SOMABILITY: EXPLORATIONS WITH DIGITAL MEDIA, MOVEMENT AND SPACE WITHIN ADULT DISABILITY SERVICES

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INTRODUCTION
This paper describes an exploratory digital interaction project developed at a day centre for adults with profound and multiple learning disabilities (PMLD). Severe cuts in funding for disability services has resulted in increased pressure on support workers to provide leisure and arts activities in addition to personal care. The introduction of new technologies, whilst offering many possibilities for augmenting creativity, also need to avoid creating unnecessary demands on carers. For this reason, our project – Somability - focused on bodily interaction as a celebration of the way we live, whereby every individual is valued for their unique relationship with the social and physical environment. Using camera and projection technologies to graphically draw attention to the moving body, the project targeted awareness of self and environment, which attuned to the organisation’s objective of supporting service users toward an independent and fulfilled life.

Background
Article 30 of the United Nations (UN) Convention on the Rights of Persons with Disabilities\(^1\) states that it is the right of persons with disabilities to take part in cultural life on an equal basis with others. Furthermore, they should have an opportunity to organise, develop and participate in disability-specific sporting and recreational activities. Many of these activities will be provided by day care services. Statistics show that in England alone there are estimated to be 58,000 people with a learning disability supported by day care services.

The project described in this paper has been undertaken in collaboration with a day service supporting adults with a diagnosis of profound and multiple learning disabilities. The service is located in an area where more people than the national average suffer from long-term illness, and fewer than the average percentage take physical exercise\(^2\).

The term PMLD is used when a person has more than one disability, with the most significant being a learning disability. These people are among the most vulnerable in society, and there is strong evidence to suggest that they have poorer general health and more specific health needs - such as problems with hearing and eyesight, mental health and behavioural difficulties, epilepsy, thyroid disorders, heart disorders and dental problems - than the general population\(^3\). A core objective of learning disability services is to support people in leading an independent and fulfilled life.
Movement
For many people, dance and music provide recreational and social opportunities. For people with disabilities they are often employed as therapeutic interventions to promote physical and emotional well-being. Research into the effectiveness of movement and dance therapy has shown that the benefits include reduced mental health problems, improving self-esteem, confidence, body image and interpersonal skills4. Moreover, the most vulnerable people are encouraged to participate, bringing them together socially, creating a positive atmosphere, and improving community relationships5. In addition to the promotion of personal and collective creativity, physical activity is crucial to staying healthy when living with a learning disability. However, ensuring that activities are inclusive and accessible can be costly and time consuming. Movement and dance activities may require additional space, or travel to another environment – a challenge in itself for day-care services - and often need to be modified for each individual based on exercise capacity and any special health or risk issues.

Agency and movement
By taking a broader view of movement as a way of being in the world, rather than a medium for intervention or therapy, we were able to target the potential for individuals, even those with more profound disabilities and a perceived lack of movement, to become active agents within their social and physical environment6. Our ideas align with Shusterman’s philosophy of Somaesthetics, which takes the view that the body is never separate from the mind7. Dourish also favours this position in his theories of human computer action, stating that “you cannot separate the individual from the world in which that individual lives and acts” 8. From the perspective of learning disability services, we sought to explore digital movement as a means to augment the relationship between the body and the physical, social and temporal space.

Digital Movement
The widespread accessibility of camera-based digital tools for augmenting movement and choreography, performance analysis and cognition, is driving technological development to such a degree that systems are becoming commercially available which allow users to make a direct connection between their physical bodies, their creative desires and the wider world around them. A great advantage of this technology, especially for people with disabilities, is that it permits unencumbered physical engagement, as no devices are required to be worn by the user. Although camera-based motion-tracking technologies have been used in interactive performances since the 1970s, the rise in visual programming and open source languages has encouraged a new wave of artistic experimentation with body movement as source material for expressive interaction. A significant feature of these experimental works is that they focus on the spatial and temporal qualities of experience rather than on the usability of an interface or how effective the system is at enabling the user to undertake a task.

Our earlier work
The basic design principles that underpinned Somability were informed by findings from two earlier research projects, ReacTickles Magic and Somantics, which aimed to capture and augment the interests of those young on the autistic spectrum9,10,11. These projects favoured abstraction over representational imagery, stripping out extraneous detail, using high contrast graphical lines and colourful shapes to draw attention to the sense of pressure, position, speed, elasticity and momentum12.
By deliberately avoiding the need for instruction, the goal was to foster autotelic\textsuperscript{13} - self-directed – play, through the physicality and aesthetics of interaction.

In 2012, we were invited to try out this work at a touch and movement therapy centre with a day service supporting adults with PMLD. During the session we used a Kinect motion-sensing camera to capture movement, which we projected onto the walls of a large studio. Almost immediately, participants appeared to be captivated by the projected effects of their actions and were observed to intentionally extend their movements. The session inspired us to seek grant funding to collaborate with a day service. This funding supported the design and development of Somability. In the following section we briefly report on our methods of designing Somability within the service centre environment, and explain how we gathered inspiration from observing and re-enacting everyday social interactions within the day service.

