

Arts + Health: New Approaches to Arts and Robots in Health Care

Damith Herath
Human Centred Technology
Research Centre
University of Canberra
Canberra, ACT, Australia
damith.herath@canberra.edu.au

Jennifer McFarlane
Curator, Arts in Health
Canberra Health Services
Canberra, ACT, Australia
Jennifer.McFarlane@act.gov.au

Elizabeth Ann Jochum
Department of Communication
and Psychology
Aalborg University
Aalborg, Denmark
jochum@hum.aau.dk

Janie Busby Grant
Faculty of Health
University of Canberra
Canberra, ACT, Australia
Janie.BusbyGrant@canberra.edu.au

Patrick Tresset
Artist
Brussels, Belgium
tresset@patricktresset.com

ABSTRACT

We describe the implementation and evaluation of a public interactive robotic art installation in a rehabilitation hospital. The project had two goals; to provide an enjoyable and novel artistic experience for the hospital community, and to better understand how human-centred robotics, particularly a receptive-focused intervention, might promote wellbeing and quality of life for members of hospital communities. By evaluating the experiences of the participants and stakeholders, the value of the installation for participants was assessed. This work contributes relevant insight towards the development of future art installations within the health jurisdiction and more broadly. The data also informs the ongoing discussion concerning the potential role of social and therapeutic robots in health care settings.

CCS CONCEPTS

- Computer systems organization → Robotics
- General and reference → Surveys and overviews
- Human-centered computing → Empirical studies in interaction design
- Human-centered computing → Interaction design theory, concepts and paradigms

KEYWORDS: Human Robot Interaction, Robotic art, Health care, Community engagement, Quality of life

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1 INTRODUCTION

Art as therapy has a long history [1-3]. Because of its ability to convey difficult and abstract ideas in powerful ways, art-making practices have featured prominently in the treatment of stress, depression and various psychosomatic conditions [4]. Beyond the visual arts, many other forms of art practice have been used in various therapeutic applications over many decades. For example, music therapy has been explored in the treatment of Autism Spectrum Disorder [5, 6]. The development of digital technologies have prompted art therapists to experiment with various digital media [7] and immersive digital platforms such as gaming or virtual reality-assisted environments [8, 9]. Traditional and emerging artistic practices, therefore, can be seen as either facilitating or directly intervening in the care process of healing and can help break the monotony of the long recovery process by introducing activities that improve the quality of life and the wellbeing of the patient.

Animal-assisted therapy is another category of interventions that have been successfully employed in various healthcare situations [10]. Wada et al [11-14] and others have endorsed robot pet therapy as an alternative to the use of animals that may have similar benefits to animal-assisted therapy. Many researchers have already experimented with 'social robots' with varying degrees of success in therapeutic contexts [11-18]. Robotic therapy now extends beyond interventions in the psychological domain to physical rehabilitation [19-21]. While further research is warranted to establish the efficacy of various robotic interventions

in therapy [18, 21], nevertheless these studies provide compelling evidence for inclusion in the therapist's toolbox.

The current study focuses on the potential use of robotic art in therapy, building on prior evidence of the role of both art and robots in health care, respectively. Robotic art outside therapeutic contexts has a substantial history [22-24] and includes robots that make art, robots as works of art and robotic performances (e.g. [23, 25-28]). While robotic art readily lends itself to the possibility for therapy and rehabilitation, only a small number of studies have explored robotic art within the healing and recovery process. For example, Cooney et al. [29] are currently developing an art therapy robot. They acknowledge the emerging nature of the field its potential to promote a humanistic, 'responsive art' approach as a starting point for art therapy robots.

This paper describes a robotic art installation at a rehabilitation hospital to assess whether an interaction with a robot is perceived as a positive experience in the healing process that contributes to the improvement of the quality of life for resident patients, caregivers and staff. As per Moss et al [30], this study also allows assessment of receptive engagement with the aesthetics of the installation, unlike many other studies which focus on active or participatory involvement with the artwork. To our knowledge, this is the first time a robotic art intervention has been studied in a receptive/contemplative context – where the participant is not actively engaged in the art-making process. This is particularly important for hospital-based rehabilitation settings where patients experience hospital stays to be emotionally and physically exhausting, leaving little energy available for more active experiences with the arts (e.g. painting, music-making). As such, this study provides insight into a potentially valuable, highly accessible intervention for hospital settings.

