Drawing Comparisons

Research project

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Abstract

Title: Drawing Comparisons
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This thesis report presents a research project that investigated how artists interact with Augmented Reality, 3D printed and live physical models in their practice of observational drawing (in an experimental environment), to evaluate their experience of using the three representations as drawing subjects. The evaluation was undertaken using qualitative research methods. Results endorse AR as a favourable tool to support certain aspects of learning drawing and some AR design issues and unique affordances are discussed.

Declaration

This final year project is presented in part fulfilment of the requirements for the degree of Bachelor of Science in Digital Media Design. It is entirely my own work and has not been submitted to any other University or higher education institution, or for any other academic award in this University.

Where there has been use made of the work of other people it has been fully acknowledged and fully referenced.

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Marie-Clare Boothman

28 April 2020

Acknowledgements

I would like to thank my supervisor, Dr. Chris Exton, for his guidance and for allowing me the freedom to explore and develop this research in the context of this final year project. I also extend my gratitude to Dr. Nora O Murchú for accepting me on the course in 2016 and to my course director Dr. Gabriela Avram for her support and inspiration.

Many thanks to Patricia Moriarty of the University Limerick Arts office for kindly providing Dromroe Village Hall as the venue for the drawing workshop. Thanks also to Ger Walsh of FabLab Limerick for his expertise and assistance while I was working on this project in the FabLab.

Thanks also to my family, including my three daughters for their encouragement and confidence in me that I would accomplish my degree goal. Thank you to my mother for her love and support. Thanks also to my friends at the Limerick Figure Drawing Society and to Alison for the gift of the mannequin for the pilot study. Finally, I am grateful for the work of researchers who are acknowledged in the reference sections.

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1. Introduction

1.1 Motivation

The goal of this research project was to investigate how a sample of visual artists interacted with Augmented Reality (AR), 3D printed and live physical models in the practice of observational drawing and to evaluate their experience of using the three representations as drawing subjects.

It incorporated an experimental workshop in which the participant artists were asked to draw from observation the model of a hand in each of the three representations. The research endeavoured to create comparisons between the artists' experiences of the three representations, through the lens of both their drawings and their recounted experience of the workshop drawing tasks. It was a qualitative research project, phenomenological in its approach.

1.1.1 Ulterior motive

An ulterior motive for undertaking this project was for the student investigator to learn how to make 3D digital models, learn to 3D print and to spend some time working in the creative atmosphere of FabLab Limerick.

1.2 Background

On Friday 2nd of November 2018 at the University of Limerick, I attended the Irish Human Computer Interaction (iHCI) conference, where I had the good fortune to hear Liam Bannon's keynote, "Framing the Human in HCI" (Bannon 2018). His presentation traced the evolution of how we have framed our understanding of human experience and activity in technological developments, from humans supposed to fit to the machines, through to users being stupid and designing humans out of the loop altogether (he questioned the current development of care robotics in place of human caring). In considering the future of HCI and putting human values centre stage in design, Bannon posed the question: "What is it to be human?" This question stuck with me. In May 2019, I determined to use the opportunity of the FYP to explore this question at some small level and the relationship between humans and digital technology. In particular, I wanted to focus on the technology of

Augmented Reality (AR), which overlays virtual objects on a real-world environment and to examine human interaction with AR.

I have an interest in life drawing, which is the act of drawing a human form from observation of a live model. I thought it would be interesting to design an experiment that would investigate how comparable an AR simulation of a human model is to a live human model when used as a drawing subject in this age-old human activity of drawing. As a member of the Limerick Figure Drawing Society (LFDS), which convenes weekly for life drawing sessions, I decided to invite members from the society to participate in the experiment. Figure 1 is a photograph of a life drawing session in Dromroe Hall, University Limerick (Berg 2015).

***Figure 1*:** Life drawing at Dromroe Hall, University Limerick (Source: Berg, L. 2015).

I had a hunch that the artists' keen observations expressed through their drawing process, coupled with an investigation of how they interacted with the subjects, would reveal some insights. I also hypothesised that a human-centred understanding could be gained through this process, which might be applicable to the design of interactive technology such as an AR app to help people learn how to draw.

Upon learning from my supervisor that the theoretical perspective of phenomenology has often been used to explore what it is to be human in various contexts, I decided to use a phenomenological approach in this project.

1.3 Objectives

1.3.1 Project plan

I endeavoured to run a drawing workshop and invite artist participants to execute three 20-minute observational drawing exercises using:

1. The hands of a live human model (the model keeps her hands still in one position for 20 minutes while the artists draw them).
2. A 3D printed replica of the model's hands.
3. A 3D replica of the hands displayed virtually via an AR app on an iPad.

Hands were chosen as they are an integral part of human body as a subject for observational drawing. We are wired to looking at our fellow human beings and we are particularly interested to looking at faces and hands (Wikipedia 2020).

Following on from the workshop, I planned to hold a focus group after the workshop, for the artists to discuss their experiences and comparisons between the three drawing exercises.

Initially, I would make the 3D printed and AR digital representations of hands for the workshop. Capturing and reproducing realistic, real-world objects for display as virtual objects in an AR or Virtual Reality (VR) environment involves scanning the real-world objects using digital cameras and computer graphics (Gutierrez et al. 2018). I intended to learn photogrammetry to scan a live model's hands. I would then use the scan to make a 3D digital replica of the hands that could be imported into an AR app on an iPad to be displayed virtually via AR, and could also be used to 3D print the hands.

Data from the workshop and ensuing focus group would be analysed by qualitative methods and the findings discussed.

The planned presentation of the research was to be in two forms, a public exhibition of the artworks curated by me and my thesis report.

This FYP idea was scoped down considerably from its first conception, which comprised a totally Virtual Reality (VR) life drawing room environment, with a virtual

model and artists wearing VR headsets, brandishing VR Tilt[1] brushes.

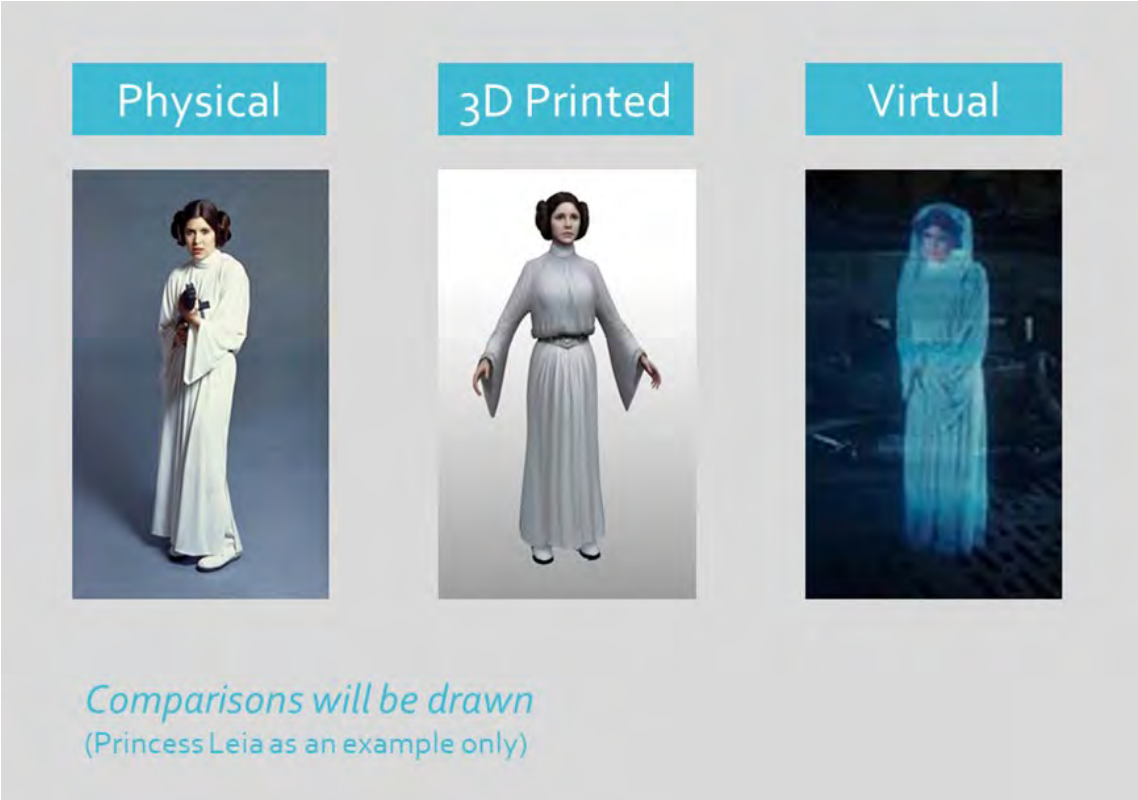


Figure 2: A slide from the project proposal presentation illustrating the concept of three representations, live, inanimate and virtual.

1.4 Research Questions

1.4.1 Does the AR subject work as well as the real?

In the context of the observational life drawing scenario, if the live model was replaced with a 3D digital model of a human viewed via an AR display, would it be a comparable life drawing subject from the artists' perspective?

1.4.2 Does AR help people to learn skills?

How might AR help people to master the skill of drawing? In this project I ask artists who are adept at observational drawing to compare the differences in their experience between drawing from a live model and an AR model to uncover aspects of AR that could be improved to make it more useful for learning to draw from.

[1] Tilt Brush is a room-scale 3D-painting virtual-reality application available from Google.

AR technologies have been designed to very successfully help train surgeons to perform surgical procedures. There are many studies on AR being used as an aid in education. How might AR be used to help master the skill of drawing? Or, how useful would it be as an aid in drawing practice? What could be improved to make it a more usable subject display medium for learning to draw from? I thought that the artists might discover some unique affordances of the AR app applicable to drawing.

1.4.3 Are humans centre stage in AR design?

Examining how humans interact with Augmented Reality is an important area of research, because as technologies become more ubiquitous people will be increasingly exposed to AR and mixed reality technologies. Therefore, it is necessary for the designers of the interfaces of these technologies to know as much as possible about how humans interact with them, to ensure that their designs will be usable and human-centred.

1.4.4 Overview of the structure of the thesis.

This thesis describes the work undertaken over the course of two semesters for my Final Year Project. Section 1 introduces the project. Literature that has inspired and informed this project is discussed in Section 2. In Section 3, there are descriptions of the actions I took to prepare for the research experiment. Section 4 describes the methodology, how I performed the experiment and the frameworks that were used to ensure the validity of the research process. In Section 5, I describe the results and how the data were organised and analysed, followed by descriptions of the findings. Section 6 is a discussion on the significance of the findings and presents two possible design ideas that could be developed based on the findings. Section 7 is dedicated to the exhibition of artworks that were produced at the workshop.

2. Literature Review

Inspired by Bannon's keynote, mentioned in the introduction, I read works by two of the people he acknowledged, Jaron Lanier, whose work has made a huge contribution to the field of Virtual Reality (VR), and Nicholas Negroponte, a pioneer in the field of computer-aided design at MIT (mitmedialab 2020).

In his book, *The Dawn of the New Everything*, Jaron Lanier recounts his story of developing VR. Lanier describes how he used VR to explore and learn about the human experience of the world. He explains that he really had to understand how human perception worked in order to invent VR. I found this requirement of understanding how you perceive something in order to create a representation of it (in Lanier's case a virtual simulation) interesting in relation to drawing. It has similarities to the situation of the artist who requires knowledge of conventions that rely on an understanding on human visual perception (Gestalt theory of visual perception) when making a 2D representation of a model with pencil marks on paper.

I also read Nicolas Negroponte's book, *Being Digital* (Negroponte 1995). This book is a collection of writings for his column in in Wired[2] magazine, in which he outlines the history of digital technologies and predicts possibilities for the future of these technologies. Negroponte coined the praise: "Atoms to Bits".

These writings inspired me. I decided to learn photogrammetry so that I could master the process of making a 3D digital representation of a human, to create a virtual version of a real person – my own take on the process of going from atoms to bits.

In the digital humanities, inter- and multi-disciplinary research approaches have been expanding our understanding of the implications and consequences of the development of new digital technologies (Frodeman et al., 2017). I believe that bringing the very old tradition of life drawing into a contemporary experimental setting is an inter-disciplinary research approach.

Putting our understanding of the user and their practices at the forefront of technology design is a perspective that is inspired by several theoretical perspectives, including phenomenology (Bannon 2010).

The founder of phenomenology Edmund Husserl said a phenomenon should be examined actively (Husserl, 1967). Using the activity of drawing by the participants will be an active way of examining the experiment situation.

[2] Wired is a magazine that covers technology and its effects on society. https://www.wired.com/magazine/

2.1 Drawing

According to Prof. Eduardo, drawing has power “within the process of acquiring knowledge”. Our way of seeing drives us towards the interpretation of two-dimensional images. This is equivalent to saying that we are driven to interpret drawings. “When you think of vision you think of eyes but most of the work is done in the (visual cortex) brain” (Dr. Daniel Yoshor 2019). We don’t often draw what we see, but instead, we often draw our brain's interpretation of what we see. These are from a selection of literatures that I drew on to endorse drawing as a valid way to explore human experience and how drawing is a very direct visual language.

Artists have explored visual perception and used their knowledge of it over the years to develop drawing techniques and tools to aid their ability to make observational drawings and make art that reflects their experience of reality more realistically.

How we use the tactile sense is not discussed enough in drawing and this will come to the fore in the project experiment.

2.2 Qualitative research

The research methodology chosen was qualitative, because of its exploratory and inductive nature (Bolderston 2012). Conclusions would be drawn from and allowed to emerge from the data. Qualitative research is mostly appropriate for a small sample such as that used in this project, and while its outcomes are not measurable or quantifiable, it can offer rich descriptions of the area of research, without limiting the scope of the research and the nature of participants’ responses (Collis & Hussey, 2003). The use of a focus group is a qualitative research methodology, which involves group discussion that is lightly facilitated by the researcher. It presents a natural environment for the participants to discuss a topic just as they would in real life. The participants of this project were familiar with the environment of Dromroe Hall, as it was their weekly drawing venue. This would hopefully make it a comfortable setting for them to have a discussion, which could be used to generate data and insights.

A phenomenological researcher is interested in describing a person’s experience in the way that he or she experiences it, and not from some theoretical standpoint. We experience differences between real and digital scenarios with our senses. Our

interpretations are often coloured by our emotions. The philosophy of phenomenology suggests that meaning comes into existence through the relationship between the outside world and our own senses and feelings. Because this project will study the artists' subjective expressions and descriptions of their perceived experiences (i.e. through their senses), it is phenomenological in its approach. I have chosen artists drawing to investigate human perception and experience in this project because "Drawing is phenomenology" (Harty, 2012). Freehand drawing is a very direct and nonverbal means of expressing experience. "Drawing is the simplest and most direct way of expressing our visual thoughts and perceptions" (Ching, 1943).

I wanted to use observation of how the participants interacted with the representations in the workshop. Observation is a method of qualitative research.

3. Preparation for the Investigation

3.1 3D Printing

I had to learn how to make 3D digital objects as models for the experimental drawing workshop.

3.1.1 Fab Lab Sept 14

I began by taking the Limerick FabLab's[3] introductory 3D printing course on September 14. At this course I was taught how to use the 3D printers. I also learned which software and materials to use and how to use the Kinect 3D scanner. Having completed the course, I was eligible to use the FabLab's 3D printing facilities. FabLab's coordinator, Gerard Walsh, updated my Fabman.io account to give me permission to book the printers online.

Back in college, I began doing Blender tutorials. I was going to need to use Blender to make and prepare the digital models for 3D printing and for displaying in AR. Blender is a free and open-source 3D creation suite. It supports the entirety of the

[3] https://fablab.saul.ie/recurrents/sat-equipment-tutorials-2017/

3D pipeline (Blender 2020). For my project, I needed to use its modelling and rendering functions.

3.1.2 Fab Lab Sept 25

To pilot test 3D printing, I chose an artist's wooden mannequin as the object to replicate. I used the ReconstructMe with Kinect (the FabLab 3D scanner system) to scan and create a 3D digital model of the mannequin. ReconstructMe is a 3D real-time scanning system (Heiindl et al., 2015). Ger had told me it was not very reliable, but I thought I would give it a try. Holding the Kinect device in my hand, I moved it around the mannequin to produce a scan, which I then saved directly as an OBJ file. I opened the OBJ file in Blender to edit it, which involved cutting away the extra bits of mesh that were not part of the mannequin, and to check the mesh for manifold edges that must be repaired before printing. This scan was not representative enough of the mannequin, and would not be suitable for printing. I decided that it would be more effective to build a mannequin from scratch in SolidWorks than try to fix this scan in Blender. So instead I decided to learn about photogrammetry as a more accurate method to scan the object.

Scanning The not so representative resulting OBJ in Blender

Figure 3: Scanning and the resulting OBJ in Blender.

An OBJ file is a standard 3D image format, which can be exported and opened by 3D image editing programs such as Blender. OBJ files contain a three-dimensional object including 3D coordinates, texture maps, polygonal faces and other object information. In Blender, a user can save the file as a .blend file and/or export it out again as an OBJ or STL for 3D printing. The OBJ or STL must be imported into slicing

software to slice the geometry into layers for the printer to print. Once sliced, it is exported as a G-code file unto an SD card, which is then inserted into the printer.

