Assistive tools for disability arts: collaborative experiences in working with disabled artists and stakeholders

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Abstract

Purpose – *The purpose of this paper is to provide a review of the experiences in working collaboratively with physically impaired visual artists and other stakeholders (e.g. disability arts organisations, charities, personal assistants, special needs colleges, assistive technologists, etc.) to explore the potential of digital assistive tools to support and transform practice.*

Design/methodology/approach – *The authors strategically identified key organisations as project partners including Disability Arts Shropshire, Arts Council England, the British Council, SCOPE, and National Star College (a large special needs college). This multi-disciplinary team worked together to develop relationships with disabled artists and to collaboratively influence the research focus around investigating the current practice of physically impaired artists and the impact of digital technologies on artistic work.*

Findings – *The collaborations with disabled artists and stakeholders throughout the research process have enriched the project, broadened and deepened research impact, and enabled a firsthand understanding of the issues around using assistive technology for artistic work. Artists and stakeholders have become pro-active collaborators and advocates for the project as opposed to being used only for evaluation purposes. A flexible research approach was crucial in helping to facilitate research studies and enhance impact of the work.*

Originality/value – *This paper is the first to discuss experiences in working with physically impaired visual artists – including the benefits of a collaborative approach and the considerations that must be made when conducting research in this area. The observations are also relevant to researchers working with disabled participants in other fields.*

Keywords *Assistive technology, Accessibility, Disability art, Disabled artists, Eye gaze tracking, Physical impairment*

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1. Introduction

Disabled artists can experience significant physical barriers in producing their work and often require the use of assistive tools to support them in their practice. In particular, artists with physical impairments can find the use of common artistic tools such as brushes, pencils, and other materials incredibly tedious and problematic to use. To help address these barriers, traditional assistive tools such as head wands, mouth sticks, and custom-designed grips (for holding brushes) are often utilised to help support artists (Perera *et al.*, 2009). Whilst these tools can make the artistic process more accessible, they can also lead to other physical complications such as damage to teeth and severe neck strain. Artists can also be highly dependent on the support of personal assistants in terms of the initial setup of tools, transportation of materials, and making any adjustments whilst an artist is working. This lack of

independence and reliance on others can result in a frustrating and time-consuming process for artists that can interrupt their creative flow.

Digital technologies can help address many of these issues and provide artists with increased independence and self-sufficiency around their practice. For instance, technologies such as eye gaze tracking (e.g. Tobii EyeX, 2016; EyeTribe, 2016), mid-air gesturing (e.g. Leap Motion, 2016), motion tracking (e.g. Kinect for Windows, 2016), speech recognition (e.g. Dragon NaturallySpeaking, 2016), and facial expression switches (e.g. KinesicMouse, 2016) have dropped significantly in price over recent years and are now much more accessible to a larger market. These tools hold huge potential to support physically impaired visual artists in their practice (through a cost effective method) and also offer new creative opportunities to experiment with different art forms. However, no work to date has explored how these types of tools can support professional artists and the impact they may have on artistic practice.

To address the lack of work in this research space we have been working collaboratively with disabled artists and other stakeholders (disability arts organisations, charities, special needs colleges, assistive technologists, etc.) to explore the potential of these tools to support artists in producing their work. This research has been completed directly with artists who have a range of conditions affecting physical movements such as cerebral palsy, muscular dystrophy, motor neurone disease, amputees, dystonia, multiple sclerosis, and arthrogryposis. Our partners have been involved throughout the research process and have helped inform the work undertaken and shape the direction of the research. This has been facilitated through a variety of research methods including online surveys and face-to-face interviews, lab-based user evaluations of technology, and longitudinal field studies where artists have been able to test technology in their own working environment.

In this paper we provide a review of the research we have conducted to date with a particular emphasis on our experiences in working with physically impaired visual artists and other stakeholders. We highlight how their involvement from the inception of the work has influenced our research and development process, the type of data we have collected, and the overall direction of our research. We also highlight some of the important considerations we have had to make when working with disabled artists who may have special needs. We conclude with the key lessons learned and highlight the next stages of our work that will involve further collaboration with artists and stakeholders.

2. Digital assistive tools for disabled artists

The research we have undertaken with disabled artists has primarily been conducted as part of the D2ART (2016) project that is exploring the potential of new digital assistive tools to support artists in producing their work. The key research questions we are focusing on in this project include:

RQ1. How can innovative and affordable sensor-based digital tools support, extend, and transform the creative practice of physically impaired artists?

