual worlds that might make them more inclusive for people with aphasia.

1.1 What is Aphasia?

Aphasia is a communication disorder resulting from damage to the areas of the brain responsible for language. It is most commonly the result of a stroke, occurring in about a third of stroke survivors (Engelter et al, 2006). People with aphasia struggle with using language. In severe cases, a person may have virtually no spoken or written language.

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Frequently there are co-morbid conditions such as right-side paralysis. There are also long-term negative impacts on well-being and experiences of isolation and social exclusion are common (Parr, 2007).

Currently about 250,000 people in the UK are living with aphasia (Speakability, 2013). Approximately 150,000 new cases are reported in the UK each year with a third of these occurring in people aged under 65 years (Stroke Association, 2013). According to the NHS statistics, more than 9000 under 55s were admitted to hospital with strokes between 1998 and 1999. This figure rose to 16,000 between 2010 and 2011 (Bestic, 2013).

1.2 Second Life: an online virtual world

SL is an online virtual world developed by Linden Lab in 2003 with over 20 million users. Users participate in 3D simulated environments via avatars, using speech or typed text to interact with each other. Environments mirror all aspects of life, with buildings, parks, cities and virtual events such as parties. People with physical disabilities have reacted very positively to the empowerment opportunities of SL, for reasons including that they can participate as if able-bodied (Jarmon et al, 2009) and anonymously (Cassidy, 2008). However, virtual worlds give rise to different access problems for people with communication disabilities, and these have not previously been explored.

1.3 Characteristics of aphasia that pose challenges for the use of virtual worlds

Each individual's aphasia is different. Problems span speech and written language, and both the comprehension and production of language (Goodglass et al, 2001). There may also be differences in cognitive functioning, non-verbal communicative abilities, and communicative needs and opportunities, either as a direct result of the aphasia or because of other stroke-related impairments (Van de Sand-Koenderman, 2011). Galliers et al (2012) describe a number of challenges faced by people with aphasia based on the experience of working with five aphasic consultants in the development of a gesture-therapy game, GeST. Challenges of relevance to the use of online virtual worlds are:

- People with aphasia struggle to produce language i.e. to generate verbal or written responses, with word finding difficulties (anomia) being the most common problem (Martin, 2011)
- People with aphasia have difficulties understanding language, (Rosenbek et al, 1989). They may be unable to read, or able only to read single words, making it difficult to follow written instructions.
- People with aphasia find abstract language and concepts very difficult to understand. (Franklin et al, 1995) (Tyler et al, 1995).
- People with aphasia find it difficult to retain as well as to retrieve information. Regular prompts or reminders may be necessary.
- Actions which take place in a sequence are a cognitive challenge to people with aphasia (Murray, 2002).
- Many people with aphasia have hemiplegia (one sided paralysis) and typically the right side of the body is affected, resulting in having to use the non-preferred hand to control a mouse or other interactive device. A problem of movement organisation (apraxia) may further impair navigation.
- Visual field deficits can obscure information presented on the right side of the computer screen (Sterzi et al, 1993).
- Extreme emotional responses are common. There may be an increase in the use of emotionally laden language, such as swearing (Gainotti, 2003).

1.4 Characteristics of SL that present challenges to people with aphasia

There is a small body of literature reporting research into digital technologies for people with aphasia; these are mostly computer-based therapy tools or assistive tools e.g. (Daemen et al, 2007), (Moffat et al, 2004), (Alankus et al, 2010), (Dawe, 2006), (Jung et al, 2006), (Ware et al, 2008), (Mountain et al, 2010). We identified forty design guidelines in this literature that were applicable to a virtual world and undertook an informal review of SL to get a sense of its compliance. We concluded that SL complied with just two of the forty guidelines, suggesting that SL would have very limited accessibility for people with aphasia. Table 1 illustrates this point by showing a sample of thirteen guidelines, including these two.