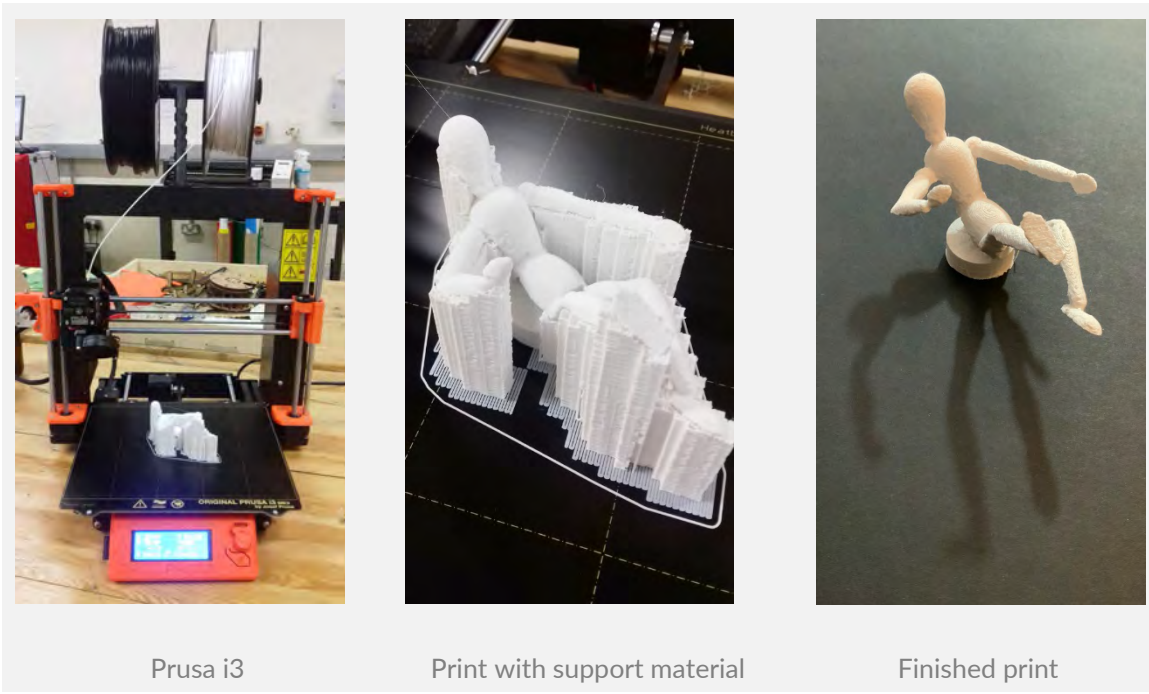
3.1.3 Fab Lab Oct 10

Once I had learned how to scan an object with photogrammetry (photography and Meshroom – details in section 3.2), I created a better 3D digital mannequin. I booked the Prusa i3 printer in the FabLab for Thursday October 10. The Prusa i3 is an open-source fused deposition modelling 3D printer, manufactured by the Czech company Prusa Research (Prusa 2020). It is used to make engineering components and other products from a variety of thermoplastic polymers (Jones et al 2010). Prusa is part of the RepRap[4] project which was instigated by Adrian Bowyer.

In Prusa Slicer[5] software, I sliced the mannequin OBJ and put it on to print in the Prusa. After 90 minutes, I could see that the print was going to be a failure, so I stopped the machine. Strings of filling material had become unstuck and tangled together. Ger showed me how to reconfigure the filling support from a sinewave pattern to a stronger grid pattern in the printer settings and I began a new print. The print time was 4 hours 10 minutes. This time it printed successfully. I snipped away the support material with a pliers. The pilot test print was complete.

[4] RepRap is short for replicating rapid prototyper, a 3D printer that is capable of printing 70% of its own parts so it's capable of copying itself. https://reprap.org/wiki/About

[5] https://www.prusa3d.com/prusaslicer/



Prusa i3 | Print with support material | Finished print

Figure 4: 3D printing the pilot test using the Prusa i3 at the FabLab Limerick.

3.1.4 Fab Lab Dec 12

I booked the Prusa i3 for Thursday December 12. My plan was to print three models for the drawing workshop in one go – two of the hands I had downloaded from SketchFab and one of the clasped hands I had scanned using photogrammetry. In Prusa Slicer, I scaled down the models to 3 cm high. Scaling was targeted at fitting the models in the printing bed and to keep print time under 6 hours. The expected print time was 5 hours, but unfortunately I had to stop the printing process after 90 minutes because the two models had detached from the bed due to the filler support failing to stick.

I decided to abandon printing the clasped hands, because from what I could see, it was not going to be a very realistic looking pair of hands. The surface was too bumpy, which was due to the rough quality of the scan. Instead, I chose to print the purchased hand model. To give it a sturdy support in the printing process, I re-sliced it selecting the option 'raft' base. I set it on to print. It was looking promising, so I left the FabLab expecting to arrive the next morning to collect my object. However, this print was unsuccessful too. Perhaps the FabLab had been too cold overnight, which may have upset the Prusa.

3.1.5 Fab Lab Dec 13

Determined to print a model successfully, I experimented with building better supports for the model in Blender. I put a model of the hand in a box support on to print. This one worked out.

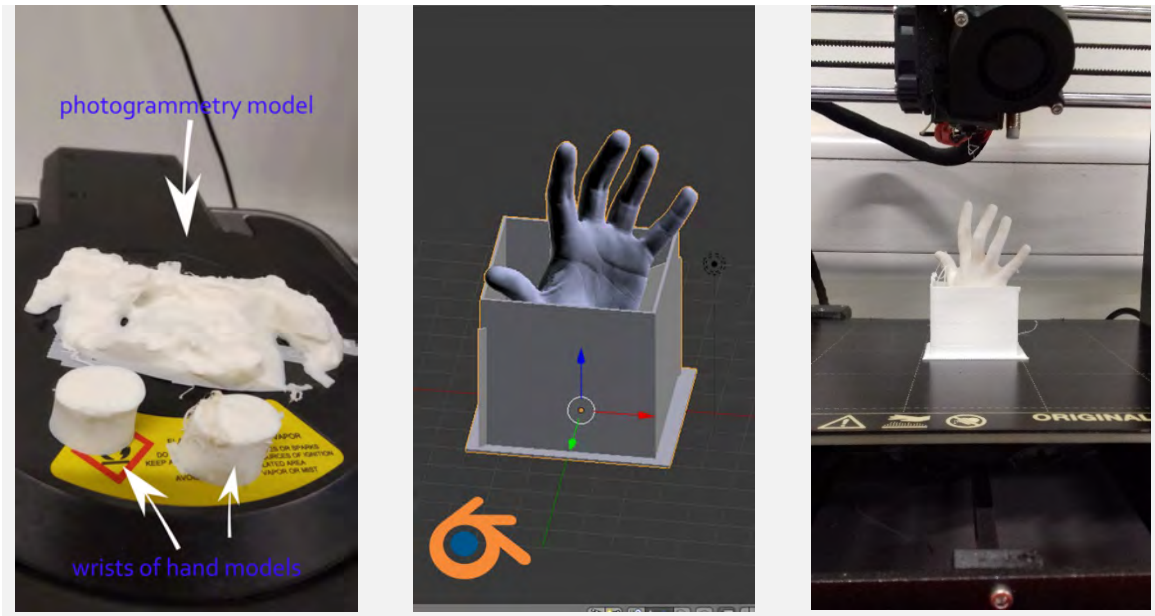


Figure 5: 3D printing the hand models.

I snipped the box support away leaving a free-standing hand. It was quite like a miniature antique plaster cast model that artists of the past used to study and practice drawing from.

3.1.6 Fab Lab Jan 9

On January 9, I printed a mirror-image version of the hand (the left hand).

3.2 Photogrammetry

Photogrammetry uses photos of an object to create a geometric representation of it. To scan an object using digital photogrammetry, the user takes many overlapping close-up photos of the object. A good depth of field is recommended, because the higher the resolution of the photographic images, the better the eventual model. The photos are then uploaded to a photogrammetry software application, which analyses and processes the images. The application utilises image-matching algorithms and computer vision algorithms that recognise features in the images to obtain the coordinates of the object. It then runs further computations to combine the

information into a dense point cloud and generate a photogrammetric mesh of the object. The user can edit the mesh and export it to a 3D file format. A significant amount of computing power is needed to process high-resolution photos; therefore, the process can take a long time. (Wheeler 2016)

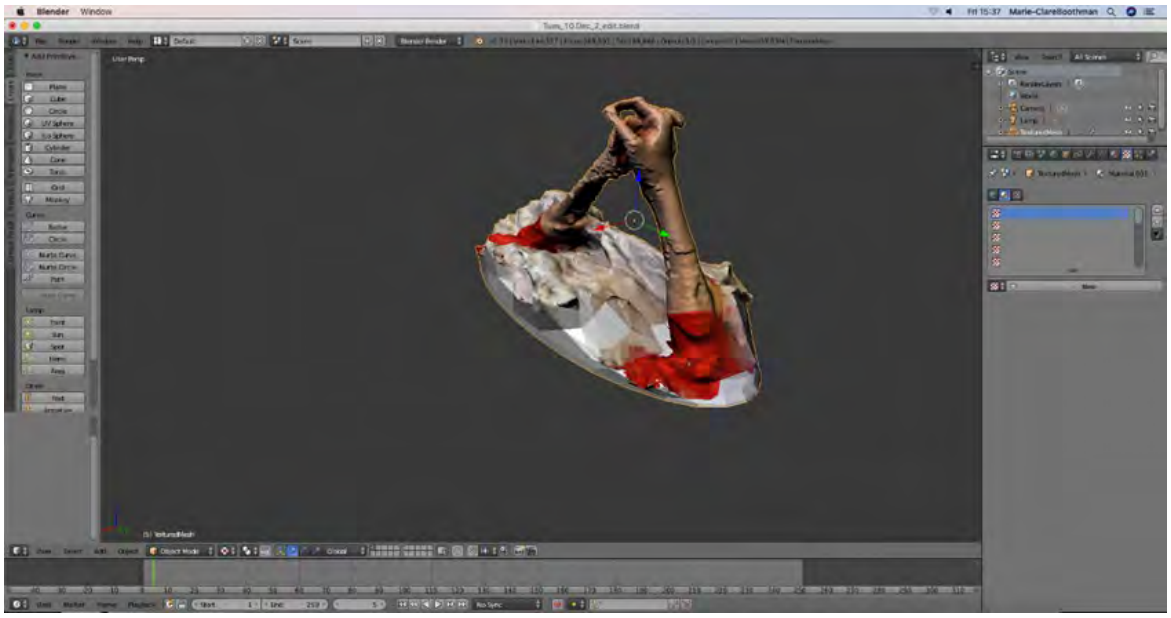


***Figure 6**: Photogrammetrically scanned model's clasped hands in Blender.*

To learn how to scan an object using photogrammetry I performed a pilot test, which involved scanning a wooden mannequin. I used a small digital camera to capture the photos and Meshroom photogrammetry software to process them.

Meshroom is a free open-source software which needs a CUDA supporting NVidia graphics card and good computing capacity. The college granted me access to the Green Screen room in CSIS with permission to use the powerful VR computer for the purpose of installing and using Meshroom for this part of my project.

Once I had successfully completed the pilot test with the mannequin, I moved on to the project of scanning the hands of the human model.

I set up a studio in a room at home. This time, I borrowed a Canon EOS 350d DSLR camera with an 18–55mm lens and a small tripod from the CSIS video equipment facility. I learned how to capture clear photographs in sharp focus with a large depth of field. I made an appointment with the participant model for a hand photoshoot. I was somewhat successful in generating a model of the hands, although slightly disappointed that the fidelity of the model was not more well defined. This was

perhaps because hands have a very complicated geometry from a computer's perspective.

See the Appendix section for documentation of my photogrammetry projects processes.

3.3 Augmented Reality

Augmented Reality (AR) combines real and virtual objects; it is interactive, experienced in real time and registered in three dimensions. It displays copies of real-world information represented digitally. The two-step process of an augmented reality application is:

1. The application determines the current state of the physical world and the current state of the virtual world.
2. The application displays the virtual world in registration with the real world in a manner that will cause the participant to sense the virtual elements as part of his or her physical world, and then returns to step 1 to move on to the next step (Craig 2013).

Aryzon's AR Studio app on iPad was used in the workshop to display the hand model for the artists to draw from. I researched various possible AR apps and suitable devices to use in the workshop before choosing Aryzon (see Appendix).

The 3D models of the clasped hands and the SketchFab single hand were uploaded to the app's library. They then could be displayed and anchored to a specific location in the real world (see Figure 7).

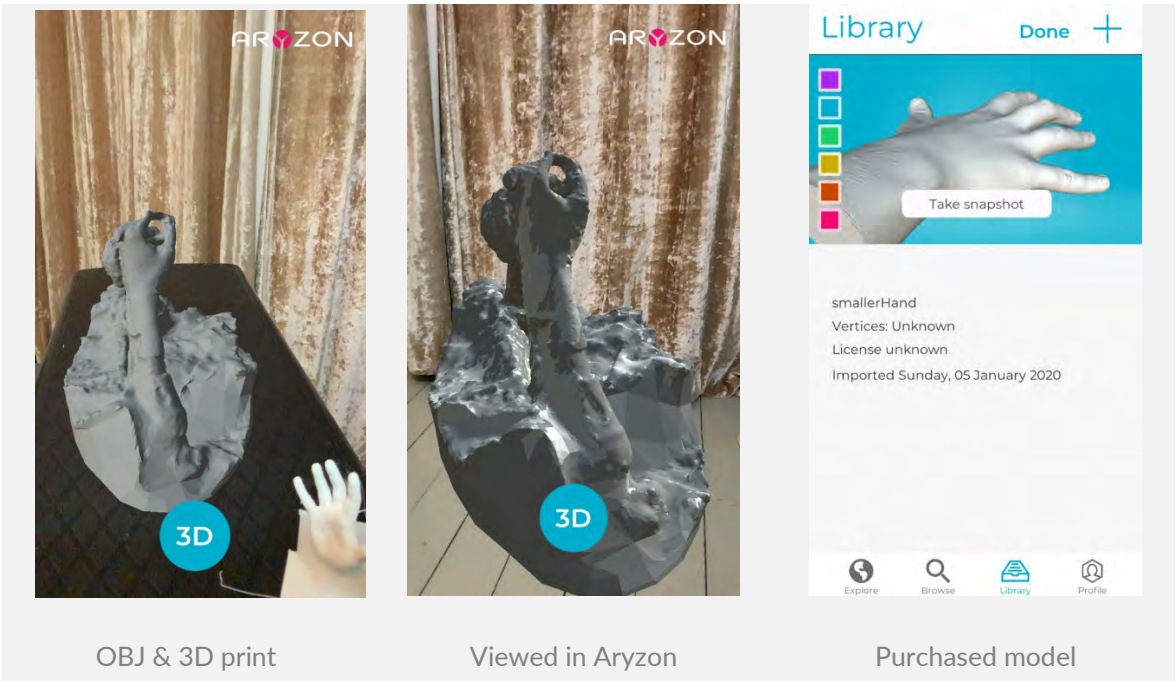


Figure 7: The photogrammetry hands model displayed in Aryzon AR Studio app. The purchased hand model uploaded to the Aryzon AR Studio app library.

After preparing the clasped hands model in Blender, I exported it as an MTL and an OBJ file and uploaded both files to the library. They both appeared, but neither file displayed the object with texture (skin colour). It wasn't until the very end of the project that I found a reason for this and a way to solve it.

The diagrams in Figure 8 and Figure 9 show how a user would accomplish the task of displaying an object using the app.