RQ2. Which new art forms emerge from these digital tools and what impact do they have on artistic identity and audience/artist perceptions of authenticity?

The key aims of this work, therefore, have involved learning more about the current practice of disabled artists (to better understand how they currently work), the common issues they experience, the types of assistive tools they are currently using, and to explore their perceptions around several digital technologies. The longer term goal of this work is to develop a suite of digital tools that support and transform the practice of disabled artists and to research the impact these have on creative process and output.

To successfully achieve these goals we felt it was essential to start building a cross-discipline/sector network of academics, practicing artists, disability arts and accessibility organisations, charities, developers, arts/cultural organisations, assistive technologists, and user experience specialists. D2ART is therefore a collaborative project with disabled artists, Disability Arts Shropshire (DASH), SCOPE, University of Chicago at Illinois, Arts Council England, and

representatives from large special needs colleges such as SCOPE's Beaumont College and National Star College. This multi-disciplinary team has enabled us to not only work directly with artists, but also with other interested stakeholders who work closely with our target audience.

There are a wide range of technologies we could have examined in detail, but the scope and time constraints around the project meant we had to constrain this to help focus the research. In consultation with our project partners we decided to primarily focus on eye tracking, mid-air gesturing, head tracking, and facial expression switches as it was initially felt that these held strong potential for disabled artists. The project started in April 2016 and built on from earlier work we conducted with disabled participants around multi-touch table accessibility (Creed and Beale, 2014) and early mid-air gesturing work with disabled artists (Creed *et al.*, 2014). Our experiences in conducting user studies in these projects with disabled participants helped to shape our research focus and the methodologies we adopted in the D2ART project.

3. Research methodology

To explore the D2ART research questions we used a variety of different methods at each stage of the project. In this section we provide an overview of the methods used along with some of the considerations we had to make when working with disabled artists and our partners.

3.1 Stage 1: understanding the current practice of disabled artists

The first stage of the project involved developing an understanding of how physically impaired artists work and the current role of assistive technology in their practice. To achieve this we initially decided to produce an online survey to enable artists who may have difficulty in travelling to provide their views and feedback. There are clear benefits to online surveys in that anyone internationally can potentially participate and provide feedback. However, this approach may also exclude some artists who find using computers and completing online forms barriers to engagement. We had 36 responses to the survey and felt this was a strong response given the specific criteria we set for completing the study (physically impaired visual artists, upper body impairment, practicing/professional artist). It is unclear though how many people wanted to complete the survey, but may not have been able to due to access barriers in completing online forms.

Our partners were essential in disseminating the survey call across appropriate channels to make disabled artists aware of the project and the opportunity to participate. DASH, for example, shared the survey across their network of disabled artists via e-mail newsletters, blog posts, and social media. Other representatives from the project advisory panel also shared the survey across social media and with organisations and individuals they felt would be interested. Moreover, the survey was advertised on the project website (www.d2art.org) and Twitter account (@d2artdigital) on multiple occasions to assist in recruiting respondents.

Once we had collated the survey responses we invited twelve artists to participate in face-to-face semi-structured interviews to explore their practice in more detail – in addition to the opportunity for being involved in the technology evaluation sessions. We invited people based on several factors – in particular, we wanted to work with artists across a range of career stages (early, mid-career, established) and artists who varied in the extent to which they are currently using assistive technology to support their practice (e.g. not using assistive technology at all, non-digital/traditional assistive tools (e.g. head wands, mouth sticks, etc.), and artists currently using digital assistive tools). Two of the artists were unable to easily travel to the university due to the nature of their impairment – in these cases the artists invited the research team to their home to meet and discuss their work in more detail.

These semi-structured interviews were essential for following up with questions from the survey, allowing the artists to express current issues they experience, to hear their frustrations, and to explore their ideas around how technology could support their work in the future. We video recorded interviews for later analysis.

3.2 Stage 2: lab-based technology evaluations

After face-to-face interviews had been conducted with artists we then asked them to interact with a range of different technologies and explore how they found using them for creative work.

The core technologies we decided to focus on included eye tracking, mid-air gesturing, and head tracking. We were also interested in observing how artists used other technologies and software (e.g. FingerMouse, SteadyMouse, trackballs, etc.) for creative work and where appropriate asked people to use them. The key goal from this session was to get a sense of how people found using the technology and the potential for influencing practice (this would then inform later stages of the project). We therefore opted for setting participants a series of specific tasks for each piece of technology and adopted a "think-aloud" protocol where participants were encouraged to verbalise their thoughts as they used the technology. We also encouraged personal assistants to share their thoughts to help collect their unique insights on how the technology could support artistic work or disabled people more broadly.