***Table 1**: Thirteen guidelines for designing digital technology for people with aphasia*

Design Guideline	Satisfied in SL?	
Use multi-modality i.e. images, sound, text as both output (Daemen et al, 2007), (Moffat et al, 2004) and input (Alankus et al, 2010)	*Y*	
Aim for simplicity in technology function, configuration, documentation and maintenance (Dawe, 2006)		*N*
Design for visibility in terms of affordance i.e. the operation of the technology should be obvious and intuitive, (Jung et al, 2006)		*N*
The technology should be usable with one hand. (Daemen et al, 2007)		*N*
Avoid designing abstract elements – make things look real (Daemen et al, 2007)	*Y*	
Keep the number of steps for any task to a minimum (Daemen et al, 2007)		*N*

Avoid hierarchies and tree-style navigations (Ware et al, 2008)		*N*
Make the interface as simple as possible with only necessary features (Daemen et al, 2007)		*N*
Support interface features with audio instructions (Mountain et al, 2010)		*N*
Place interface elements in the centre or towards the left side (to allow for right-side physical impairment) (Daeman et al, 2007)		*N*
Interface elements should be big to be noticed (Daemen et al, 2007)		*N*
Use short phrases and sentences, avoiding long words (Tee et al, 2005)		*N*
Provide visual and audio cues (Lee and Cherney, 2008)		*N*

Taking this a step further, and based on the challenges faced by people with aphasia summarised in section 1.3 and the forty guidelines referred to above, the specific characteristics of SL that we anticipated might cause problems for people with aphasia were:

(i) Lengthy sections of text in text boxes.
(ii) The hierarchical nature of many menus.
(iii) Sequences of actions required to interact with objects.
(iv) Inconsistencies in the precise sequences of actions required, in particular with respect to left and/or right clicking.
(v) The many distractions including complex environments, pop-up boxes with text and chat from other avatars.
(vi) Actions requiring combinations of keys, necessitating the use of two hands.
(vii) Actions requiring the use of different interaction devices, such as keys and a mouse (or trackpad).
(viii) Communication with other avatars via either typing or speech.

These concerns were the starting point and the focus for the empirical study of SL described below.

2. THE STUDY

2.1 Method

We undertook an exploratory study of SL with two young people who have aphasia. The high-level goals were firstly to determine if SL was accessible to the participants by investigating whether they could manage simple interaction and communication tasks and, secondly, to discover whether people with aphasia might be able to engage with SL sufficiently to experience benefits such as having fun.

For the purposes of this paper, we have called the two participants Ann and Bob. Ann was in her mid twenties and was able to both speak and read individual words and short, simple sentences. She was a competent computer user but could use only her left hand to interact. Bob was in his early thirties. Unable to speak, he was able to read some individual words but not sentences or chunks of text. Bob also only had use of his left hand and no longer used a laptop at home; however, he did use an iPad. Once ethical approval for the study had been obtained, both Ann and Bob individually took part in two, two hour sessions in SL.

The aim of the first session was to familiarise the participant with simple navigation and interaction tasks. Avatars had previously been created for each participant and located in a quiet rural environment in SL. Some simple navigation tasks, such as moving the avatar by using the cursor keys to both walk and orientate, were demonstrated and then the participant was asked to do the same. Once these were mastered, the participant was asked to try running, flying and teleporting, as well as interacting with various objects e.g. sitting on a chair, riding a horse, drinking a coffee. When other avatars were present, the participant could engage in a chat conversation if they wanted.

The second session focused more on communication. Another researcher was present as an avatar in the world. The researcher and participant communicated via voice (using a simultaneous Skype session) and the researcher's avatar led the participant's avatar on a journey through the environment, guiding them towards objects to be interacted with (Figure 1).