3.3.1 Journey map of participant in Aryzon AR Studio App.

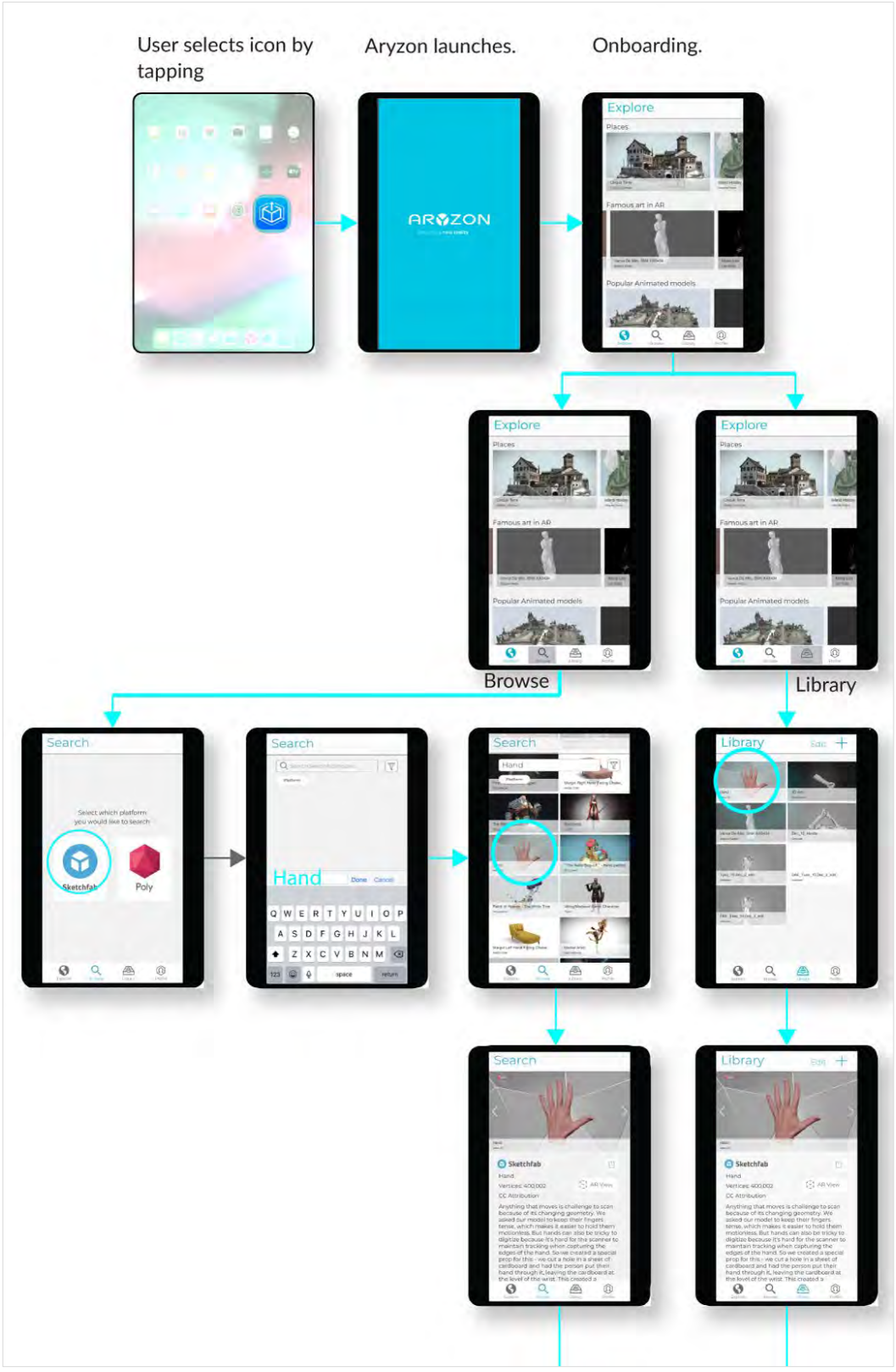


Figure 8: Aryzon AR Studio journey map, *part 1.*

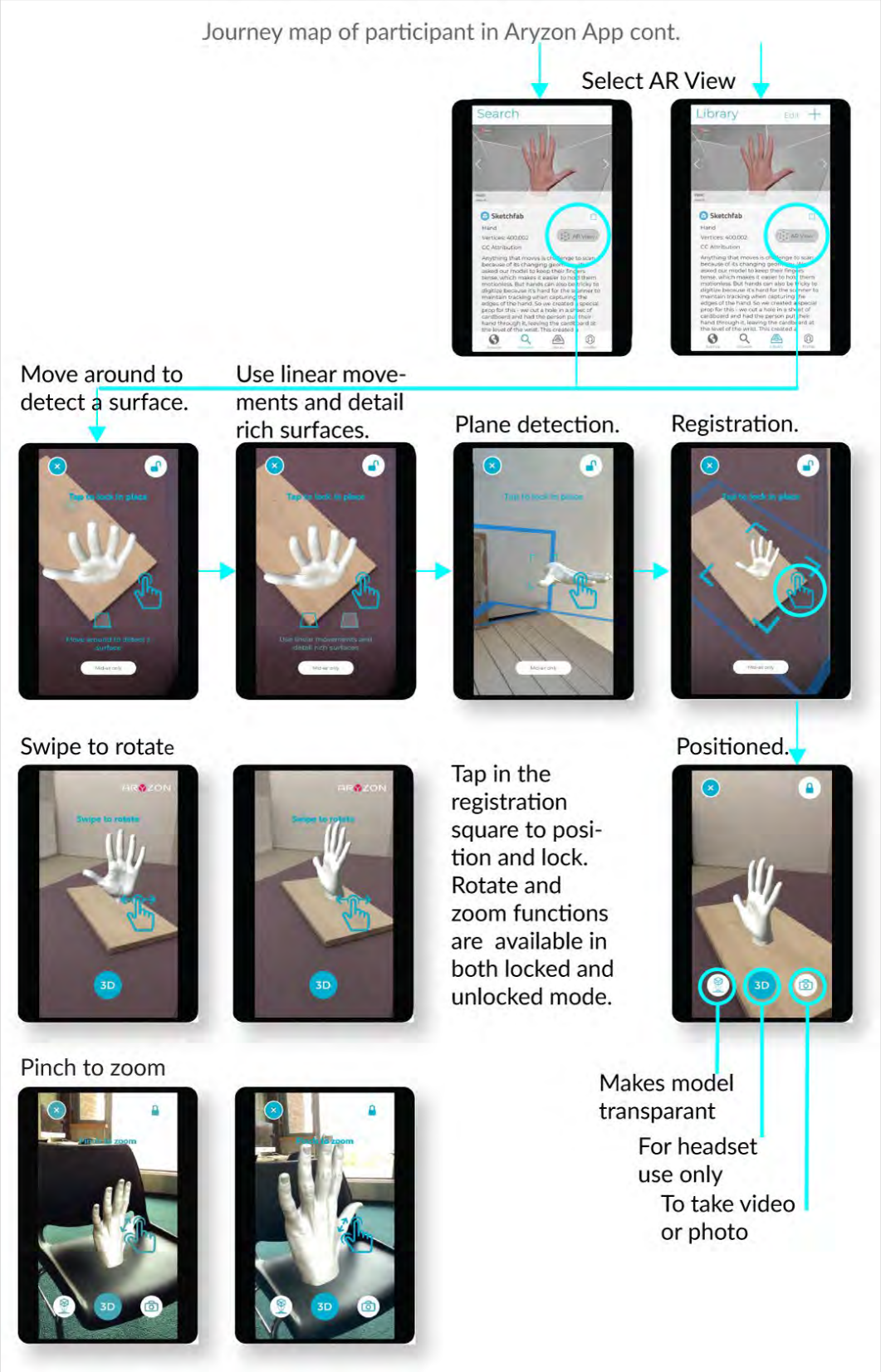


Figure 9: Aryzon AR Studio journey map, part 2.

3.4 Phenomenology

Invented by Edmund Husserl, the philosophy of phenomenology involves taking an exhaustively close look at the lens that the objects of our experience are always seen through: human consciousness, or our subjective experience of the world. Husserl hoped that we could arrive at certainty about these phenomena and how they relate to each other by understanding all of the ways that our human experience of the world distorts reality. Martin Heidegger was a student of Husserl who added Dasein's concept of "being" to the field of phenomenology (West 2017). Heidegger posed the question: "What does it mean to 'Be'?" From my very short study of this wide field, my sense is that human experience cannot always be examined objectively, and that for these philosophers, there is a notion of subject-object inseparability within consciousness.

A phenomenological perspective would allow me to conduct research that would not necessarily prove whether the AR app worked or not, or whether it was good or bad on a numerical scale. Instead, such an approach would allow me to explore the subjective experiences of the participants as they used the app in context, and to observe their resulting drawings. When conducting research through a phenomenological model, both known and unknown phenomena can reveal themselves (Coyne et al., 2002).

When taking a phenomenological approach, the researcher must park all notions and preconceptions from the outset (this is called bracketing) and notice their own biases.

4. Methodology

4.1 Overview

Qualitative and interpretive methods were used. A partly grounded approach was employed, to observe what emerges from the data. The drawing workshop experiment was not conducted to obtain quantitative data, but rather, it was a qualitative investigation using a phenomenological approach.

4.2 Workshop Design

The workshop comprised three 20-minute observational drawing exercises of each one of the following:

1. Hands of a live human model.
2. A 3D printed replica of human hands.
3. A 3D digital replica of human hands displayed in Aryzon AR Studio app on an iPad Pro.

The venue was the spacious Dromroe Village Hall at the University of Limerick. Tables and chairs were set up to accommodate three drawing stations. Figure 10 shows the layout of the drawing stations.

The workshop schedule was 2 hours in duration, consisting of a 10-minute introduction, three 20-minute drawing exercises, a 15-minute break, followed by a 30-minute focus group. See the drawing workshop and focus group schedule in Table 2, which was filled in as the workshop progressed.

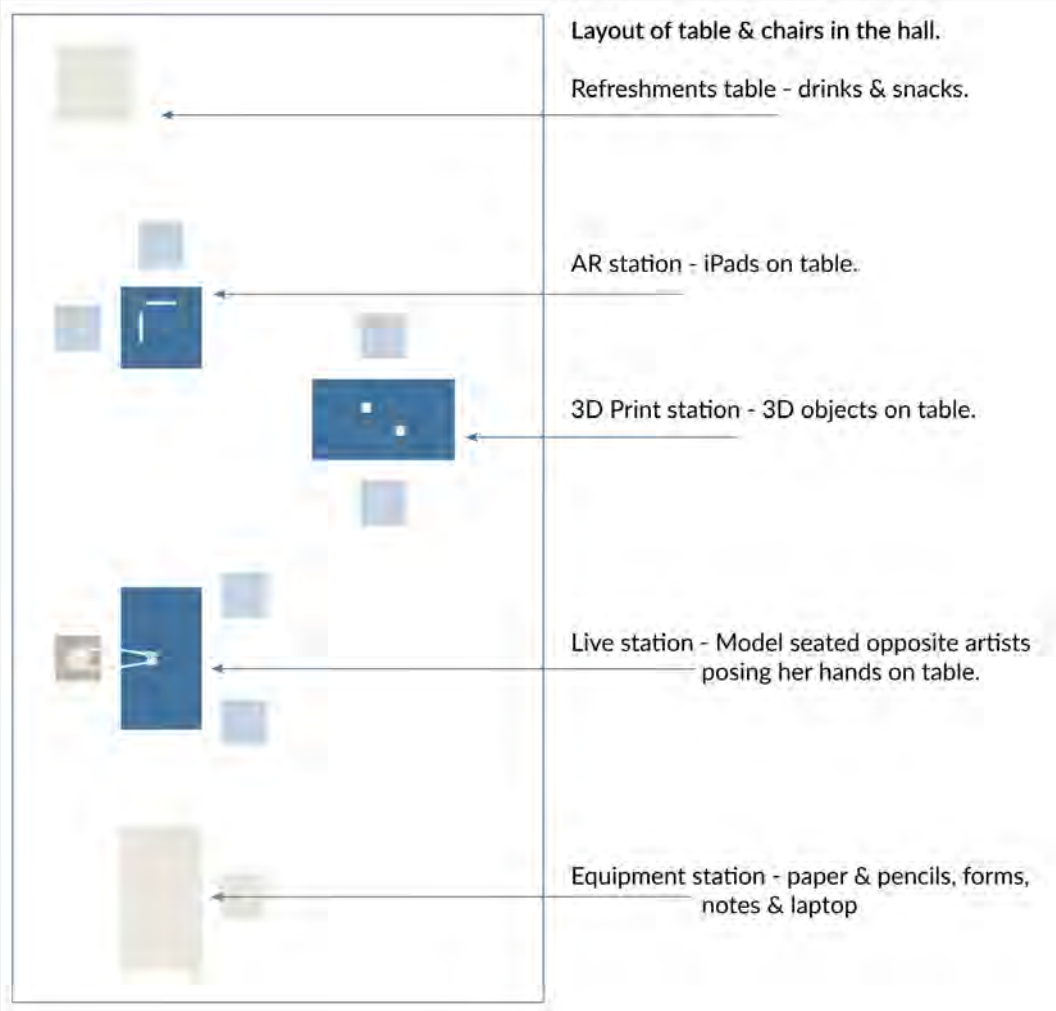


Figure 10: Layout of the workshop drawing stations.

4.3 Focus Group Design

Focus groups typically involve around six to eight participants. This focus group comprised a pre-existing group of six participants. It is termed as a pre-existing or "naturally occurring" group (Kitzinger and Barbour 1999) because the participants were all known to each other. Five of them are members of Limerick Figure Drawing Society[6] (LFDS) and one, Brian, attends LFDS life drawing sessions occasionally. The focus group was scheduled to follow on from the workshop. The artists were invited to reflect on and discuss comparisons between the three drawings they created in the workshop, their thoughts on using the AR app and their experience of the

[6] The Limerick Figure Drawing Society is supported by the University of Limerick Arts Office. The society meets weekly on Sunday evenings in Dromroe Village Hall to practice life drawing.

drawing exercises in general. The discussion was lightly guided by me. With their permission the discussion was audio recorded.

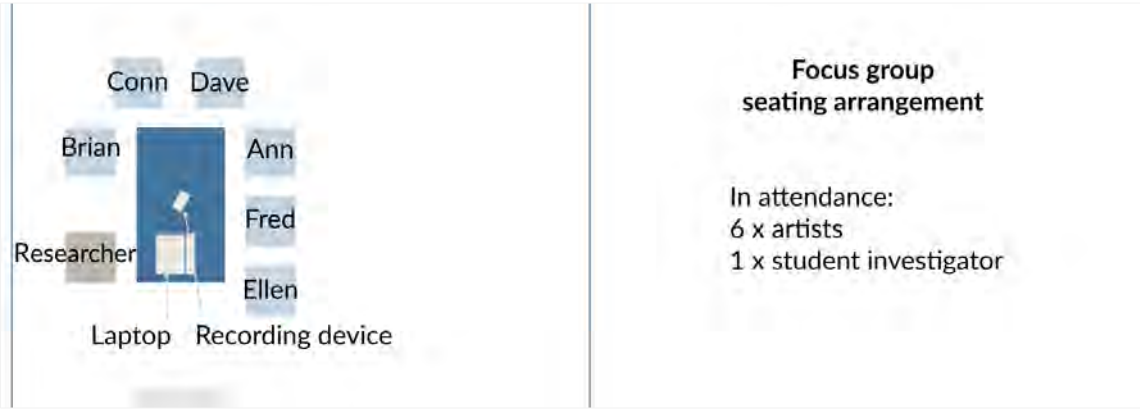


Figure 11: Focus group layout.

4.4 Participants

The participants were a purposeful sample from the Limerick Figure Drawing Society (LFDS), recruited personally by the student investigator. They are all acquaintances of the student investigator who is herself a member of LFDS. All participants were familiar with the venue, as it is the same venue that LFDS hold their weekly life drawing sessions. The artists agreed to participate out of interest (with no inducement). The project information sheet and consent forms were emailed to each participant to read in advance of the workshop, to ensure that they would be well informed of what the project entailed.

Maximum age variation in a sample of eight participants was aimed for. Of ten artists invited to participate, six accepted (age range 40–75), four of whom were male and two of whom were female. Younger artists who had been invited (age range 20–35) were unavailable. The sample age range was therefore wide but did not achieve the maximum age range goal.

All six participants are professional visual artists. All are regular practitioners of life drawing and therefore would be considered experts in observational drawing.

The model is female, in her thirties, and models regularly for LFDS. She has the expertise to maintain a very still pose for up to twenty-five minutes at a time. It was explained that only representations of her hands and forearms would be drawn and 3D modelled. She was offered the modelling rate of €25 per hour (4 hours in total,

which included modelling for the photogrammetry). She agreed to participate with these terms.

The student investigator is within the age range of 50–60 and female. See Table 1 for the participant profiles.

Table 1: Participant profiles.

code	pseudonym	age range	gender	occupation
A	Ann	70 – 80	F	Artist
B	Brian	50 – 60	M	Artist-teacher
C	Conn	70 – 80	M	Artist
D	Dave	40 – 50	M	Artist-illustrator
E	Ellen	60 – 70	F	Artist
F	Fred	40 – 50	M	Artist-teacher
R	Student investigator	50 – 60	F	Artist-student
S	Sophia	30 - 40	F	Dancer-model

4.5 Equipment and Materials

4.5.1 Workshop equipment and materials

Paper and pencils were provided as drawing materials. Participants were also encouraged to bring along their own favourite drawing media. Two iPads were used, an iPad Pro 11 inch and iPad pro 12.9 inch, with the Aryzon AR Studio app. Two digital models of hands, one created using photogrammetry of the live model's hands and one bought from Sketchfab[7]. The purchased pair of 3D printed hands comprised a left hand and a right hand with a height of 35 mm.

Refreshments were provided, including soft drinks, water, crisps and sweets.

[7] 3D Model Hand by fenrir https://skfb.ly/6MFGY

An iPad mini was used to take photos to document the workshop.

4.5.2 Focus group equipment and equipment

Recording devices:

- Voice Recorder App on Samsung Galaxy J3 (2016).
- Adobe Audition audio software on HP Pavilion Notebook.

4.6 Comparisons

The elements in the drawing outputs to be investigated for comparisons were:

- Quality of light (how were shading and shadows represented).
- Quality of outlines (the great nineteenth drawing teacher John Ruskin said that shading and outlines are the basic and very important elements of a drawing) and spatial depth (perspective, occlusion, foreground/background) (Ruskin 1857).
- Quality of mark making.
- Orientation of the paper.
- Choice of media (charcoal, pencil, conté chalk) and choice of paper (textured/smooth, coloured/white).

The differences that the participant artist experienced between the three drawing exercises were also to be compared.

4.7 Procedure

This section describes how the workshop and the focus group proceeded. I arrived at the workshop venue an hour in advance to set up and prepare the room.

4.7.1 Interacting with and instructing the participants

I emailed all the participants the information sheets and consent forms (see appendix) for them to read in advance of the workshop. For the four participants who owned iPads and iPhones, I emailed instructions on how to download and install the Aryzon App (see appendix).

On Wednesday evening January 15th at 8pm, the participants arrived at Dromroe Hall, UL. I welcomed them, handed them each a copy of the project information sheet and the consent form. Then I gave a brief overview of the research project, outlined the main points on the forms and asked them to sign a consent form each. I showed

them three drawing stations in the hall (see Figure 10) where they would draw: the live station at which the model, Sophia, sat ready to pose her hands; the AR station, equipped with two iPads; and the station with the two miniature 3D printed hands. I had the workshop schedule (see Table 2) to hand to fill out the order in which the participants would be assigned to the stations. I began by asking if anyone had a preference for which station they would like to start at.

Brain and Conn expressed a preference to start with the live model drawing exercise. For this entry in the table, I filled in C and B (for Conn and Brian), Drawing 1, and "Live". The others had no preference. I assigned them to the spaces on the schedule for Drawing 1, 2 and 3 by asking them which slots they would like to fill in. The artists proceeded to the drawing exercises in those assigned orders.

Table 2: Drawing workshop and focus group schedule. 15th January 2020.

	Welcome & intro	Sequence to eliminate carryover effect.			5 min break	Focus group	Finish up
Start time	20.00	20.10	20.30	20.50	21.10	21.25	22.00
Actual	20.00	20.10	20.40	21.10	21.30	21.40	22.15
Drawing	1	2	3				
C & B	Live	3D Print	AR				
D & A	3D Print	AR	Live				
E & F	AR	Live	3D Print				

4.7.2 Counterbalancing carryover effects

The participants were assigned the exercises in different orders because firstly, there were only two available iPads for the AR drawing exercise, and secondly, carryover effects needed to be counterbalanced. A carryover effect is any difference that might be caused by the order in which a participant executes the exercises (Price et al., 2015).

The carryover effects considered for this workshop were:

- A practice effect, where the participants execute the drawing better in the subsequent exercises because they have had a chance to practice it.
- A fatigue effect, where participants execute the drawing worse in later exercises because they become tired or bored.
- A context effect, where starting out in one exercise can change how participants perceive stimuli or interpret their task in later exercises. For example, an artist might repeat the manner in which they draw the first representation in the second and third exercises.

4.7.3 The Workshop

I kept time, keeping as close as possible to the schedule (see Table 2). I let the participants know when to start drawing and to finish when each 20-minute period was over, alerting them one minute beforehand.

With hindsight, I should have allocated a 5–10-minute turnaround time between the exercises. The participants needed time to change stations, to move themselves and their drawing equipment, and to set up at the new station; because of this we ran over schedule slightly.

Whilst the workshop was in process, I kept my interaction with the participants to a minimum. I sat in a corner, made some observation notes and took photos.

4.7.4 Reflexivity

Reflexivity entails the researcher being aware of her effect on the process and outcomes of research based on the premise that “knowledge cannot be separated from the knower” (Steedman, 1991). Therefore, I kept a journal of my own experience of facilitating the experiment and how I think my presence may have influenced the research situation.

4.7.5 Ethical considerations

Full ethics approval was sought because two of the participants are over 65 years of age. They are both of sound mind and body. Full ethics approval was granted.