2 THE INTERVENTION

Robot named Paul (Drawing Robot) is an interactive robot artwork designed by the internationally recognized artist Patrick Tresset (Figure 1). The robot takes a picture of a seated visitor and using computer programming draws that person's portrait using an ink pen and paper using line drawing hatching techniques. The drawings are abstracted, recognisable renderings of the subject (Figure 2). A novel aspect of the experience is the interaction with the robot, and the expressive gestures made by the interactive camera which gives visitors a sense of engagement and the feeling of being included in the art-making process [31]. The drawing robot is less of a fixed artwork and akin to a performance event that creates community, stimulates discussion, and places participants/ patients at the centre of the experience. At the beginning of the sitting, once the participant is seated in front of the installation, the artist turns on the robot by moving its arm (Figure 2-2) to the canvas area. Then the interactive camera (Figure 2-1) 'looks up' at the participant recording the first impression of the participant. The robot arm then begins 'sketching'. Throughout the drawing process, the interactive camera regularly 'looks at' the drawing as well as the participant,

generating the perception that the robot is actively engaged with the evolving artwork while remaining focused on the participant.



Figure 1: Installation in a public area of the hospital with onlookers



Figure 2: Closeup of the robot installation [1-interactive camera mounted on a 2-degrees-of-freedom robot arm, 2-the 3.5-degrees-of-freedom robot arm with the drawing attachment, 3-portrait in progress]

2.1 Aims

The aim of this study was to evaluate the effect of the robotic art installation on participants' experience within the hospital environment and to evaluate the perception and attitudes towards therapeutic social robots as members of the community where these types of assistive devices are most likely to be deployed. It was hypothesized that participants in the robot installation would report positive outcomes from the interaction and that this would be reflected in their responses with respect to the hospital environment more generally.



Figure 3: Onsite exhibition of portraits

2.2 Methodology

Sample. Participants were recruited from a rehabilitation hospital located on a university campus. Hospital patients, carers, visitors and staff were all eligible to take part. The research staff, in collaboration with hospital staff, identified those participants who should not be considered to take part, for example, those aged under 18 years or current patients for whom it would not be appropriate for cognitive or behavioural reasons (this approach was agreed with hospital staff during the consultation phase of the project).

Procedure. The artwork was installed in a public space at a university rehabilitation hospital and included both the robot set up installation (Figure 1) and nearby the exhibition of portraits (Figure 3). The entire installation was visible from the main hospital entrance and adjacent to a small public café. Although it was located in a high-visibility, high-traffic area easily accessible by passersby, the installation did not impede passage through the hospital. The installation ran for three consecutive days, with 20-minute time slots available for potential participants between 2 pm and 5 pm every afternoon. This time frame was selected by hospital staff as the most suitable given meal and rehabilitation schedules.

Members of the research team working with hospital staff canvassed patients in the days leading up to the installation by discussing the project with potential participants, with interested

participants signing up in advance for a time slot. Participants wishing to take part in the installation could also approach the research team on the day to be allocated any available time slots. The activity was very popular, with almost all time slots booked ahead of time and all participants attending at their selected time.

The artist and at least two members of the research team were present at all times. Upon arrival at the installation, participants completed a Photo Consent Form as required by the hospital ethics committee. Participants then sat at the chair provided, or with the chair removed, had their wheelchair positioned appropriately. Sitting time was approximately 15 minutes, although the participant was welcome to leave earlier if they wished (however none took this option). During this time, the robot completed the portrait, and the participant often engaged in discussion with the artist, other research team members, hospital staff or their visitors/carers. Participants were then shown the completed portrait and watched as it became part of the exhibition of portraits. The portraits were identified with the participant's name (on the reverse) and were given to the participants at the end of the three-day installation.

After the portrait was completed, participants were asked if they would like to take part in a brief survey evaluating their experience. If interested, they were provided with a laptop displaying an information sheet and informed consent form. After consenting, they were presented with the survey. All survey items were presented using Qualtrics survey software. The survey was anonymous. Ethical approval for the research was obtained through both the hospital and the university ethics review boards.