In both sessions, we also introduced specific tasks to target the potentially problematic aspects of SL listed in section 1.4. Both participants were asked to undertake activities that included using menus, performing actions requiring a sequence of individual actions, performing actions requiring a slightly different sequence for a similar action in a different context, navigating in areas or performing tasks where chunks of text appeared, navigating environments with varied types of distractions, performing actions requiring two hands, and performing actions requiring use of the mouse as well as keyboard.

Figure 1*: Ann and a researcher's avatars riding in SL*

The sessions were recorded, with face-on video recordings of the participants' faces and hands as well as simultaneous screen capture. A researcher was present at all sessions, demonstrating, guiding and supporting the participants with reminders, suggestions and assistance where necessary. Ann and Bob were also interviewed by the researcher at the end of each session. They were asked whether they liked certain aspects of the experience and whether they found particular tasks easy or hard. In order to answer these questions, they were offered rating scales that showed a thumbs-up sign at one end and a thumbs-down sign at the other. They were also asked about their enjoyment of the session, using a scale of smiley to glum faces.

2.2 Results

We present a descriptive account of the SL sessions, focusing on the accessibility of different interactions. Table 2 provides a summary against the anticipated problems.

The simplest interaction task was 'walking' an avatar. It involved a single action and there was a direct mapping between the user's action (pressing a cursor key) and its effect (the avatar moving). Directional control via the cursor keys whilst moving the avatar was also immediate. After a little practice, both Ann and Bob managed this well.

An additional step was required in order to make the avatar run or fly. This involved using the mouse to selecting the travel mode by pointing at and clicking a button on the screen. Another button needed to be selected and clicked to stop the avatar running (or flying). Ann was able and happy to do this simple sequence of actions involving two interaction devices. Bob was less adept at swapping between mouse and keys although he was slightly better with the trackpad (possibly because he is an iPad user). Bob preferred to keep his avatar walking. It is possible this could have been because he was better able to control the avatar's speed when walking. In addition, he had some difficulty in seeing the on-screen cursor.

A more complex sequence of actions was required in order to interact with objects, frequently involving more than one menu. For example, interacting with some objects resulted in a text box appearing and a request to 'save' the object. Clicking 'Save' caused the object to be placed in the user's inventory. The inventory then had to be selected from a toolbar, the object found and selected from a menu within the inventory, and finally the action selected, e.g. to 'wear' it (which is also counter-intuitive when the object is, say, a cup of tea or piece of cake.) Both Ann and Bob did this but required step-by-step instruction from the researcher each time.

***Table 2**: A comparison of predicted accessibility issues against results of exploratory study*

Anticipated problem in SL	**Result**
(i) Lengthy sections of text in text boxes	This was less of a problem than anticipated. Where they could be ignored, both Ann and Bob ignored chunks of text; otherwise the researcher read them out.
(ii) The hierarchical nature of many menus	These were a problem and both participants needed help to manage the hierarchical menus.
(iii) Sequences of actions required to interact with objects	Short sequences of actions (e.g. to make an avatar sit down or touch an object) were manageable and remembered by both participants. Longer sequences were challenging and required assistance.
(iv) Inconsistencies in the precise sequences of actions required, in particular with respect to left and/or right clicking	The inconsistencies in right and left clicking were difficult to manage (as they are for people without aphasia).
(v) The many distractions in terms of complexity of the environments, pop-up boxes with text and chat from other avatars.	Busy environments did not bother either participant. Pop-up boxes were ignored or the researcher was asked what they were. Ann liked other avatars around and wanted to 'chat' as much as she was able; Bob avoided other avatars and their 'chat'.
(vi) Actions requiring combinations of keys, necessitating the use of two hands	Ann managed one of these by stretching her one hand; she was very adept with a keyboard and mouse. Bob could not do this.
(vii) Actions requiring the use of different interaction devices, such as keys and a mouse (or trackpad)	Bob had some problems switching between mouse and keys, but it was not impossible; he just took time to remember when he needed to change. He managed better with the trackpad. This worked well for Ann.
(viii) Communication with other avatars via either typing or speech	Ann sought out communication opportunities, engaging in limited chat as well as voice conversations.