4.7.6 Confidentiality and storage of collected data

The participants were anonymised by assigning pseudonyms. The focus group transcription file was password protected on my own computer and was then passed on to my supervisor, Dr Chris Exton, via a memory key. He transferred the file to his password protected computer, room No: CS2-013. Only Dr Chris Exton and I have access to this data.

The drawings were to be curated in a public exhibition at Showcase Day in April 2020. The artist participants were offered the choice to sign their drawings or not. All of them chose not to sign their drawings. The drawings remained the property of the artists and will be returned to the respective artists after the coronavirus lockdown situation has been lifted.

Digital copies of the drawings were coded with the [artist pseudonym initial] + [1, 2 or 3, depending on whether it was the artist's first, second or third drawing] + [Live, 3DP or AR, depending on the representation drawn]. For example, "A_3_Live" is for Ann's third drawing, which is of the live model's hands.

4.7.7 Analysis of the drawings

The drawing outputs were examined in respect of the questions in Table 3 which were drawn up from the literature research.

Table 3: Drawing evaluation guide

Examine	live	3D printed	AR display
Outlines: Does expression of line change?			
Shadows: How does your rendering of light and shade compare?			
Qualities in mark making: Directions, line flow and rhythms.			
Unique affordances (e.g. that AR offers).			

Does expression of line change between the different representations of subject, direction of shading lines indicating surfaces?			
Emotional: Is there a particular attitude or mood expressed regarding experience of each representation?			

The intention behind the installation of an exhibition of the drawings was to offer the public the opportunity to view them and perhaps by contemplating them to reflect on the richness and subjective nature of perception. It would be an event at which to meet the artists.

5. Results

5.1 Describing the data

The artist participants generated three forms of data

1. Visual - the artworks, their drawings.
2. Verbal - the transcript of the recorded focus group.
3. Behavioural - the investigator's observation notes and workshop photos.

There was 22 minutes of digital audio recording of the focus group. This was transcribed initially by the Distiller App but there were too many discrepancies, so I then transcribed it manually verbatim.

5.1.1 The artworks

The artists were free to choose the paper and media they preferred. Figure 12 displays the six artists' live model drawings. Brian used charcoal on A3 white paper; Ellen and Conn used pencil on white A4; Dave used a mix of pencil and conté on A4 brown card; Ann used sanguine conté on white A4 and Fred used a mix of conté on grey card. All chose landscape orientation except for Ellen who chose portrait. All the six artists have drawn shadows cast by the hands unto a surface beneath the hands. The shadows give the impression of the hands being present in an environment.

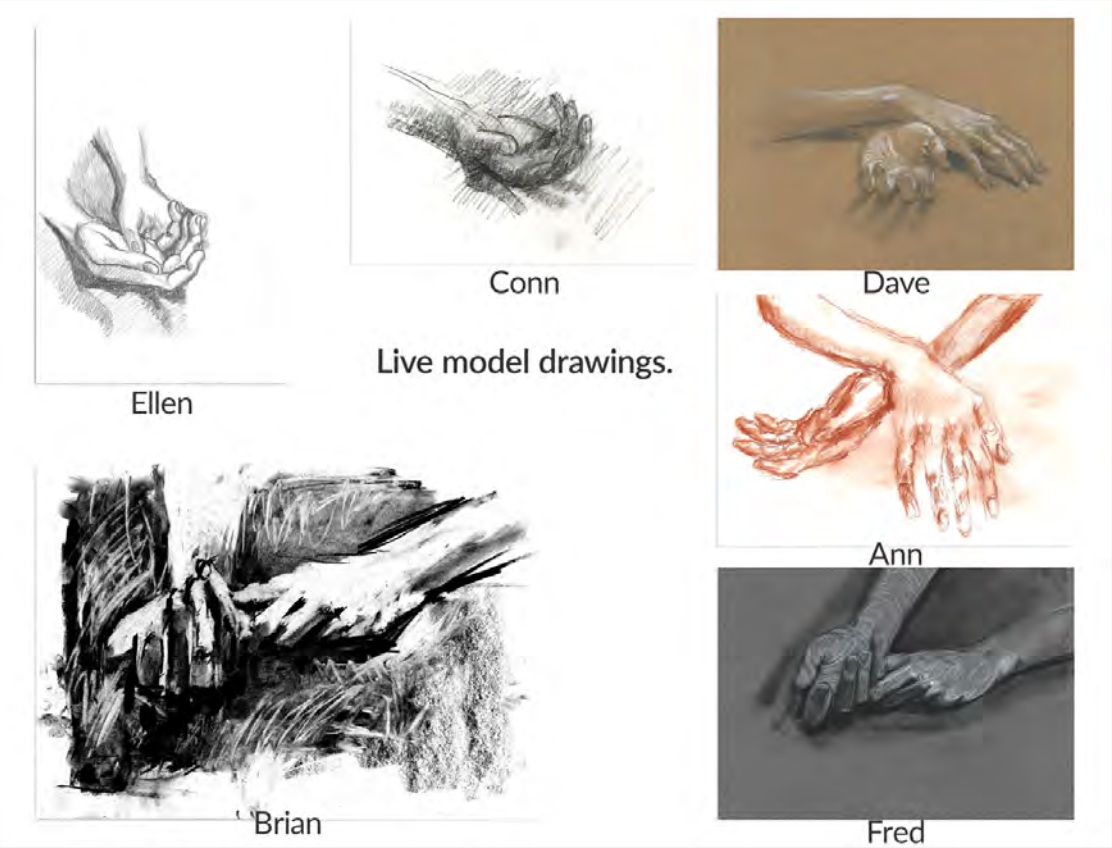


Figure 12: Drawings of the live model's hands.

In Brian's drawing the hands are erased out of the dark environment ground. The tactile marks are as if fingernails had been scratching into the environment around the hands. A sense of depth is achieved with dramatic shadows and light highlights on digits. The outlines are formed mainly due to erasing with a few black heavy gestural swipes.

Ann chose a sanguine coloured media with which to make her live drawing possibly a response to skin colour.

In the drawings of the 3D printed hands below (Figure 13), the figure and the ground are distinctly separate, showing the phenomenon of figure-ground organisation in Gestalt theory (Gordon, 2004). Fred has drawn the hand on concentric rings as if the hand is reaching out of a pool. Ann, Ellen and Dave have drawn the models on definite surfaces. Brian has framed his hand and within the frame in the dark charcoal background are traces of his own fingerprints.

Figure 13: Drawings of 3D printed models.

In the AR drawings (Figure 14) all six artists orientated the hand model standing up on the tabletop. They seemed to accept that the default position for this hand was to stand upright on its severed wrist. Perhaps due to lack of familiarisation with the app, they didn't realise that they could choose to register it on a wall in a horizontal position.

Brian's AR drawing is very different to his live drawing. He chooses pencil which is a less tactile media, the outlines are hard and the shading marks are sharp, linear and dense. The spatial depth is confusing as the hand is depicted in a room without a floor. He has rendered the light and shadow consistent on both the walls and hand.

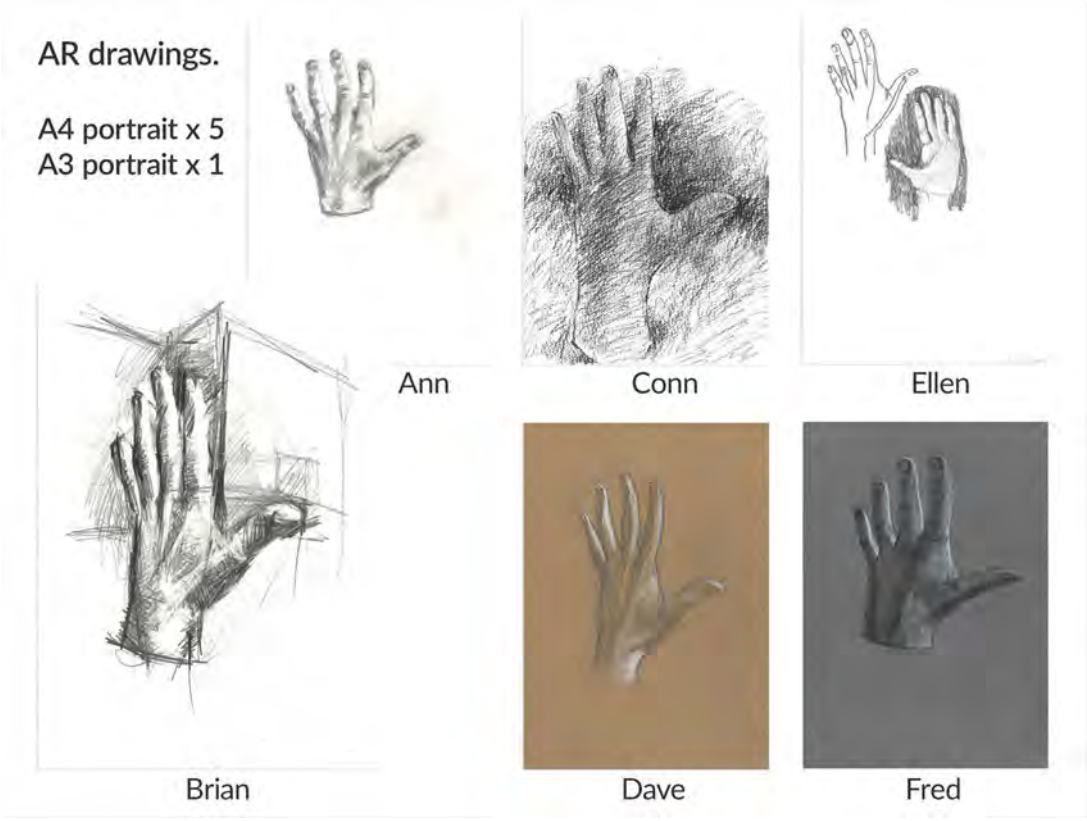


Figure 14: Drawings of the AR hand models.

5.2 Organising the data

NVivo is a qualitative data analysis software. I wanted to learn how to operate NVivo as it is a widely used tool for qualitative research. It offers many ways to organise data and it never duplicates data. I found that it is best viewed on a large screen. Below, in Figure 14 and 15, are two participant cases and their associated data displayed in an NVivo Explore diagram. From Conn's diagram we can see that he is a participant in the project and what his attributes are. All the data entries that are associated with his case are displayed: the transcript file, the images the artworks, the workshop photos, and a word cloud image generated from the 50 words most associated with him from the transcript.

I found that in the process of organising the data in NVivo was a great way to become very familiar with all the data.

Documentation of the data can be found in the Appendices.

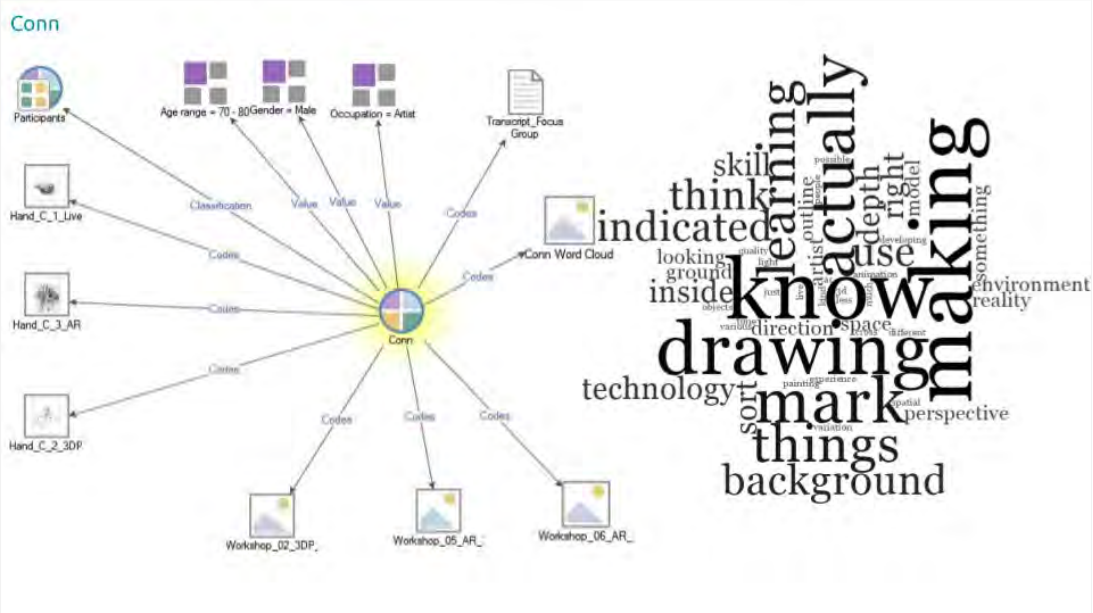


Figure 15: Conn's NVivo explore diagram.

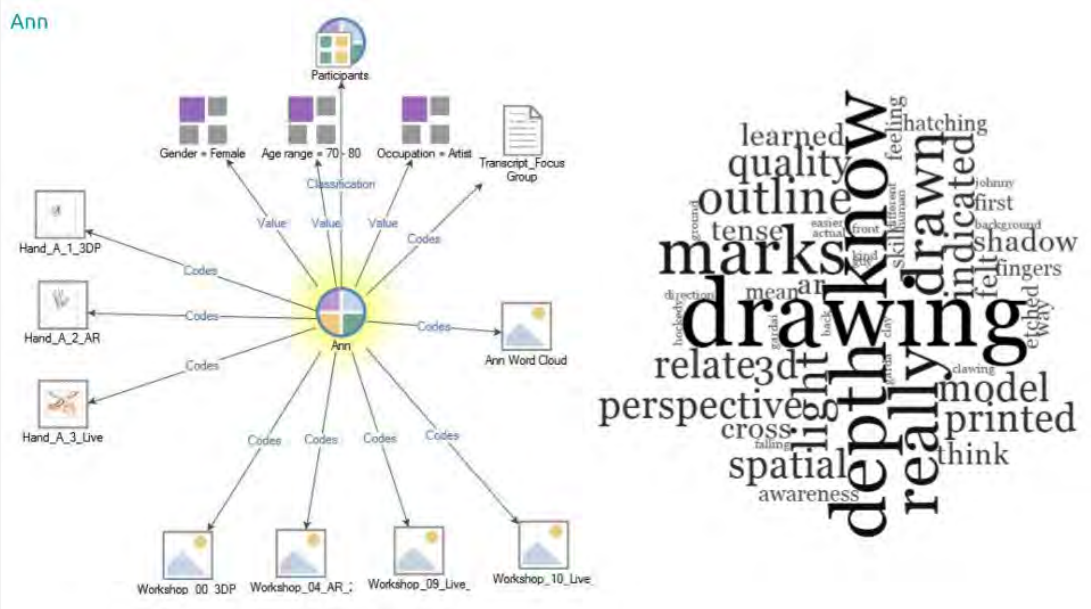


Figure 16: Ann's NVivo Explore diagram.

5.3 Analysing the data:

I imported the transcript into NVivo and then coded it using thematic analysis. Selecting sections of the text, and assigning them to nodes (codes)/concepts the text suggested eg: Senses, Perception, Human quality, drawing from 2D (see appendix

for full list of transcript codes). The codes were then grouped into categories and the categories were then synthesized into themes. The main themes were:

- Presence
- Atelier
- Possible Affordances of AR

5.4 Findings from the observation notes

5.4.1 Onboarding

Familiarisation with using the AR app is necessary. This was the first time the participants had ever used an AR app. With hindsight, had they been given time to practice using the app beforehand, this would have prepared them to use it for the workshop drawing tasks and eliminated any feelings of intimidation that they may have felt. According to an article I read subsequently, there is a learning curve for onboarding in augmented reality mobile applications; therefore, practice using AR should be undergone (Kurbatov 2017).

5.4.2 Registration and behaviour of AR model

The 3D registration of the virtual hand with the real objects in the environment (the table in the hall) was not accurate or stable because, “it kind of floated”, or seemed to move very slightly. This slight movement was enough for the artists’ concentration to be disturbed and to break the illusion of the subject being real. In their drawing practice, artists measure the subject in relation to its environment and record these measurements with their pencil marks. If the subject moves in relation the environment, it throws this drawing process off.

Aryzon does not allow real object to occlude the object it displays. Therefore the illusion of realism was broken if the artist put their hand or another object in front of the iPad.

5.4.3 Usability

I noticed that the artists used both of their hands to draw, one to hold and manoeuvre the media and the other to rotate, move or apply antagonistic pressure to the art board that the paper was on. Having a free hand to hold the iPad was not

an option. Therefore, to view the subject through the iPad screen they had to position it on the table in front of them. This was a limiting constraint of the AR device. In this situation, the technology gets in the way of the task at hand, and the artist has to position herself/himself in relation to the device to be in a position to see the subject to draw.

Figure 17: Scene from the drawing workshop.

5.4.4 Presence

I observed the moment when the participant could see how the app was registering the object in the iPads view of the room, shortly before they tapped to anchor the object in a position. They pointed in space (as in the illustration Figure 18) while viewing the object in the screen. As if their finger believed the object being viewed did really exist in the real environment.

The artists' sense of a presence of an object compared to their sense of presence of a living human being can be contemplated while viewing their drawings.

There was for the artists also the sense of the presence of the live model and the sense of presence to each other of the other members of the group.

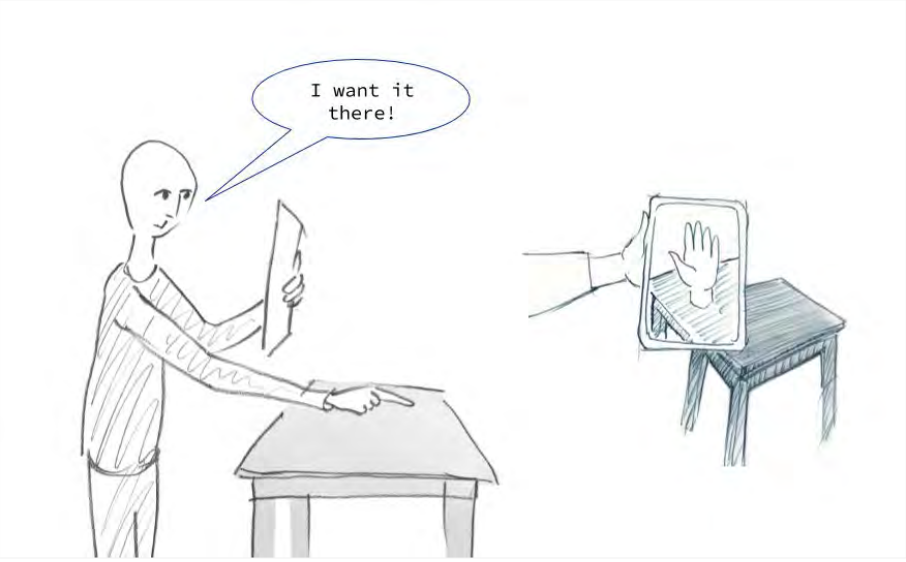


Figure 18: The moment when the AR display tricks the user into believing the virtual object is in the real world

5.5 Findings from the focus group

5.5.1 Vergence

Drawing at the AR station demanded the most concentration.