**DESIGNING SOMABILITY**

When addressing the lived experience of people with profound disability, tools and techniques are required that value people with disabilities as part of a supportive community, empowering them to participate through appropriate social interaction with peers, carers, and other familiar members of their community, as well as the design team\textsuperscript{14 15}. An example of this can be found in the design of an assisted living device for a person with Autism Spectrum Disorder (ASD)\textsuperscript{16}. The research employed a participatory design method that focused on learning-by-doing and factored in everyday habits and routines, which led to the discovery of important cues for action without the need to cognitively process information. We approached the design of Somability in a similar manner, however, due to the complexities of PMLD, we focused on understanding the day-to-day patterns and interactions between staff and service users at the centre, rather than on the routines of individual service users.

**Ideation Workshop**

The first stage of design took the form of a workshop hosted in the communal dining room at the day centre. We were keen to situate the design activities in a familiar space, and to try to ensure that participants could feel relaxed, particularly as our workshop included unconventional activities that were outside of the working practice of participants. Importantly, environmental factors such as proximity, depth, light and speed can all impact on the quality of interaction, making it crucial to situate design within actual user settings.

Sixteen people participated in the event, including the centre manager, support workers and a dance therapist. Initially, there was some resistance to participation, there was a perception that they did not have the appropriate skillset to contribute. In order to address this, we proposed a combination of role-play and paper prototyping, and set a series of challenges that required re-enactments of daily routines, allowing for approximations of service user experience without any reference to technology. With consent from all participants each session was video-recorded and subsequently reviewed by the participants and the design team. The details of the workshop are beyond the scope of this paper, therefore the next section focuses on the ideas that emerged, and how they informed the various iterations of the Somability software.

**Somability prototypes**

Using the video footage from the workshop as inspiration, we produced a series of four-frame storyboards in which we used line drawings to abstract the movement from the situations that were being acted out. Ideas were presented to the the service team, and following several iterations of the storyboards we produced three initial digital prototypes, *Reach, Balance, and Flow*, and proposed
using the Kinect camera for its capacity to capture full body movement. The device was compatible with Windows laptops already in use at the centre, making it easy to install and test prototypes with a portable projector.

These first prototypes had two visual modes, (i) Mirror projected a mirror image of the user in their environment along with the graphical imagery, and (ii) Skeleton placed a linear stick-figure over the body in addition to the mirror image.

The intention behind Reach was to challenge the user to extend their upper limbs in order to reach a row of four coloured shapes - a square, triangle, hexagon and circle - as they appeared to be in the room (Figure 2). When the user reaches to hover over a shape, multiple miniature versions of the shape are released, which rain down and gather along the horizontal edge of the screen, making a floor of mini reactive shapes. Using lower limbs to disturb the floor can trigger more movement. In later iterations of this concept we set preferences for the size and location of the upper row of shapes to enable wheelchair users to more easily interact.
Balance combined sound and movement. The intention was for users to "throw" a ball by making a sound. The louder the sound, the more balls are released. When the balls hit another user’s body this causes them to bounce around the room. Alternatively, the user can use their arms to catch and gather the balls and balance them along the outstretched limbs (Figure 3). The user has the choice to remain still and keep the balls balanced or to move, tip or flick the balls to the floor. The gradual accumulation of balls allows for a pause in the action to observe the results of the effort, before deciding whether or not to redistribute them. The user responsible for making the sound also has the choice of whether to continue to add more balls, or to pause and observe.

The idea for Flow was to keep the body in motion through limb movement. Even small limb movements could cause coloured lines to attach to the body, resulting in a dynamic pattern of lines (Figure 4). If the mover pauses, the lines gradually lose their opacity, providing the opportunity to reflect and observe as they gracefully fade, and to choose whether to re-invigorate the lines.

The prototypes were tested at the centre during weekly sessions over a period of six weeks. Generally, the feedback was positive, however, there were concerns that some service users could not detect their own body movement, particularly those with visual impairments. The video mirror was visually
cluttered and the lines on the skeleton were too thin. Another persistent problem was the accuracy of detecting wheelchairs. When Somability was in skeleton mode a seated skeleton appeared over the chair, however it behaved quite erratically, sometimes disappearing altogether. These problems were resolved in the next iteration of Somability. As well as fixing the wheelchair bug, we enlarged the skeleton effect, making it more of a feature, and introduced two new visual modes: Silhouette and Effects. Silhouette converted each body into a bold coloured shape by extracting background information so that the silhouette contrasted against a black canvas, and Effects showed only the effects created on a white background, with no bodily representation, thus producing a new art work with every movement.

CREATING THE SPACE FOR SOMABILITY

As confidence with the system grew the service team began to gather evidence of service user engagement as part of their regular monitoring procedure using the ASDAN Towards Independence framework. ASDAN includes several modules that are specifically designed to accredit people with PMLD for their achievements, and to set targets for developing personal, social and independence skills. Of these modules, “Multi-sensory experiences” offered an appropriate match for addressing awareness of self and environment.