In terms of the eye tracking technology we explored use of the Tobii EyeX in combination with Project IRIS (2016) software which enabled cursor control via a user's eyes. For head tracking, we used a standard web camera built into a laptop along with EnableViacam (2016) – software that allows for cursor control through head movements. The tasks we set participants for both eye and head tracking were the same in that they involved basic shape manipulations in Photoshop such as creating a new square (with specific dimensions), rotating and resizing it, and finally moving it to different locations around the screen. We also explored further basic functionality such as the ability to select different tools (e.g. brush, eraser, and pen tools) via different toolbars. In terms of mid-air gesturing we used the Leap Motion sensor in conjunction with the Sculpting (2016) application to examine how participants found 3D digital sculpting via a range of different mid-air finger movements and gestures.

Individual tasks were designed to take no longer than a few minutes to complete although we closely monitored how participants felt whilst working on the tasks in case they experienced any discomfort (e.g. tiredness in the eyes, tension headaches, or neck strain during head tracking). In addition to artists sharing their thoughts whilst working on the tasks, we also collected quantitative data (e.g. time to take to complete tasks, number of selections made, etc.) to help provide a sense of how long it was taking artists to complete the exercises. The session concluded with a final interview where we explored thoughts around the technology tested and their views on how it might influence artistic practice. Where possible, representatives from DASH were also present at evaluation sessions to provide more context from an artistic practice perspective (Plate 1).

3.3 Stage 3: longitudinal field research

After the technology evaluations sessions we wanted to take one piece of technology and test it more thoroughly over an extended period of time. This was because it is not possible to obtain a complete sense of how a tool might influence practice in a short lab-based environment. We wanted to conduct field studies to enable artists to use the technology in their own environment which we felt would provide a better sense of the potential of the tools to influence practice.

Plate 1 Artists working on the head tracking and mid-air gesturing experimental tasks

In terms of choosing the technology, we spoke with our partners and took into consideration feedback from artists during the previous evaluations. It was decided that eye tracking would be an interesting area to explore further – this was primarily due to several artists identifying cheap eye trackers as holding significant potential for them – despite having some issues in using them in the previous sessions.

Prior to starting the D2ART project, we saw the longitudinal research as being an extension of the earlier technology evaluations in that we would look at how a tool could be used to support creative work (over a longer period of time). However, feedback from the technology evaluation sessions altered our direction primarily through a comment made by one of the personal assistants of an established artist. He highlighted the importance of new assistive tools not just supporting creative work, but also all of the wider essential tasks that must be completed by artists (e.g. e-mail correspondence, managing/editing budgets, ordering of supplies, managing contracts, conducting research on the web, etc.). These are tasks that many disabled artists struggle to complete as they are typically undertaken on a computer and can therefore become hugely time consuming (thus taking time away from creative work). It is therefore crucial that we take a more holistic approach to building assistive tools for artists where both creative and wider practice activities are supported.

The use of new assistive tools to support wider practice activities is an area that has received no attention to date in the research literature and we therefore decided to explore this area in more detail in the next phase of the project. This also seemed the correct direction to take given our experiences in using eye tracking with existing software such as Photoshop. All users had difficulty in using the Photoshop interface as it has primarily been designed for a mouse and keyboard interaction – which is very different from using our eyes. Simple tasks such as selecting tools from the toolbar or resizing a shape – which typically takes less than a few seconds with a mouse – was taking people over 30 seconds or longer with their eyes. This work demonstrated that "bolting" new technologies onto existing platforms will not result in an optimal user experience – we need new designs that better support people using these types of technologies for creative work. It therefore did not seem hugely valuable to get people to evaluate an application like Photoshop over a longer period of time if it would result in a frustrating experience (developing new software at this stage was outside the scope of the D2ART project).

We therefore decided to invite five artists to participate in the study and provided them with a laptop and a Tobii EyeX device to explore how they found completing the wider tasks across artistic practice. In terms of software we used OptiKey (2016) – an open source communication and computer control application that supports eye tracking technology. We asked participants to use the eye tracking system for at least a week and gave them a series of daily tasks designed to take no longer than 15 minutes of their time to complete (e.g. sending an e-mail, browsing a website, etc.). The study design was completed in collaboration with DASH and we incorporated a series of e-mails (which artists were asked to reply to) which simulated DASH commissioning the artist as part of their Art Express (2016) programme. We asked artists to complete as many of the tasks as possible, but did not insist that they all must be completed. We also emphasised that artists should not feel obliged to complete a task they had started – if they could spend at least 15 minutes on the task then that would be sufficient. Many of the artists we worked with across the project experience chronic fatigue, so we had to balance tasks that would be useful from a research and artistic practice perspective, but also not too strenuous in the effort required to complete them.