Conn: “it was really difficult”

Ellen: “You had to really concentrate”

Fatigue has been reported in studies of people using 3D visual displays. The uncoupling of vergence and accommodation (of the optical system of human eyes) required by 3D displays frequently reduces one’s ability to blend the sight from the two eyes (binocular fusion) and causes discomfort and fatigue for the viewer (Hoffman et al., 2008).

Vergence in binocular vision is when both eyes move simultaneously inward to view a near object (convergence) and outward (divergence) when the object is further away. This is to keep the image of the object centred on the fovea, which is the area on the retina where visual acuity is highest (Everyday Sight 2020).

Hoffman et al.’s paper also suggests that, if the AR app rendered view-dependent lighting effects on the model, it would be more realistic and less fatiguing to the viewer. However, in the case of the Aryzon AR app, the lighting is always rendered on the model independently of the view’s lighting. When registering the model in Aryzon on a horizontal surface (e.g., a floor or tabletop), the model is always lit from

behind, regardless of the light source in the environment at that moment. Likewise, when the model is registered on a vertical surface (e.g., a wall), the model always appears lit from above, regardless of the direction of the light in the view. Once registered, when the viewer moves the iPad around the area where the model is registered, the model remains lit with Aryzon's independent lighting system.

From the workshop observation notes, Fred found this independent lighting feature to be fascinating.

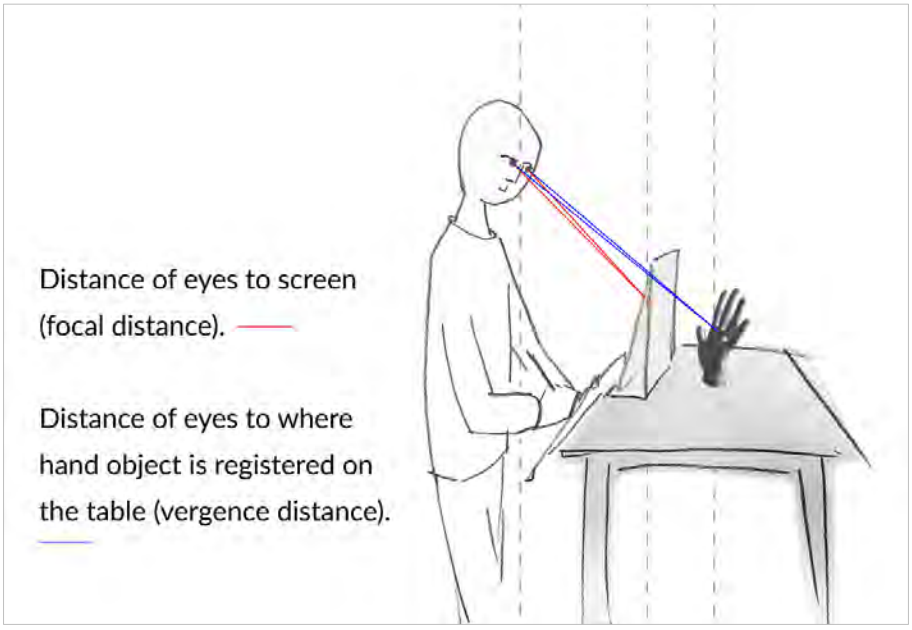


Figure 19: Illustration of focal distance and vergence distance of artist as he draws subject viewed in AR app.

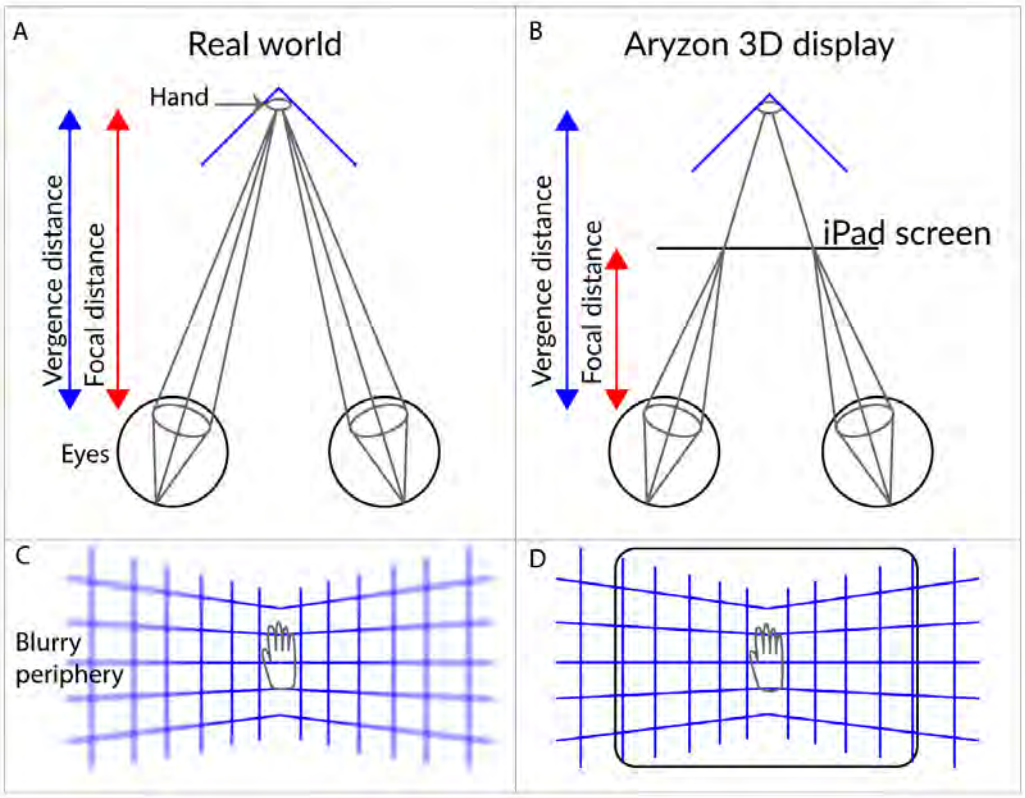


Figure 20: Diagram illustrating the uncoupling of vergence and accommodation.

Figure 20 is a diagram adapted from Hoffman et al.'s paper to illustrates the uncoupling of vergence and accommodation. It shows how the viewer lacks the depth cue of blur in his peripheral vision when viewing the hand object through a display. The retinal image is sharpest for objects at the distance to which the eye is focused and blurred for nearer and farther objects. The correlation between blur and depth in real scenes aids depth perception. Also, the object in view is framed by the iPad rectangle screen. Interestingly the hands in five of the AR drawings (see Figure 14) are all similar in size proportionally on the page and lack any reference to their scale or situation in an environment, which would point to this phenomenon that the artists were missing depth perception cues. The same five drawings are in portrait orientation which the artists may had chosen because they were using the iPad in portrait orientation. Ellen who was not one of these five has similarly drawn the AR hand model with no scale reference to an environment. She also chose to make the drawing in portrait, but she used the iPad in landscape orientation.

5.5.2 Atelier System

AR could be used as a resource for the atelier system of learning drawing.

> Dave: “What we’re seeing is a very good example actually, what you have set, of the atelier system – draw from flat prints first, then move onto sculpture models and then only after a couple of years you move on to the live model, I think there’s things that could be learned from each one and obviously the live model has the most information.. If you’re a beginner, you might be better off dealing with the simplified version of things.”

Dave is referring to the atelier system which provides an art training based on the way an apprentice used to learn how to draw and paint from a master centuries ago. In this system the student apprentice spent a year copying prints and plaster casts using charcoal on paper. In the second year, he would draw live models. In the third and fourth years, he would progress to using paint and colour (Cooke 2020). Dave is suggesting that viewing the model in AR could be used by students to copy from the same as copying prints because he considers viewing the subject via the screen the same as viewing a 2D image. He is also saying that as the digital models can be 3D printed, they can be used like plaster cast sculptures from which to practice drawing.

> Dave: “If you have the goggles it would be the equivalent of having a sculpture room you know like in the olden days, they used to make them copy sculptures. So, I can imagine that being a great resource.”

Fred made the suggestion that drawing figures from AR would be a good substitute for life drawing if you did not have access to a life drawing group.

> Fred: “It would be great if you lived far away from a life drawing group.”

We did not know the identity of the person whose hand had been scanned to make the model that I had purchased for the workshop. I thought that it was interesting then when Conn mentioned the work of an Irish artist Elaine Hoey. One of the areas Hoey’s work looks at is the dilemma of who owns the body in technology? There are rigged scans of bodies that people buy for use in VR spaces. Some of her work explores this phenomenon.

> Conn: "Yeh. I did, I was just saying to Marie-Clare, in the RHA there was a lady artist (Elaine Hoey[8]) who produced this environment. Now the environment didn't exist until you put the goggles on, then it became something moving around. And it's slightly scary. It's like being in outer space."

In the discussion the artists spoke about their emotional experience of making the drawings. Ellen said that drawing the 3D print model was the most enjoyable drawing because she found the geometric shapes was want interested her the most. For Ann the 3D print model was her least enjoyable drawing because the 3D print models triggered a memory of a story (of a buried body's hands protruding from the ground) which disturbed her.

It was agreed among the artists that drawing from life is a learned skill. Part of this skill is for the artist to edit what he/she sees. That perception takes place in the brain was discussed. Drawing from observation incorporated all the senses was mentioned often. There was also a suggestion that to test if a person could learn to draw using AR an experiment should be designed for people with no drawing experience who are starting out to learn to draw.

5.6 Findings from the artworks

There are possibly many interpretations to what can be seen in the drawings, the following are mine only.

Figure 21 displays details from Fred's drawings. I have highlighted some of the mark making in blue to point out that the gestural quality of the lines he made is different in each drawing. In the AR drawing the marks are fast, straight, parallel, and follow geometric planes. In the drawing of the 3D print they are parallel and trace the contour of the curved surface. Fred responds to the live model with loose and

[8] Elaine Hoey is an Irish artist whose installation art works look at 3D representations of humans in meta verses (called "skins" in these online VR meta verse platforms). Her work explores the politics of digital humanity and our evolving relationship with the screen (IMMA 2020).

squiggly marks that draw the viewer into the interior of the form as opposed to the surface of the form.

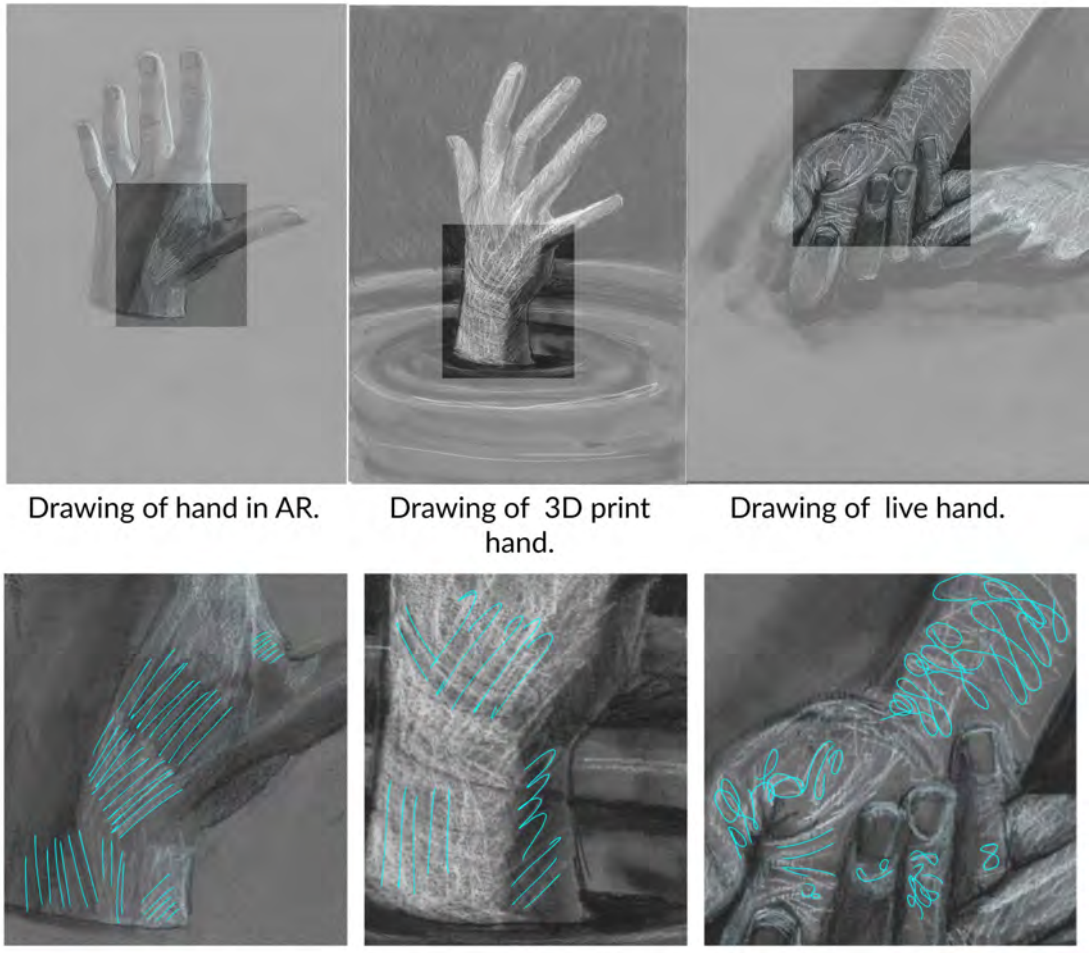


Figure 21: Close up details of mark making in Fred's drawings (marks highlighted in blue).

The looseness of the mark making gestures suggests that the artist is engaging more freely with the information his senses are receiving.

Figure 22 displays details from Conn's three drawings. Considering the outline marks, in the live drawing they are made with sweeping gestural marks running along the lines of the arm, palm and digits. Shading lines are worked perpendicular to the outline marks through the shadow, hand and environment. Marks in the area of the wrist are lighter and broken, intimating the impression of a pulse beating.

In comparison, the 3D printed and AR hand shapes are outlined with determined marks. To this viewer it gives the impression that the artist is approaching these drawings quite tensely, determined to make a solid representation of the object. This artist expresses the hovering appearance of the AR hand by drawing a shadow below

it. He has chosen to make this AR hand drawing on rough textured paper perhaps to counteract the smoothness of the screen through which the model is being viewed.

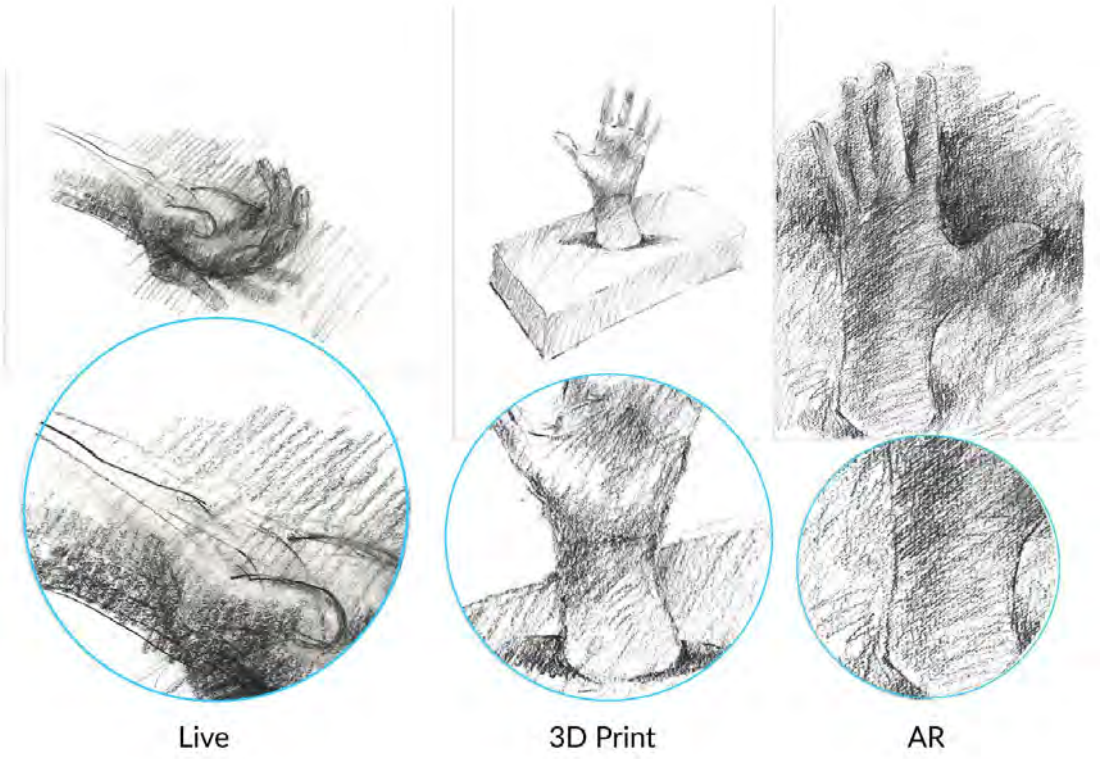


Figure 22: Details of Conn's drawings

Ellen utilised the rotate feature of the AR app to draw a back and front hand view in her AR drawing (see Figure 14). With more familiarity with using the app it can be surmised that she would find more ways to innovate with it.

5.7 Limitations

It was a pity that my photogrammetry scan of Sophia's hands did not have enough clarity to be used as the model in the experiment. Had the artists drawn a replica of Sophia's hands in the experiment, the exercises would have been more comparable. Perhaps I should have asked Sophia to pose her hands in the same way as the purchased hand model, with fingers pointing upward.

The 3D printed and AR models did not have skin colour which makes them immediately different from the live human model.