Survey. The survey was designed to provide feedback about the experiences of the participants in the installation in the hospital environment. Two questions asked participants to identify as either a patient, carer/visitor or staff, and how long they had been staying or working at the hospital. Participants were then provided with ten statements about the installation and asked the extent to which they agreed or disagreed with each statement, on a five-point scale from strongly agree to strongly disagree. The statement stem was "overall, participating in this art project:" with statements that the project made them feel more positive, improved their day, was enjoyable, reduced their anxiety, made them feel more positive about the hospital environment, was a talking point, improved relationships with others, gave them an activity to do, relieved boredom and made them feel cared for.

In addition to these survey questions, participants were also asked their agreement with the statement that the project was of a high standard and a series of questions about their beliefs regarding robots in health care. The survey questions were based on a questionnaire previously developed with hospital staff and an external consultant to assess projects and programs developed for the Arts in Health program in place at hospitals across the region. Four additional questions concerning robots in health care were also formulated.

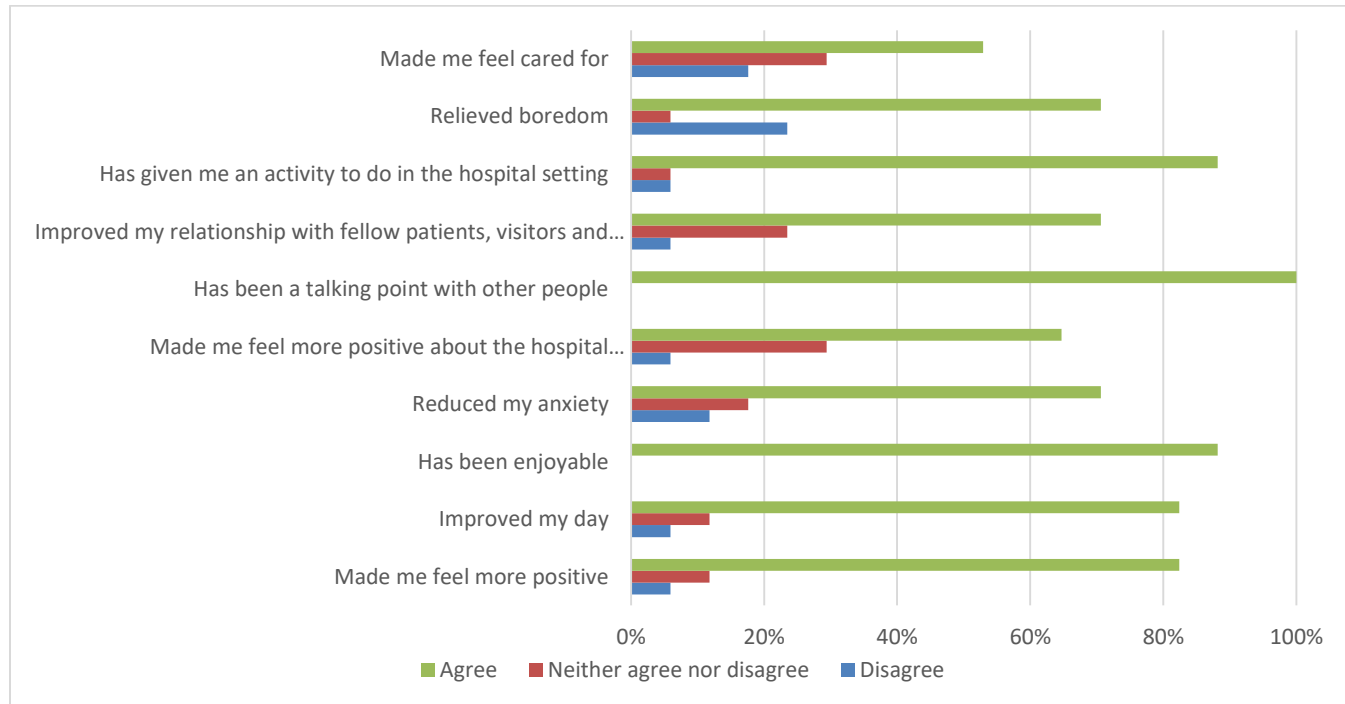


Figure 4: Participant responses to the experience of installation questions.

3 RESULTS

A total of 27 individuals participated in the robot art installation, 9 on each of the 3 days of the installation. Of these, 17 consented to complete the survey (7 on Day 1, 5 on Day 2, 5 on Day 3). Completion of the survey took on average 1794 seconds ($SD = 2099$), ranging from 118 to 8823 seconds.