Simpler interactions were sufficient for some interactions with objects. For example, to sit the avatar on a chair or a horse involved a single menu with individual words. However, the method was inconsistent in SL: sometimes a left click and sometimes a right click was required, depending on where and what the object to be 'sat' on was. This did not seem to frustrate or upset either of the participants. The same process of selecting a single word item from a menu also enabled the avatar to dance when the cursor was positioned over a dance ball. Both Ann and Bob really liked doing this - it made them laugh - but whereas Ann could read the simple menu involved, Bob needed to be led through the procedure each time.

With regard to distractions, neither Ann nor Bob were particularly distracted by noise or complex environments. Bob was happier away from other (unknown) avatars but it was unclear whether they actually distracted him. Interestingly, any lengthy chunks of text that appeared were simply ignored by both participants.

Communication via "chat" (text exchanges) was impossible for Bob and he avoided it by moving his avatar away from other avatars. Ann however could manage very simple chat interactions and positively sought them out, using the overview map very effectively to guide her to other avatars. As soon as the exchange became too complex for her to read, she typed "Bye" and moved her avatar away. In the second sessions, we explored the participants' responses to voice interactions with the second researcher's avatar. Observations showed that both participants understood what was said to them; they responded well. They also expressed enjoyment at engaging in a joint exploration of the 3D world by frequent laughing and smiling. In interview, both immediately selected 'good' when asked how the session had made them feel.

Importantly, both Ann and Bob expressed a lot of enjoyment in the sessions, emphatically selecting 'Good' when asked how the sessions had made them feel. Both enjoyed moving their avatar around but were confused when objects did not respond to their input as expected, although neither got upset. In such cases, both were happy to move off and try something else.

3. DISCUSSION AND CONCLUSIONS

This was a small study, due to the challenges of recruiting and working with people who have aphasia. Nonetheless it has provided valuable data and insights to be followed up in further studies.

Overall, although there were only a few interactions in SL that were fully accessible to these two people with aphasia, both were able to use simple interactions to navigate their avatar through the 3D environments and had fun doing so. This gives us food for thought as regards future opportunities for bringing multi-user virtual worlds into the technological landscape for people with aphasia.

Many of our findings from the empirical study were an endorsement of existing design guidelines and of our informal assessment of the compliance of SL with this guidance. We found that interaction in SL relies heavily on written language, on navigating menu hierarchies and on remembering sequences of actions, some of which involve inconsistent left and right mouse clicking. All of these were a barrier to accessibility. In addition, use of multiple interaction devices and combinations of keys were difficult for people with use of only one hand. However, for these two participants, distractions such as the complexity of the environments and the abundance of menus and text boxes did not turn out to be as much of a problem as had been anticipated. Issues of pace and control were also manageable. One possible explanation is that Ann and Bob's youth and experience with technology, both before and since their strokes, may be partly responsible for these results. While this would require a much larger study to investigate, it draws attention to the fact that aphasia is very variable and that a "one size fits all" approach to design guidance may be counter-productive.

The results highlight the fact that only simple adjustments would be required to make multi-user virtual worlds like SL more accessible to people with aphasia. These include: reducing the reliance on text and hierarchical menus; stripping the menus and toolbars down to offer fewer options; making interaction tasks consistent and ideally mapping them directly to individual keys on the keyboard or an adapted external device. Options for enlarging elements of the interface, such as the on-screen cursor and text, already exist.

From our point of view, the most revealing result is that both Ann and Bob indicated that they would continue to use SL on their own if they were able to do so, in spite of the fact that they had difficulty in accessing various aspects of SL. This draws attention to the importance of providing engaging and motivating user experiences and the positive effect they have on user's perceptions of an otherwise challenging experience. In summary, this study has shown that making multi-user virtual worlds accessible to people with aphasia could provide enjoyable and inclusive opportunities for this hard-to-reach community.

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