6. Discussion

Does the AR subject work as well as the real? It does in so far as it can be copied faithfully by the artist to produce a drawing that looks like a human subject. The artist may find it more fatiguing than drawing from a live model due to it being slightly more demanding on the optical system. The AR subject may appear to hover, which makes it appear weightless. It neither casts shadows nor reflects the light in the environment as a real subject would. As a representation of a human (or part thereof), it displays a visual simulation but lacks the sense presence of another being, which diminishes the enjoyment factor for the artist. There is a level of interaction and engagement between the model and the artist that it cannot replace.

Regarding the question of AR helping people to learn skills, the Aryzon AR Studio app can help in the same way that copying from 2D images can be good practice for people learning to draw. It has some advantages over copying from a 2D image in that the user can rotate and zoom the object to view and draw it from various angles and at various sizes. A disadvantage is that it will not teach you to draw the subject using the direction, contrast or intensity of light into good effect because of its independent lighting system. It has therefore some possibilities to be used as a resource for the atelier system of learning traditional figure drawing.

Regarding the question of humans being centre stage in AR design. Viewing the display through an iPad is a bit awkward. A hands-free set up such as glasses or projections would help this technology to get out of the way of the task the human is focusing on.

Regarding comparisons, by far the most significant comparison is the freedom and expressiveness in the mark making of the drawings of the live model drawings compared with the straighter crisper marks in the drawings of the AR and 3Dprinted models.

Finally, a bit like Lanier learning about human perception by needing to know about it to create VR I have learned about life drawing by experimenting if it would work if you replaced the real live model with an AR or 3D digital model. What would be missing is the intelligent presence of the other, the model and the human interaction with the model. I am reminded of a paragraph in *Dawn of the New Everything*:

“Look at another person’s skin and you will see that you are probing into the interior of the skin as your head moves. (The skin and eyes evolved together to make this work). If you are looking at another person, if you pay close attention, an unfathomable variety of tiny head motions messages bouncing back and forth between you. There is a secret visual motion language between all people.” (Lanier 2017) Which possibly resonates with Heidegger’s phenomenology and being in the world in interaction with others in what we are doing.

6.1 Intervention

A design intervention prompted by the findings of this research would be to design a remote life drawing scenario in which artists simultaneously in different location use AR displays to view the live human model from which to draw. This could be achieved by live streaming a Motion Capture (MoCap) scan of the model who is in a MoCap studio posing in real time for the artists. If the artists and model were also connected via audio the sense of each other’s presence would be enhanced.

7. Curation of Showcase Day Installation

An exhibition of the artworks was planned to offer the public an opportunity to view and appreciate the artists’ drawings. Given that the CSIS Showcase Day cancellation due to the Covid-19 situation prevented a public exhibition from taking place, it might be said that the project did not reach one of its goals. However, I created a video of the artworks entitled *Drawing Comparisons*, which is submitted in partial fulfilment of the requirements for my Final Year Project and can be shared online for public viewing.

To shoot the exhibition video, I first installed the artworks on a wall in my home. Additionally, I came up with an idea to make the artworks into objects to display in the AR app. I reached out to a Blender expert who taught me the process of making a JPG image into a digital object to display via the Aryzon AR Studio app. The JPG file of each artwork was imported into Blender, saved as a .blend file and then exported as an FBX file. The FBX and the original JPG image were saved in a folder together (the FBX needs to be able to call the JPG as a texture), which was then zipped and uploaded to the Aryzon AR Studio library. The library preview image

showed the 3D image with the texture of the hands drawing and could then be displayed via AR view (Figure 23). By converting all the JPG files of the artworks into AR objects in this way, it was possible to share them for individual exhibition via AR with anyone, anywhere. There are shots of some of these in my exhibition video. Figure 24 is a screenshot from the video at the point where the video transitions between the indoor physical exhibition to an outdoor exhibition captured with the Aryzon video function.

Having learned this process, I now have the knowledge to solve a problem I encountered earlier in the project, which was to make the photogrammetrically scanned clasped hands model display in the AR app with its skin colour texture.

During this time of the Covid-19 crisis, most art institutions worldwide have closed for the indefinite future (Armstrong 2020) and exhibitions of artworks are moving online. Some galleries are launching exhibitions via video conferencing tools. I researched possibilities for hosting my exhibition online. One possibility was Artsteps, which is a web-based environment that allows its members to create virtual art galleries in lifelike 3D spaces (Artsteps 2020). Time for this project ran out. However, using an application like Artsteps is something I would like to explore in a future project, perhaps for hosting and sharing an exhibition of my own drawings.

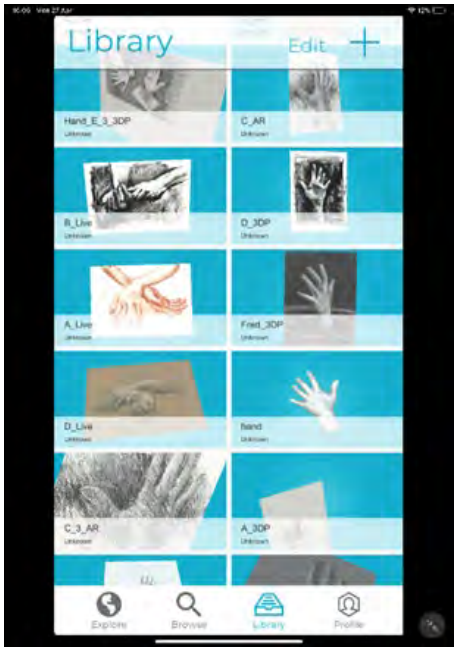


Figure 23: Aryzon AR Studio library preview of the drawings.

Figure 24: Capture from the exhibition video

Link to *Drawing Comparisons* video: https://youtu.be/grJx74taiKY

8. References

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8.1 Image credits

Princess Leia images

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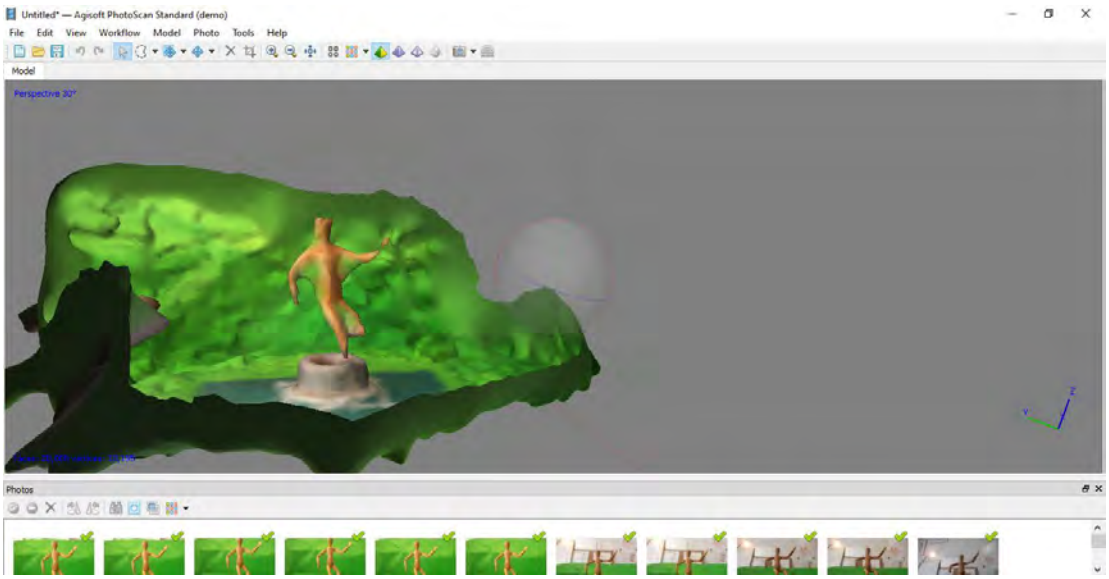
Appendix A

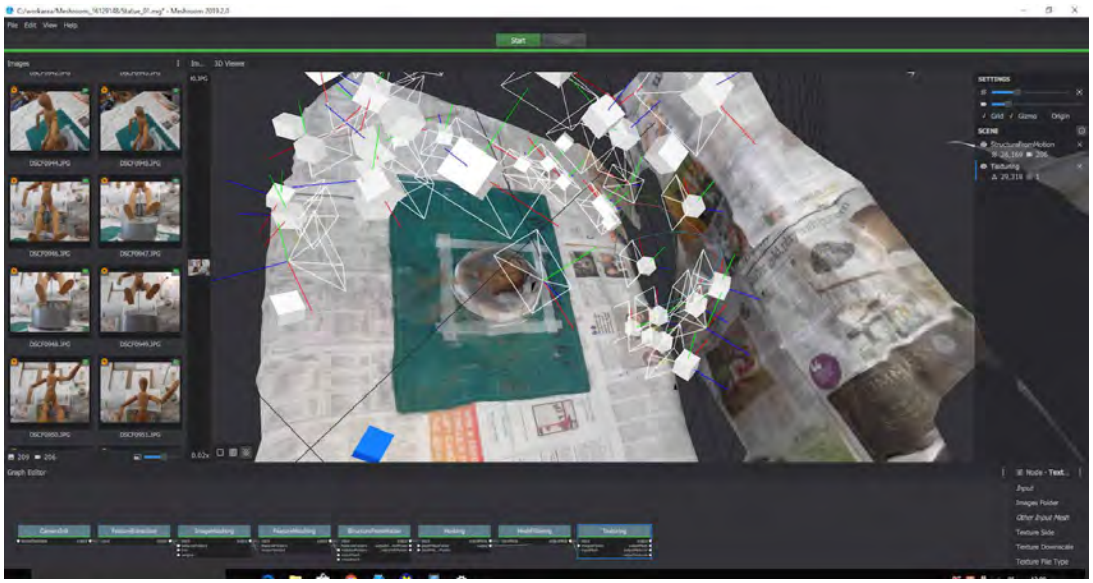
Photogrammetry process

Pilot Test with Mannequin

To make a 3D object from individual photos I downloaded Agisoft Photoscan https://www.agisoft.com/downloads/installer/ on my laptop. It allows use of a demo mode without a purchasing a licence (no saving or exporting function allowed). I shot three different objects in two different environments - plain background indoors (diffused light is best my setup had too contrasting shadows). First attempt.



Someone gave me advice to photograph on newspaper that the lines of print were good for registration. But I found the software captured the environment and not the object.

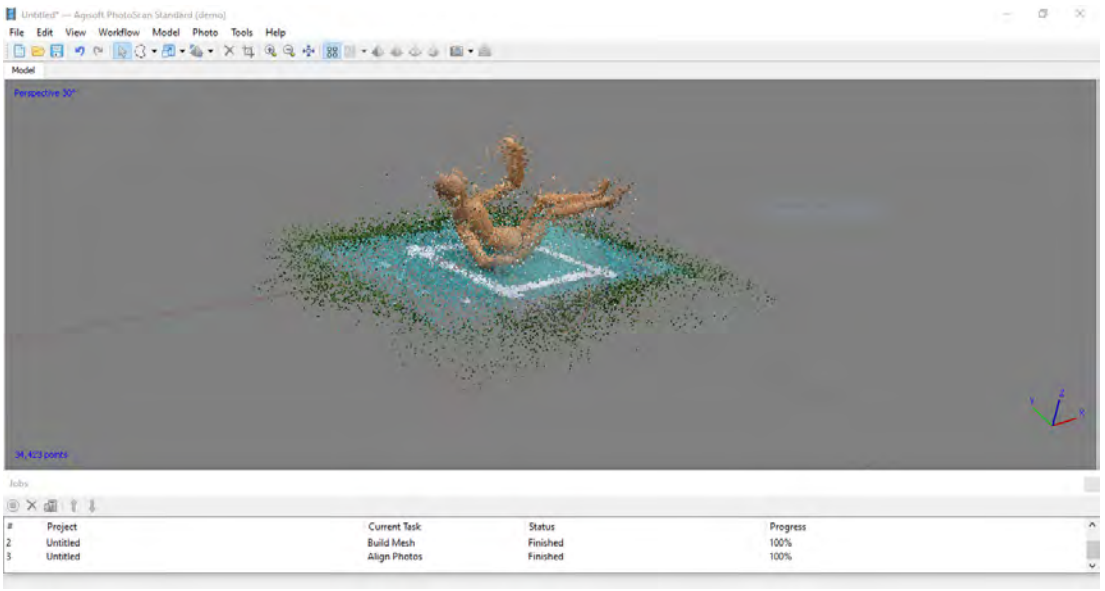


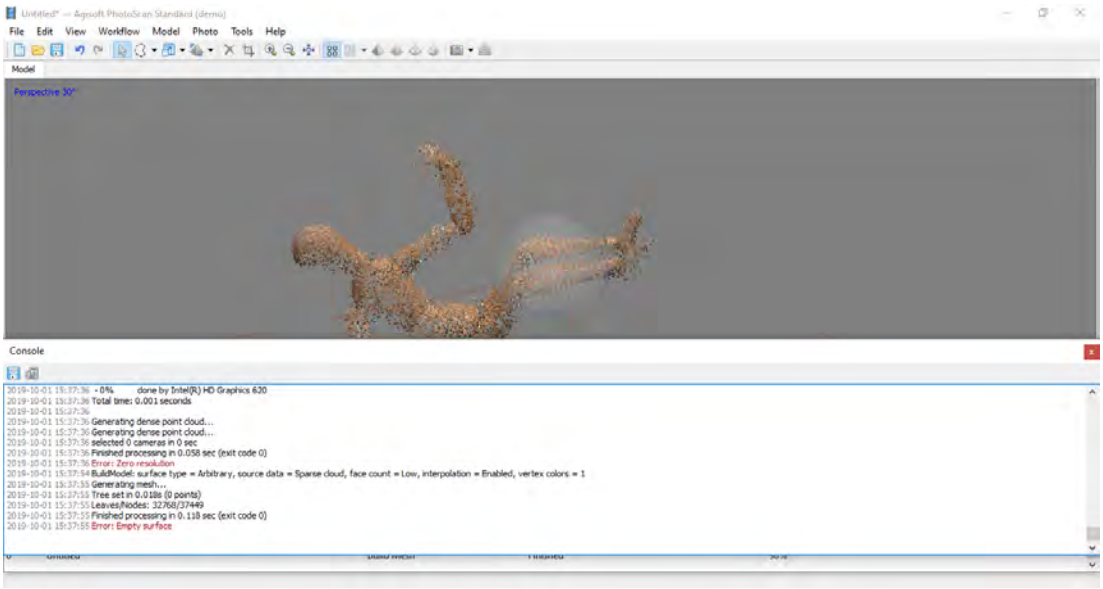
Heinrich Mallison's lessons on Photogrammetry on his blog 'dinosaurpalaeo' – a blog on dinosaurs and palaeontological topics had helpful advice on how to capture the best photographs for photogrammetry.

https://dinosaurpalaeo.wordpress.com/2013/11/16/photogrammetry-tutorial-2-picture-taking-general-remarks/

The CSIS SLR cameras were not available to hire, I plan to book a good still camera from CSIS to take a batch of high-quality photos with good depth of field - very small aperture.

122 photos (out of 130 taken, discarding blurry an ones) were used to make the model below in Agisoft Photoscan demo mode	


File Edit View Workflow Model Photo Tools Help
Model
Perspective 30°
34,423 points
Jobs
Project Current Task Status Progress
2 Untitled Build Mesh Finished 100%
3 Untitled Align Photos Finished 100%



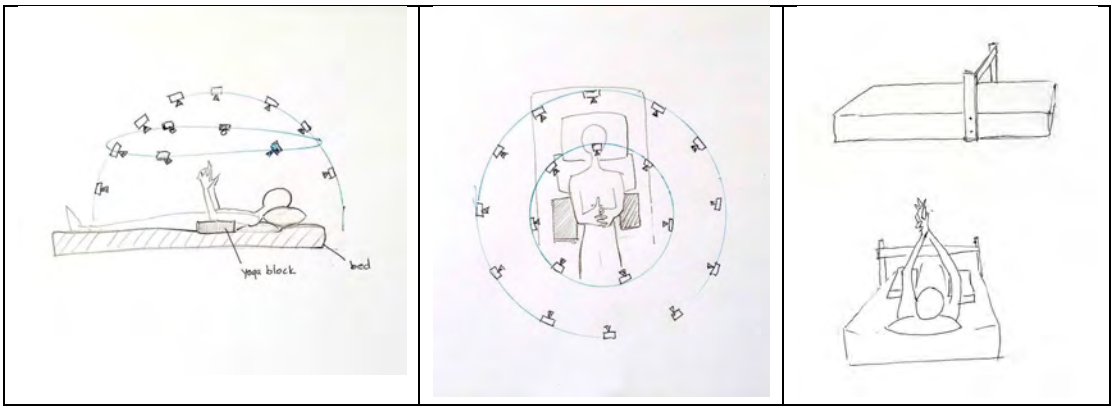
Photogrammetry software research			
Agisoft Photoscan or Agisoft Metashape	https://www.agisoft.com/downloads/request-trial/	OpenCL or CUDA-compatible graphics card	$179
Meshroom	Alice Vision https://alicevision.org/ https://github.com/alicevision/meshroom/wiki	NVidia Card. (CUDA programming environment)	Open source Free. No MacOS build
COLMAP	https://www.youtube.com/watch?v=Zm1mkOi9_1c	NVidia card	Free
Maxcloudon	https://photogrammetry.maxcloudon.com/why-choose-maxcloudon-service/	A service Send them the file	$20 for first object trial print
RealityCapture	https://www.capturingreality.com/Products	NVidia GTX980 PC and 32GB RAM.	Pricy
3DF Zephyr	https://www.3dflow.net/3df-zephyr-evaluation-download-page/	NVidia card	Free 50 photo version
TRNIO	https://apps.apple.com/us/app/trnio/id683053382	iOS 11.3 +. iPhone, iPad, iPod touch.	$2.99

Photogrammetry Project to make a model of two clasped hands.

Diffuse light is required for photogrammetry. Shadows are features; they need to remain in a constant relative location.

I set up a small bedroom with two over head lights, two LED standing lights and a table lamp. I wrapped each light in tracing paper to diffuse the light . I draped a white sheet across the window to diffuse the indirect daylight (it faces west and wouldn't have direct sunlight at the time of the photoshoot). I asked a dance artist to be the "hand model". She would be skilled in keeping her hand still because as a dancer she has a keen body awareness. I draped a white sheet over her clothes to blur the surrounds. I wanted the photogrammetry program to focus on the details of the hands.

Sketches to work out the photo shoot and illustrate to the model what was required.