14 (82.4%) of those who completed the survey were patients, and 3 (17.6%) were carer/visitors. Two of the visitors were only there for the day, while the other had been there for up to a week. Of the patients, 1 had only been there for a day, while of the remainder 2 were up to a week, 4 up to a month, 5 up to 6 months and 2 up to a year (note the hospital had only been open for a year).

In particular, there was a clear consensus that the experience provided a talking point with others (100% agreement), gave them an activity to do (88.2% agree) and had been enjoyable (88.2% agree). The lowest agreement ratings were to the statements made me feel cared for (52.9%) and made me feel positive about the hospital (64.7%).

Given the low numbers of carers/visitors, following values are reported for all 17 participants. Figure 4 presents the responses to 10 positive statements about the participants' experiences of the installation, with the 5-point response scale collapsed into three categories Agree/Neither/Disagree. Responses were generally positive, with all questions receiving more than a 50% agree rating.

Four more general questions about robots in health care were also asked. When asked their agreement with the statement "Robots such as these are important tools in a holistic health care program" none disagreed, 82.4% agreed and 17.6% were unsure. When asked "If robots become more common as therapeutic tools in the future,

would you consider using them?" similarly none disagreed, 82.4% agreed and 17.6% were unsure. However, the results were more mixed regarding patient care, with 35.3% saying they had concerns about the use of 'social' robots in the care of patients (52.9% disagree, 11.8% unsure), and 34.7% said that robots should not replace human workers (35.3% disagree, 29.4% unsure).

Participants also reported that they thought the project was of a high standard, with only one of the 17 participants disagreeing. Open text responses to the survey reflected participants' enjoyment of the installation and their interest in the robot in particular.

3.1 Post-event Interview

There is evidence to indicate that reminiscing provides useful insight, particularly in the study context [32]. Post-event interviews generate useful information about the study experience in a more relaxed setting by developing a better rapport with the participant. Such information can be useful in understanding how the intervention was perceived by the participants and what parameters could be explored in future interventions.

Study participants were given the option to take part in an optional interview with the researchers 2-3 weeks after the event. As no participant information is collected during the initial intervention, the invitation was sent as an open communicate to the wards and facilities within the hospital that initially participated in the intervention. Three of the original participants were able to take part in the post-event interview. Other participants were no longer contactable, except for one participant who declined to participate in the interview. The interviews took

place two weeks following the original intervention and participants signed a second informed consent form for the interview. All three interviews took place in a space familiar to the participants, either in their wardrooms or in the dining room. Each interview lasted approximately 20 minutes, with each participant being asked the same four questions. One researcher interacted with the participant by asking the questions while a second researcher then transcribed the answers. The four questions and responses are collated below as they provide useful insights into the intervention;

Q1. What are the positive outcomes of this event, if any?

A1.1 Fun event to participate. Get to meet people community. I didn't know many people before the event, now we know more, know everyone. We were all talking about it in the foyer, trying to pick out who was who.

A1.2 I enjoyed it. But I don't know about positive outcome. Because the experience was quite enjoyable, that is a positive outcome when I think about it. I always felt that hospitals should be place [sic] not just look after your body there's awful lot to human body, there's emotions, feelings and psychological side of you. And all those points need to be cared for. Hospitals are not places where these are often considered but they should be. But often not. The whole person needs to be cared for.

A1.3 It helped break the monotony of the daily routine. It was something new and different to talk about. Stimulating. Everybody was talking about it in the gym and dining room all very abuzz, exciting.

Q2. What are the negative outcomes of this event, if any?

A2.1 Time of the day – the daylight was not good. There was a technical issue with poor lighting- reduced the quality of the finished product.

A2.2 Only thing I can think of is that the robot didn't do a good portrait of me. On the other hand, when I asked my brother and sister in law whether they could find mine, they said we did. I said how did you know. My brother said "You had your sunglasses on and your hair was short and straight." And he was right. I thought it was a negative but in fact it wasn't.

Q3. Would you like to see more events like this one in the hospital?

A3.1 It's like a big family. It is very therapeutic to take part in something like this, it takes your mind off. More arts. Little minibots would be good for hand eye coordination. Collaboration, to mix the old people with the young, have something to laugh about and have a discussion at dinner time.