We met with artists at a location that was most suitable for them – this varied from in their homes, studios, or at other public spaces that were convenient for them. We decided on using a laptop (as opposed to desktop PC) to ensure the kit was portable and lightweight – we also provided a laptop bag for packing away and transporting the laptop. We initially showed artists how to set up the technology (i.e. plug in the sensor) and calibrate their eyes via the installed software. This was followed by an overview of how OptiKey worked and we then asked artists to complete three tasks which we filmed. We then left the equipment with participants and asked them to keep a journal of how they found using the technology. They were encouraged to update the journal immediately after completing a task or session (if feasible). They were also provided with admin rights to the laptop and told they could use the machine however they chose (i.e. they could install

any artistic, graphical, or other software they were interested in testing). When we returned to collect the equipment we asked participants to complete the same three tasks undertaken at the initial meeting to see how usage had changed over the duration of the study. We also conducted a final interview exploring their perceptions of the technology, the issues they experienced, and potential impact on future practice.

4. Lessons learned

There are several lessons we learned through our collaborative research with disabled artists, partners, and other stakeholders.

4.1 Research study design

A common approach in conducting user studies with technology is to run highly controlled studies that will attempt to determine any significant difference between a range of experimental conditions (typically based on a variety of quantitative measures). However, when running user studies with disabled participants, this type of approach can be problematic due to the number of unpredictable variables. For instance, participants may need support from their personal assistants when completing tasks, they may need a break halfway through a task, their input method (e.g. a switch) may fall on the floor or be knocked out of their reach, or they have difficulty in communicating and asking for clarification on tasks. All individuals will have their own set of unique requirements that makes controlled evaluation difficult. Therefore, quantitative measures such as the time taken to complete task become less valuable and have low levels of validity (if attempting to make comparisons across participants). We have found a more informal and flexible (yet structured) session where participants are asked to share their thoughts whilst working on specific tasks to be more productive. We still collect quantitative data to obtain, for example, a sense of how long it takes to complete tasks – however, we do not see much value in making comparison across individuals. The combination of qualitative and quantitative data has therefore helped to provide a more holistic view of participants' experiences in using assistive technology.

4.2 Longitudinal field study considerations

The artists we worked with during the longer term studies had varied experiences in evaluating the technology. For instance, we had mixed results with the journal approach where we asked artists to note down their thoughts after completing a task. One of the artists embraced this approach and provided detailed notes whereas others had difficulties due to their impairments or they felt too tired after a session to write extensive notes. People with physical impairments may also require more technical support in longer term studies – both in terms of setting up equipment, but also in working through the range of set tasks. It is therefore important to check that participants have personal assistants who will be available over the duration of the study and that they are free to be involved in the initial study meeting. We also found that it was necessary to extend the study with several artists – mainly due to illness during the study, personal assistants not being available to support artists, or simply not having the free time on some days.

4.3 Flexible research approach

In addition to the point around research study design, we also found that it was essential to be flexible in our approach to running and tailoring the studies to individual artists' requirements. This is in contrast to a common user evaluation approach where something very specific is tested and there can be little deviation from the plan (as it might lower the validity of the data collected). For instance, in the longitudinal studies, we had to extend the study in a few instances due to illness or through the need to a have a personal assistant available. It was also important that we adapted the technologies we evaluated based on each artists' requirements and preference for work in the technology evaluation sessions. These adaptations to the original plan make it difficult to make valid statistical comparisons across participants – although that was never our primary goal. Our collective view is that digital tools and solutions should be tailored for an individual's unique requirements, so attempting to generalise our findings has limited value.

4.4 Artists and stakeholders as advocates

We found that by including artists at each stage of the process (from collecting initial views via the survey through to longer term studies) they became pro-active collaborators as opposed to test participants. Artists would use social media to discuss their experiences, write blog posts, and disseminate the work amongst their colleagues and peers. This plays an essential role in helping to disseminate the work to audiences who may most benefit from it. We found it was crucial to build relationships with participants – this is obviously more time consuming than simply approaching people for testing, but it is essential for conducting collaborative and impactful research. As a result, artists were keen to be involved at each stage of the research – even though we were unable to offer compensation for their time (aside from travel and accessibility expenses). It is arguably unlikely that the same level of project engagement would be achieved if artists had been invited only for testing purposes. Artists have also openly offered letters of support for funding applications which can help strengthen future applications (without researchers requesting the letters).