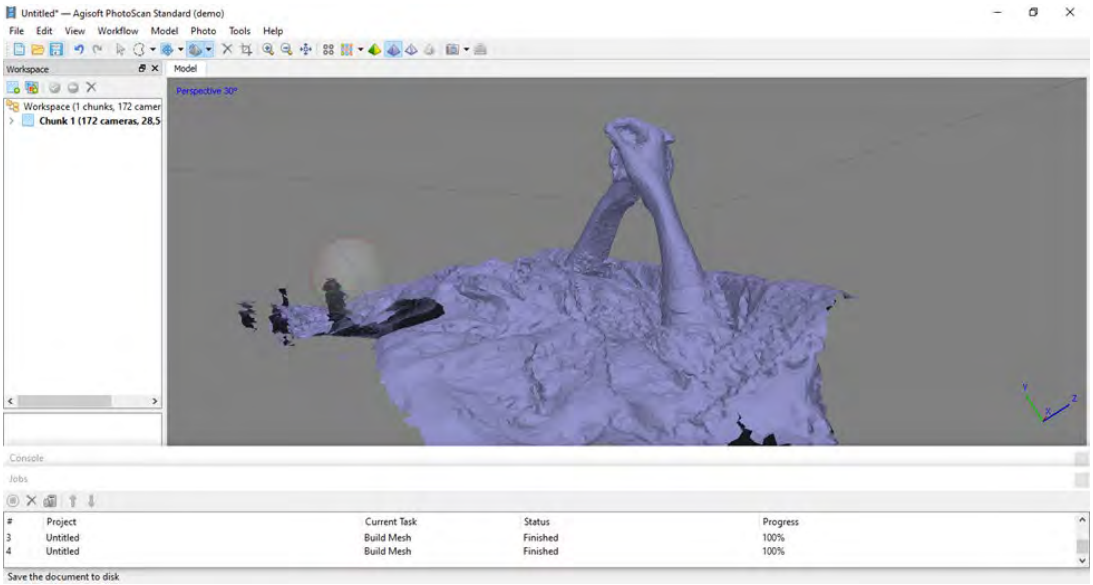


Camera settings: depth of field, FF 16 , IOS 200. I chose 200 instead of 100 to speed up the exposure time a fraction.

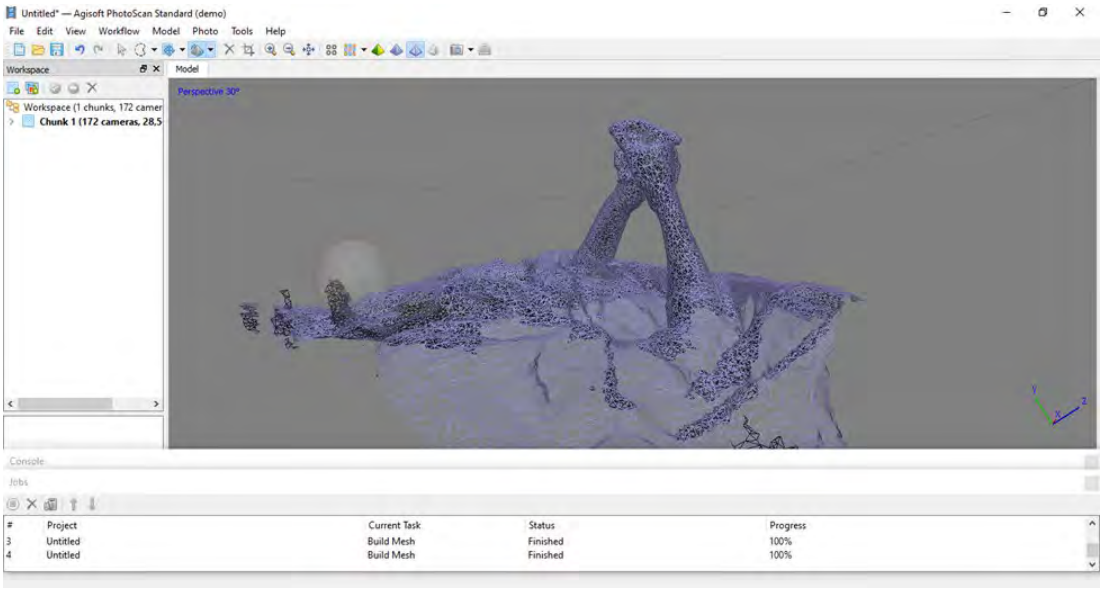
172 photos taken in 55 minutes. I discarded blurry photo which left 135.

I did a test run with the photos in Agisoft in demo mode.

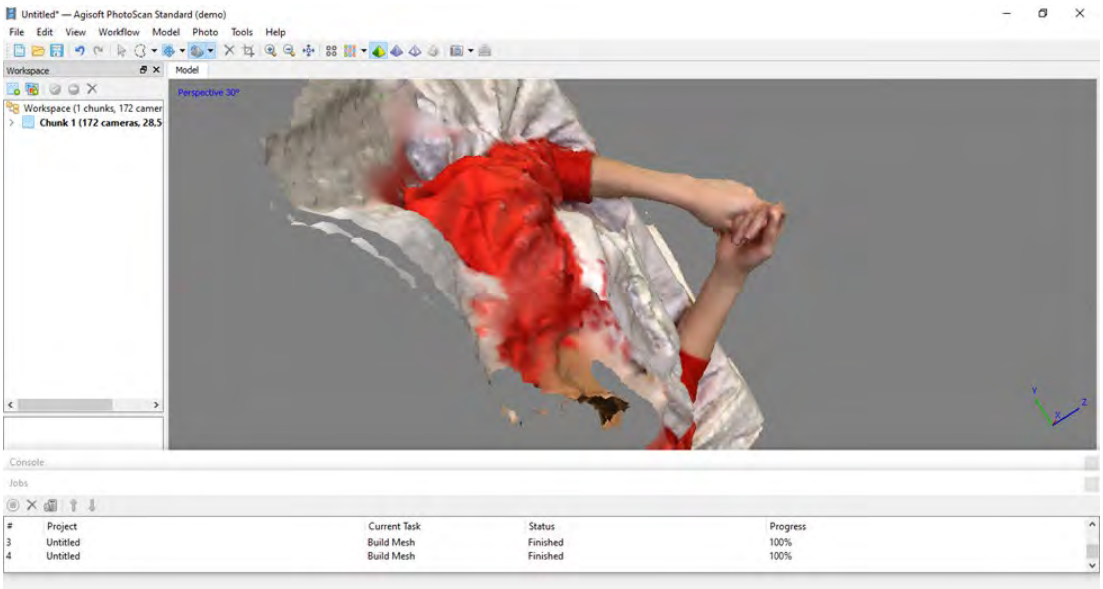
Screenshot of how it appeared in solid view.



Screenshot of how it appeared in Agisoft mesh view.



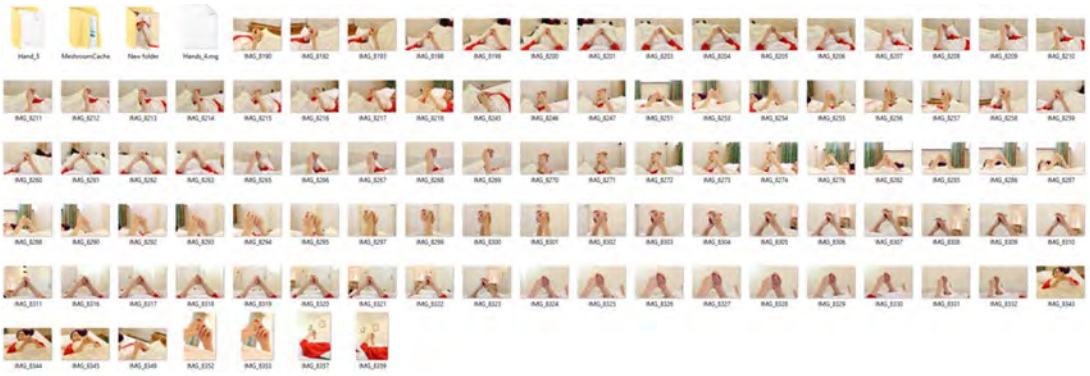
Screenshot of how it appeared in Agisoft texture view.



I ran the 135 through the Meshroom to see if the model would have a clearer resolution. They looked promising. But I don't have a licence for Agisoft I may only use the demo mode so I can't download this model.

I opened the 135 photos in Meshroom. Meshroom discarded all but 14 of the photos and produces a very poor model. So, I investigated adjusting the node settings. Experimented, googling for help, I did a multiple different run of the photos through the Meshroom process.

I sorted the photos into folders for each of the different version runs.



Consulting https://github.com/alicevision/meshroom/wiki/Reconstruction-parameters for instructions on adjusting settings. The following are the node settings for version Hands_4 (the most successful version using 92 photos):

FeatureExtraction: Change DescriberPreset from Normal to High

FeatureMatching: Enable Guided Matching

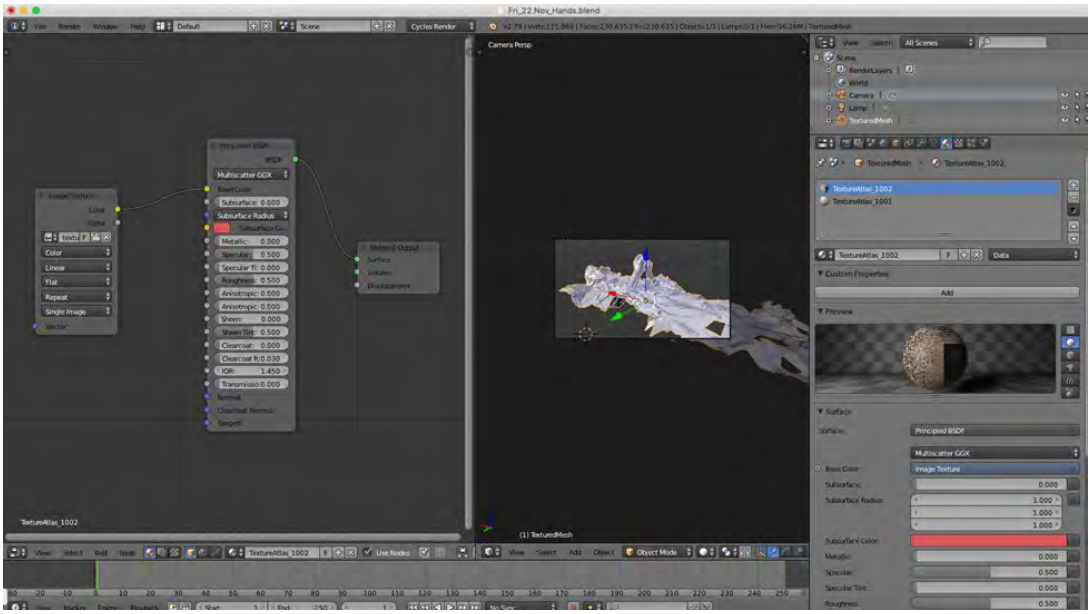
Enable AKAZE as DescriberTypes on FeatureExtraction, FeatureMatching and StructureFromMotion

I think a problem with the photos may be that at one stage the day light coming through the window changed (a passing sunburst). Another problem is that I chatted with the model at times during the photo shoot. I didn't think that movement of her face from talking would interfere with the capture of her hands but in retrospect it probably would have been better if there was no movement at all in the periphery of the hands. It would give less variation for the Meshroom computations to deal with.

This is a screen shot of the model viewed in Microsoft 3D Viewer before I put it into Blender to cut away the mesh that is the environment (wall and curtains of the room).

I followed the same method to prepare the model in Blender as in the pilot test from tutorial which I used for the pilot test. *How to 3D Photoscan Easy and Free!* https://www.youtube.com/watch?v=k4NTf0hMjtY

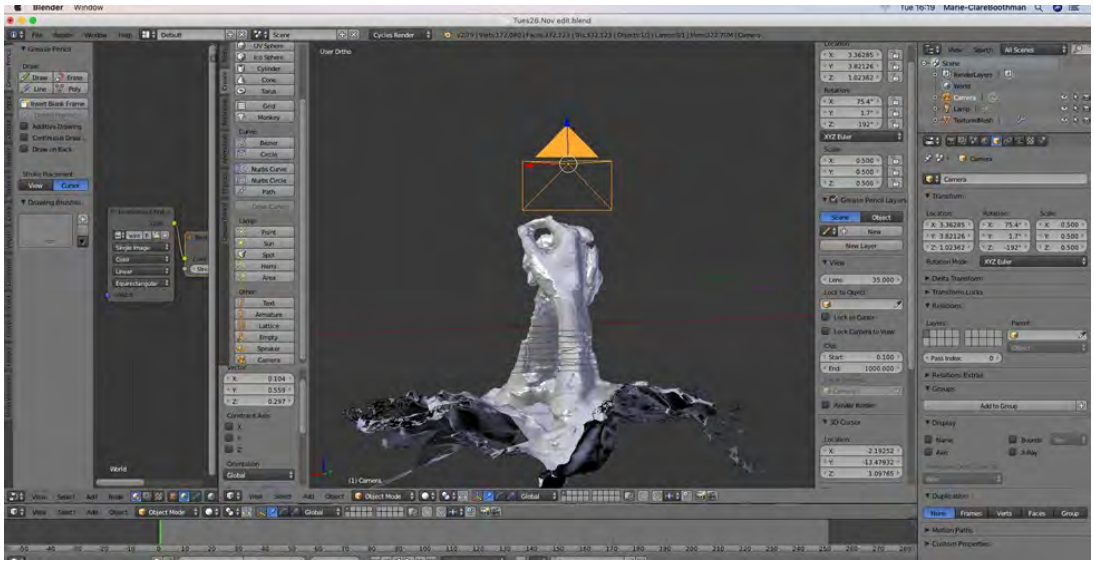
Import the OBJ file and then reduce the geometry without seeing too much noticeable difference. Modifier tab. Add decimate modifier to reduce the number of vertices.



Opening the model texture in Blender using Principle Node. The texture is a PNG file created by Meshroom.

I cut away the mesh leaving only the hand forms. I made a second version without using the decimate modifier to improve the texture.

I had to learn to move the camera and view through the camera to position the model relative to the world.

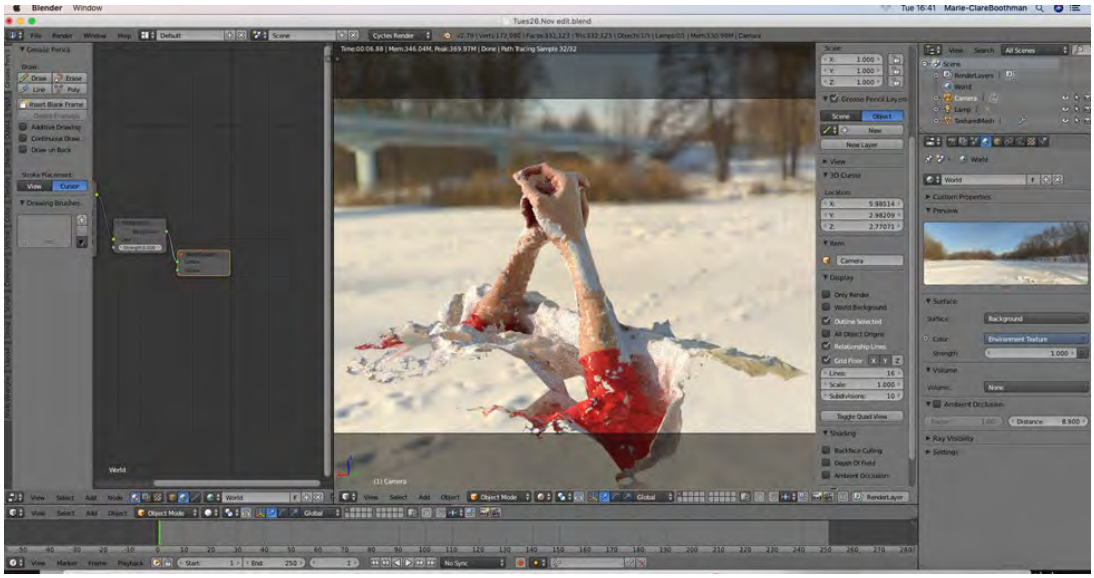


I used World view in Blender to add HDRI textures with which to light the model. I found some CC free ones at https://hdrihaven.com/hdris/

High-dynamic-range imaging (HDRI) is a high dynamic range (HDR) technique used in imaging and photography to reproduce a greater dynamic range of

luminosity than what is possible with standard digital imaging or photographic techniques. https://en.wikipedia.org/wiki/High-dynamic-range_imaging

After a lot of moving the model around, 'Ice river' HDRI works. I found there is a lot of potential here to make interesting imagery.



Research to find a suitable AR app

AR Viewer from Google Play store

https://play.google.com/store/apps/details?id=com.ipol.arviewer.app&hl=en_IE

Aryzon AR Studio for phones supporting ARKit and ARCore

https://play.google.com/store/apps/details?id=com.Aryzon.AryzonViewer&referrer=utm_source%3Dlinkedin%26utm_campaign%3Dlaunch import your own 3D models and view them in true 3D Augmented Reality

https://medium.com/@leon_72548/aryzon-ar-studio-view-your-own-models-in-true-3d-augmented-reality-70fd89d9fd20

List of devices compatible with Googles AR platform

https://www.digit.in/news/vr-ar/google-arcore-heres-a-list-of-devices-that-are-currently-compatible-with-the-companys-ar-platform-41746.html

Android 8.0 in order for ARCore to work.

ARCore requires Android 7.0 or later (some phones in the list have or require newer versions as noted below). The phone also needs to have Google Mobile

Services (GMS) and the Google Play Store.

https://blog.novoda.com/designing-for-ar-with-arkit/

Looking Glass (interactive display device)

https://lookingglassfactory.com/

Bracketing

I did not try to do the drawing experiment myself first so as I would not have prior knowledge or personal experience that would bias my interpretation of the data. I waited until I had the data coded and then tried it myself just to get a feel for what the artist participants had gone through. Then I reread the focus group transcript.

I feel comfortable with members of the art community, so it was easy for me to work with these participants and ask them to participate. Moreover, I have been drawing regularly with them in the Limerick figure drawing society.

Re representation: I'm noticing artists want to make their own individual representations.

My attention was taken by trying to get my laptop recorder going for the first few minutes. It would have been easier if I had had an assistant to look after the recording.

I should have taken photos of each artists drawing media.