In addition, we regularly video-recorded the sessions and reviewed the material with centre managers as a method of refining the design. This had the advantage of enabling reflections on the impact of the project on the service as a whole. One reviewer commented that people who would not usually be expected to participate, as they had difficulty with self-awareness and limited movement, were self-initiating interaction. It was suggested that the high visibility of the projected movements enabled service users to demonstrate their awareness of their environment, enabling them to notice where and when an activity would take place, so they were able to independently choose whether or not to join in, and when to end.

Over the next six months, the support team continued to experiment with Somability in different settings and to reflect on their observations of multi-sensory experiences. The dining hall became the main arena for open-ended experimentation as it provided a large performance space. With the hardware (camera, laptop and projector) placed on a trolley, the space could be easily transformed to accommodate wheelchair users, and the software included adjustments for height, space and size, so that all users could share the experience. Service users who would normally take responsibility for the dinner trolley were invited to move the hardware and help set up the system. Chairs and wheelchairs were positioned on the periphery of the space leaving enough room for people to access the screen, and to choose how, and when, to move around the space. Projecting Somability on a large portable whiteboard permitted the opportunity to focus and mirror the flow of movement.

A classroom was transformed into a dedicated digital movement room, and a group of four service users was able to independently set up the equipment and run an activity. This in itself was expressed as transformational, in as much that service users were often given dedicated tasks, but it was unprecedented for them to choose to run an activity on their own.

The video reflection also provided comments on how valuable it was to be able to follow the cues of service users, and to have greater access to their “world” by watching how they entered and left the space, choosing when to join in. Support workers were also surprised by how much variation emerged within each application.

“Service user engagement is astonishing, even those people who are very difficult to engage are extremely keen to take part, and just the mention of having a session generates such excitement. I think
the biggest surprise for me is the results we are seeing with individuals with ASD. To see people that find it very difficult to engage in an activity, who find it impossible to make a connection with another individual, can’t even give eye contact, rushing to interact with both the equipment, and others taking part in the activity, holding their hands, giving eye contact, really enjoying the whole experience, is priceless.” Senior Development Officer

The perceived flexibility of the system was addressed in the reflections of support workers who remarked that the portability of the system enabled them to maximize on the available space and thus be more responsive to individual interests in their familiar settings. Staff were also able to experiment in their offices, and one wheelchair user took the equipment home. Observations on the benefit to health were also made, with particular transformations for those individuals who find more deliberate forms of exercise difficult. It was also noted that the software offered a “level playing field” between those who are more able and the more profound, complex and high dependency individuals. The fact that the pacing and duration of a movement could express individuality meant that even very limited movement became a source of creative agency. There were many recorded examples of a person beginning seated but then choosing to move in different ways as they saw the effects they were producing on screen. An increase in concentration, even when watching others, was also noted with instances of participants not noticing that it was time to go home. Simply pausing over a shape in Reach had a dynamic effect as the system interpreted the time spent on the shape as a hovering action, and more shapes “rained” down to collect along the surface.

Some wheelchair users needed assistance from support workers to enter and leave the space, however as the application Flow drew attention to the process of entering and leaving, moving forward and backward, the collective energy was rewarded.

Increases in expressive movement were reported, which appeared to encourage new, previously unseen, shared experiences as service users improvised on each other’s movements, sometimes experimenting with the effects of joining bodies together. Some service users voluntarily entered the space while a peer was interacting and did not appear to be looking at the projected imagery, however, there was a reported increase in co-located interaction, evidenced in the mirroring and improvisation of posture. The process of seeing others becoming more active generated a sense of energy, and even those service users who were watching others interact from perimeters of the space, appeared to be more physically engaged.

“When we carry out an activity such as Armchair Aerobics, getting individuals to carry out the movements can be problematic, especially those who really need it, due to their carrying extra weight etc. With Somability we see individuals spending so much time ‘making different movements’ that we need to get them to rest. As well as our service users becoming fitter, we have seen other improvements – in fine motor skills (needed to press different shapes on screen), spatial and body awareness, increased turn-taking/sharing, relating to others and their environment, and also the concept of being able to make things happen, their every movement causing a responding reaction. These may seem like small things to us, but for many of our service users, these are significant leaps forward.” Senior Development Officer

CONCLUDING REMARKS
The Somability project demonstrated how ordinary spaces, such as the dining room, sports hall, or even a small classroom, can be converted into an extraordinary creative environment. By making a
direct and visceral connection to the movements of the body - the stretches, flickers, pauses – even those movements that seem involuntary or purposeless – the environment becomes a canvas for creative self-expression.

In the context of this project, those people who are generally marginalized, due to their physical or cognitive impairment, or their poor self-awareness and motivation, can be enchanted by seeing themselves amplified in their everyday environments, and go on to experience social connection, inclusion and independence.

Since this time, the software has been released as a free download. The day service has widened participation to other adult learning centres, and many special education teachers are using the software with hard to engage learners.

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REFERENCES


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