4.5 Target audience driving research focus

Through working with artists and stakeholders directly we were able to obtain a more holistic understanding of their practice that would not have been possible without their input. This was demonstrated through the technology evaluation sessions where it became apparent that assistive technology was not only required to support artistic work, but also the wider tasks that artists must complete. This seems like common sense, but it was not something that we had identified at the start of the project and perhaps might not have teased out had we not worked with our target audience. These insights from participants helped shape the project and altered the focus of the research for the longer term studies, thus enabling us to address pertinent and real-world issues for disabled artists.

4.6 Importance of partnerships/wider research impact

Working with "non-academic" partners such as DASH enabled the project to explore and understand the potential impact of the research. They were able to advise around the wider issues in working with disabled artists and could disseminate (through social media, blog posts, e-mail newsletters, presentations at events) the work across their network of artists and related organisations. Our partnership with SCOPE and National Star College enabled us to look at the broader potential of the work and will allow us to conduct further research studies with disabled students (who are not artists). Working directly with artists has also resulted in wider benefits and impact from the research. For instance, through participating in the project, several of the artists have informed us that they have purchased some of the technology and are currently using it to support their interactions with computers. Another example is how artist involvement in the project has supported further grant success – in particular, one of the established artists we are working with has recently been awarded significant funding for a new project. This artist was made more aware of the digital opportunities available through participating in the D2ART project and was therefore able to add a strong digital component to the application (thus adding a new dimension to her work).

4.7 Role of personal assistants

Personal assistants play a crucial role in research studies with disabled participants. They may be required to help set up the system to suit the needs of the participant, make any necessary amendments during an experimental task, or to assist with communication. We encouraged personal assistants to share their views during tasks as they are aware of how the artists work and may have a different perspective on the issues they experience. It is also common for some personal assistants to work with a variety of disabled people which can enable them to see the wider potential of the technology and possible applications in other areas.

4.8 Adapting to needs of participants

This is closely related to our point around adopting a flexible research approach as it is essential to always prioritise the needs and preferences of participants over a research team's desired plans.

This, of course, is necessary for any type of research but arguably more so when working with disabled participants. For instance, due to the nature of some participants' conditions, they may miss or need to re-arrange appointments at short notice, only be available at certain times of the day (e.g. they may have more energy in the afternoons), and there is – in some cases – an increased possibility that they may become unwell over the duration of a longer term study. It is therefore essential to adapt a research approach to the needs of an individual to ensure they are comfortable and happy – as opposed to setting a rigid experimental design that participants must strictly adhere to.

4.9 Access options for online surveys

People with physical impairments may require additional options to be made available for completing online surveys. It may be more feasible for them to have a face-to-face meeting with a researcher or to provide responses via the phone (either to a researcher or through an automated system). This needs to be taken into account by researchers prior to choosing this research approach as it can add significant time and resource into the design of a survey. It is also essential that all online surveys are fully accessible and can easily be used through the use of a switch or keyboard to maximise the number of people who can participate.

4.10 Additional costs and resources

There are additional costs that are important to cover when working with disabled participants. This can include travel expenses, the time of personal assistants, and other accessibility costs. Researchers may also need to travel to the homes of disabled participants to whom travel is a significant barrier.

5. Conclusion

The research we have conducted has been enriched through our close collaborations with disabled artists and stakeholders. It has helped to inform and shape the research focus of the project which in turn has helped to enhance broader impact of the work. We feel that moving away from highly controlled quantitative studies to more structured qualitative research sessions has enabled us to maximise feedback and observations from artists. The D2ART project has been crucial in laying the foundations around designing digital tools for physically impaired artists – both through the research conducted and in the network and relationships that have been developed. The next stage of our work will involve looking at shifting the focus from exploring how digital assistive technologies work with existing platforms (e.g. Windows) and instead look at how we can co-design and evaluate new tools that better support artists using these types of technologies. We feel that this will likely require radical, creative, and new approaches to interface design that require us to move beyond the more traditional interface paradigms developed for mouse, keyboard, and touch interactions. Our partnerships with artists and stakeholders will again be crucial in enabling us to explore these areas and to better understand the real-world impact on the practice of disabled artists.

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