A3.2 I like to see all sorts of different events. The kinds of thing I like is something like a talk by an author. It'd be quite interesting. I like to look at paintings. We do have some concerts I like to have more of those. I would like to have a good poet read their poetry. Any event that happens at

hospital takes them out of their comfortable room and puts them near the café. And I think that's useful.

A3.3 I think that would be really really good - for breaking the monotony and having something to look forward to.

Q4. Do you have any other comments?

A4.1 It was good. There is other technology here, that lady (points) has just discovered Siri. It was good to have something we can keep, a memory. There are quite a few kids here, it can be like a big family.

A4.2 I've never seen a robot actually doing anything. I thought it was fascinating to watch this little robot drawing. I know there was a person behind the act of it. But to actually watch a robot drawing you was well it was a bit hard to see. You had to be still so they could actually draw you, but if you could tipped your head down a tiny bit you could see how they were doing it. I found that to be a very interesting thing to watch. Having seen a robot, it takes away a fear. If you had to have surgery and were told it was a robot you would fear something might go wrong. But if you had seen a robot actually working you would not be so fearful.

Informally, the project received substantial positive feedback, with patients, visitors and staff stopping frequently to look at the installation and the exhibition of portraits and showing great interest in the process and the artwork. One doctor stopped to say that the project had 'turned the hospital into a community'.

4 DISCUSSION

This study assessed the potential for a receptive, robotic art intervention to improve patient wellbeing in a hospital setting. The findings indicate that overall, the participants had a positive experience and experienced the intervention as enjoyable. Most participants attributed joy to be the singular most important quality attached to the experience, which is directly related to the quality of life and wellbeing [29]. Particularly telling is the post-event interview answer A1.2 which highlights the patient's desire to be cared for holistically – physically, emotionally, and psychologically – during a hospital stay. The particular response alludes to the importance of a holistic and participant-centric approach to rehabilitation and hospital stays. Patients in rehabilitation hospitals express concern that when they become institutionalized in the hospital environment, their sense of self can be eroded. This intervention, which places patients at the centre of the experience without explicitly calling on them to generate artworks, proved beneficial to preserving the sense of self. As also supported by answers A1.1 and A1.3, the intervention positively addressed these concerns about individual wellbeing.

As noted by Moss et al. [30], little attention has been given to the study of receptive art engagements in healthcare within the mainstream. In the current installation, the participant is a passive observer in the installation, receptive to the aesthetics of the robot's movements and the emerging portrait. The finding that positive outcomes are apparent with a receptive art piece such as

this is promising for the development of therapies with patients who have a substantial physical impairment and suggests further research is warranted with other forms of receptive art interventions. However, it is also important to consider the nature of the installation itself. The drawing robot has been successfully exhibited at international galleries, museums and festivals. The artist attributes the international acceptance and success to its ability to appeal to a wider audience – “*The thing about this artwork is that it's for everybody. It works on every type of person, across age and class. When I exhibit this work in galleries, everyone from the curators to the cleaners to security guards, and children, it is accessible to everyone.*” Anecdotally, this was true for the current installation as well. We believe accessibility to be one of the important elements to be considered in a robotic art intervention.

Hospital stays can be quite isolating experiences. Without access to familial contacts and relying on strangers for care and companionship, it can be particularly trying for long term residents, some of whom formed part of the population in this rehabilitation hospital setting. Sustained community-building activities are vital in this context. Our intervention seems to have had a strong positive role in creating alternative communities, where the patients have a new identity that is no longer marked or defined by their illness. For example, all participants (100%) agreed that the installation has been a talking point with others. This was also reflected in the answers given in the post-event interview, in which respondents stressed the importance of similar interventions in the future as a means to building communities (A3.1) and alleviating boredom and sense of hopelessness (A3.3). This also alludes to the appeal of the installation to a wider audience given the participants came from a broad cross-section of the society. We also noticed that the associated exhibition provided an opportunity for re-engagement with the project for the patients, with many returning to the lobby and increased activity in the days following the exhibition which then had a flow-on effect within the community. Participants actively discussed the project with the broader hospital community long after the intervention period. The responses to Q4 overtly indicate that participants have further pondered about the intervention. They indicate a positive outlook for robot-mediated therapeutic interventions due to the measured introduction to robotics through the project.

The lowest rating was recorded for the statement ‘Made me feel cared for’, to which only little more than half of the respondents agreed to. We speculate that this may be because participants could not see the relationship between the art intervention and their clinical care. As the intervention was never framed in a therapeutic/clinical context, and the participants were not exposed to such care/devices beforehand, we believe the participants interpreted the intervention as something outside of their daily care regime. If this hypothesis is valid, then it could be argued that integrating and framing similar interventions as part of the rehabilitation process may result in a better perception of the offered care program.

We would like to argue that the art installation’s most substantial intervention was the act of *being seen*. The hospital environment is host to many clinical machines that ‘see’ into hidden parts of the

body that have failed, are imperfect and might be fixed. These machines image what is wrong, not what is right. The drawing robot offered a space for the patients to be seen as a person, not a pathologized body. The event was a structured occasion where the individual was captured, measured and considered by their carers, other patients in the hospital and staff in a non-judgmental way. The sitter was always the superior standard by which the robotic portrait was measured. With the subjective biases of a human portraitist absent, issues of truth and authenticity were evacuated of any loaded implications for the sitter. The sitter was imaged confidently facing the provisional eye of the non-judgmental robotic gaze. The resulting portrait was perceived as an image of the sitter that was neither flattering nor critical, that made no reference to their temporary ill health and was recognizable at some essential level. The drawing robot’s act of seeing and drawing them enabled their individuality to become present in a way which had not been obvious when their witness was clinical machinery. This truth is essentially captured in the poignant answers given to Q2 in the post-event interview, which reflect a focus on personhood so often lost in institutionalized settings.

Finally, there is a growing interest in using social robots in care settings and therapeutic contexts to provide companionship, motivation, and diversionary activities. At the same time, the use of medical robots for diagnosis and surgery is also on the rise, and patients and their families have concerns or anxiety about being treated by robots. This interactive artwork provides another context for meeting and interacting with robots in a way that makes robot technologies more approachable and less fearful. As response A4.2 indicates, there is tremendous potential in creative interventions that do not aim at traditional therapy or rehabilitation but render machines and interactions with machines less scary and more familiar, possibly reducing anxiety for patients and their family members and providing a meaningful site for dialogue about these concerns.

5 CONCLUSION AND FUTURE WORK

The above interpretation of this research centre around the needs of the participant. However, this intervention has an important alternate perspective – that of the artist. The hospital setting made demands on the artist’s performance that reflect the distinctive environment of the hospital; a very different space to a gallery or museum. Similarly, the installation opened up the space of the hospital to new understandings. The most obvious of these was the decision to use the French translation of the title for installation; *Etude Humaine #1* rather than the more usual *Human Study* that has been internationally used, because of the clinical associations of the phrase in a hospital environment. The most fundamental aspect of the deployment of the artwork to this environment was the shared understanding that in a hospital context, the most important element of the project was the audience; the patient. Each facet of the project was designed to accommodate the needs and requirements of this vulnerable community. Rather than using the chair provided, many came in wheelchairs, rather than sit for 50 minutes (the nominal sitting time in a gallery setting), the more manageable timeframe of 15

minutes was set. Rather than contributing to the artist's growing gallery of images (over 30,000 at the time of writing), the portraits were gifted to the participants following the display. However, as the artist would have envisioned, the conversations about the event set the *gym* (the communal sports facility) abuzz and revealed the individuality of the conversationalists, their interests in Virtual Reality, in philosophy, art and their children's exploration of robotics.

None of the participants disagreed with the general statement about robots playing a role within a holistic care program. They were also optimistic about the possible future use of therapeutic robots. However, on the question of 'social robots' and robots replacing humans in the care situation, the responses were more mixed. This alludes to the importance of 'human care' within the therapeutic context. This is important in framing future research in rehabilitation and therapeutic robotics. While this is mostly speculative based on the responses to the final four general questions by the participants, we invite the HRI community to explore these findings further.

As some of the participants reflected (e.g. A4.2), robotic art interventions may help alleviate fears towards robots in therapeutic settings. It could be drawn from the overall positive outcome that there is an important role for receptive, non-clinical robotic art interventions within a broader rehabilitation regime in care facilities such as hospitals. But for such interventions to succeed, all the parties including the artists, caregivers, patients, health staff and the researchers need to engage with each other throughout the design and implementation phases of the project in a mutually respectful, trustworthy and compassionate manner.

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¹ https://www.arts.act.gov.au/_data/assets/pdf_file/0011/863372/Report-on-Art-at-the-Canberra-Hospital.pdf