We were running short on time for the focus group because I hadn't factored in transitioning time between the three drawing exercises had taken at least five mins (check first recording)

I'm so glad I didn't also film,.. how would I manage all the data?!

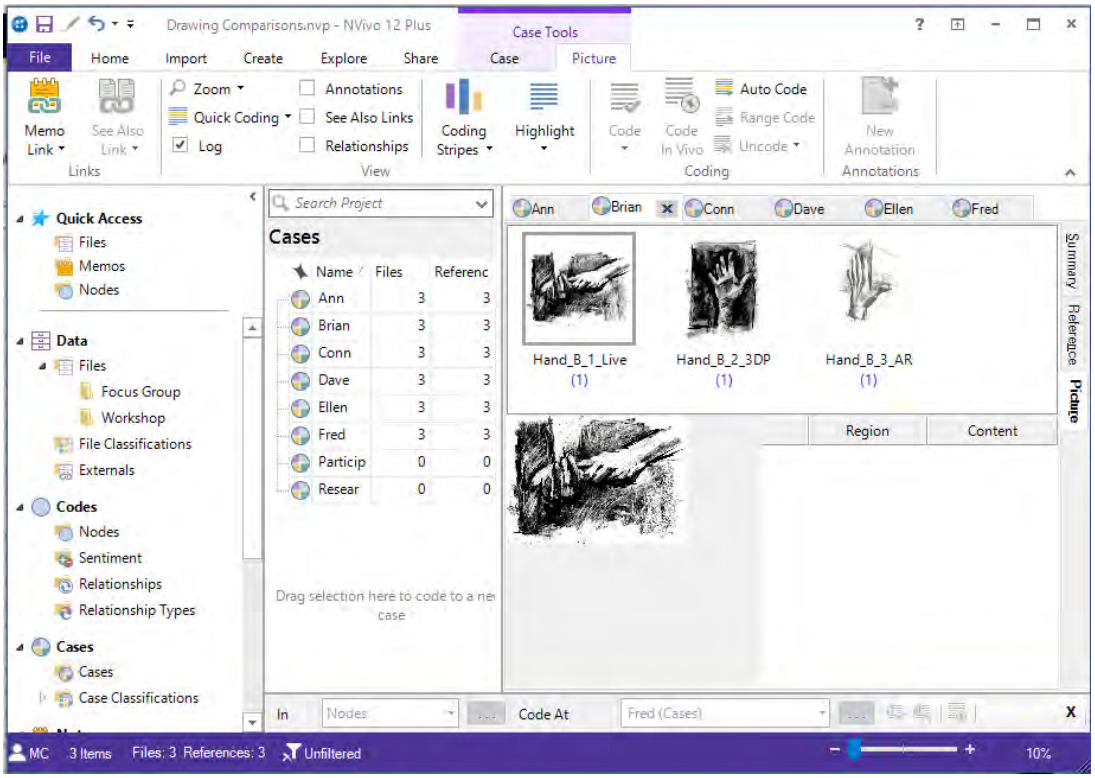
These people have a vested interest in observational drawing. They enjoy it and find it supports their artistic practice. They seem to get a closeness to the subject through drawing.

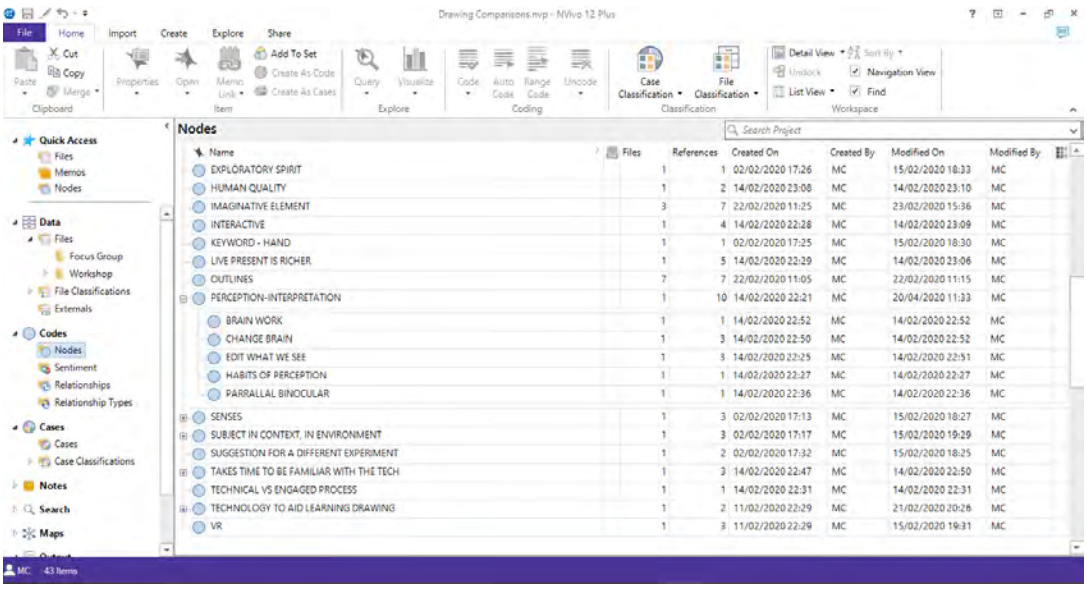
I also realized that it would have been helpful to have stuck the drawings on the wall in view for the participants view and discuss during the focus group (that's the second thing I would have needed a technical assistant for).

I should have maybe asked the model to pose her hands in the same pose as the purchased hand model. (bit concerned about that) .

I'm learning that phenomenology involves much writing!

Appendix B
The coding and data in NVivo





A Selection of the data stored and organized in NVivo.

Ann

SUMMARY TEXT PICTURE

Picture


Hand_A_3_Live
2 of 8


Hand_A_1_3DP
3 of 8


Workshop_00_3DP_1
4 of 8


Workshop_10_Live_3
5 of 8


Workshop_04_AR
6 of 8

Image References

NO.	REGION	COVERAGE
1	0,0 - 1080,1530	100.00%

Log References

ID	REGION	COVERAGE	CONTENT
1		100.00%	Draws single hand, back view, upright and hovering in black pencil
2		100.00%	Quality of light:very like the AR model's own constant light source Spaal dep th: the hand has depth but the environment has no depth. Awareness of: Drawn marks : cross hatching and etched tense outline

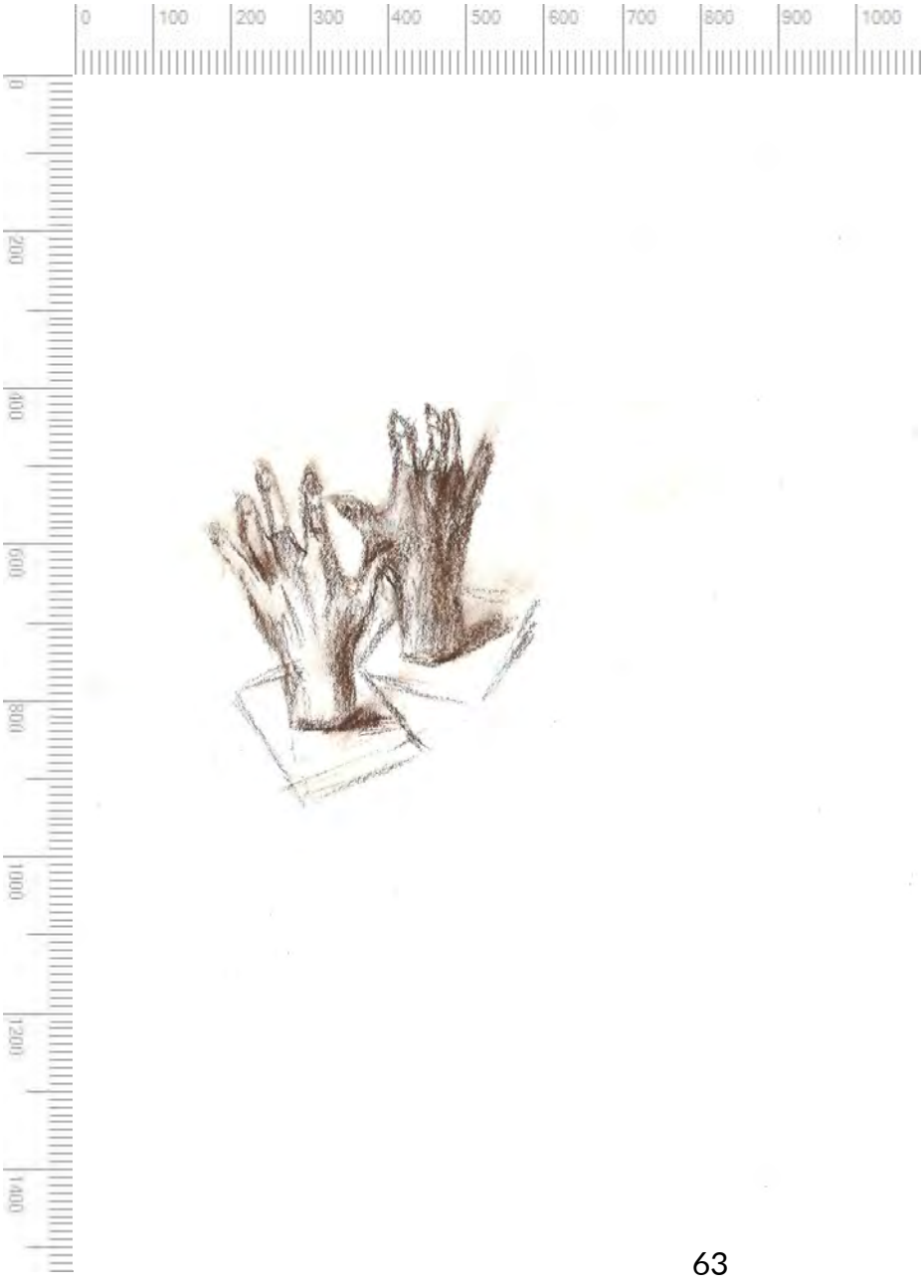
Hand_A_1_3DP

Overview

TYPE	Picture	**DIMENSIONS**	1080 x 1530 pixels
CLASSIFICATION	Drawing	**SIZE**	87 KB
		LOG ENTRIES	5

Content

Image



Log

ID	REGION	CONTENT
1		Draws pair of 3D printed hand models with dark brown conté. Hands upright on rafts. Backs of hands facing. Ann struggled to make a start on this drawing she discarded her first a empt. She seemed to have an aversion to relang t o them as human hands, they reminded her of a story about Johnny Hockedy's clay hands clawing their way up out of the front lawn of Roxboro Garda Staon. Representav e of true to scale, the 3D printed hands were very small compared to life size, this ars t has drawn them very small on the page. Funny/wonky finger of the 3D print captured. There is drawing perspecv e
2		Quality of light: shadows are drawn. Awareness of skeletal structure of the human hands can be seen edges: there is occlusion Spaal dep th: there is perspecv e
3		Drawn marks : outlines are tense, strong and heavy
4		wonky finger - good powers of observaon
5		imaginaon associa tes it to story of Johnny Hockedy

Classification

Drawing

ATTRIBUTE	VALUE
Artist	Ann
Representation	3D Print
Order	1
Orientation	Portrait
Favourite	No
media	conté
Color	Yes
3D Background represented	Yes

back to overview

Hand_A_3_Live

Overview

TYPE	Picture	**DIMENSIONS**	1530 x 1080 pixels
CLASSIFICATION	Drawing	**SIZE**	330 KB
		LOG ENTRIES	3

Content

Image

Log

ID	REGION	CONTENT
1		Quality of light: variety of contrast Spaal dep th: not perspecv e but the viewer can interpret the posioning of the hands cr ossed at the wrists resng on a surface is indicated by the smudges below. Awareness of: how one arm rests untop of another
		Drawn marks : soft outlines are softer less ridgid
2		outlines loose
3		combinaon of v ariety of weights of loose marks

Classification

Drawing

ATTRIBUTE	VALUE
Artist	Ann
Representation	Live
Order	3
Orientation	Landscape
Favourite	Yes
media	conté
Color	Yes
3D Background represented	Yes

back to overview

Picture


Hand_B_1_Live
1 of 6


Hand_B_3_AR
2 of 6


Hand_B_2_3DP
3 of 6


Workshop_03_3DP_2
4 of 6


Workshop_06_AR_3_
5 of 6

Image References

NO.	REGION	COVERAGE
1	0,0 - 1530,1080	100.00%

Log References

ID	REGION	COVERAGE	CONTENT
1		100.00%	the hands are are erased out of the dark environment
2		100.00%	there scatching into the environment around the hands dramac c ontrasts
3		100.00%	Quality of light: dramac, shado ws under hands Spaal dep th: look through the fingers - foreshortening Awareness of: Drawn marks : energec liv ely gesturesaround te hands Outlines: formed mainly due to erasinig with a few black heavy swipes (gestural)

Log

ID	REGION	CONTENT
1		the hands are are erased out of the dark environment
2		there scatching into the environment around the hands dramac c ontrasts
3		Quality of light: dramac, shado ws under hands
		Spatial depth: you can look through the fingers - foreshortening Awareness of: one hand touching the other Drawn marks : energetic *lively* gestures around the hands. Free moving marks Outlines: formed mainly due to erasing/subtraction with a few black heavy swipes (gestural) Scale: life size.

Classification

Drawing

ATTRIBUTE	VALUE
Artist	Brian
Representation	Live
Order	1
Orientation	Landscape
Favourite	Yes
media	charcoal
Color	No
3D Background represented	Yes

back to overview

Hand_B_2_3DP

Overview

TYPE	Picture	**DIMENSIONS**	1080 x 1530 pixels
CLASSIFICATION	Drawing	**SIZE**	665 KB
		LOG ENTRIES	1

Content

Image

Log

ID	REGION	CONTENT
1		Quality of light: subject dappled with light, background dark and murky Spatial depth: Volume to the hand achieved by light on fingers & interior shading of palm and dramatic contrast with background. Awareness of: artist's own hands as evidenced by finger prints in the charcoal Drawn marks : sharp gestures around the hands. Texture marks on wrist of hand Outlines: heavy dark , dramatic contrast between background and subject. Scale: Enlarged (the 3D model is only 3.5cm high. This hand drawing is almost the size of a live hand.

Classification

Drawing

ATTRIBUTE	VALUE
Artist	Brian
Representation	3D Print
Order	2
Orientation	Portrait
Favourite	No
media	charcoal
Color	No
3D Background represented	Yes

back to overview

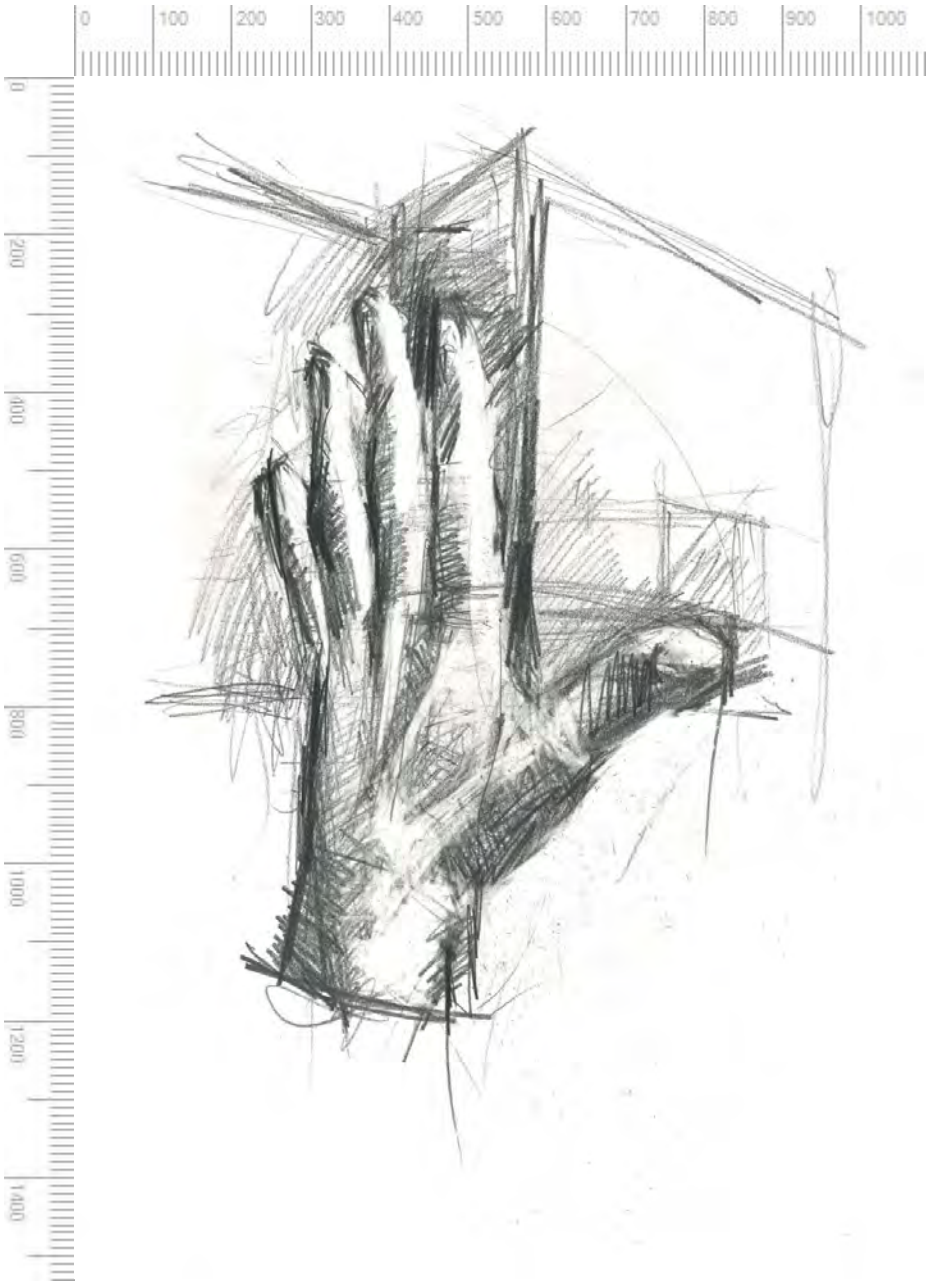
Hand_B_3_AR

Overview

TYPE	Picture	**DIMENSIONS**	1080 x 1530 pixels
CLASSIFICATION	Drawing	**SIZE**	244 KB
		LOG ENTRIES	4

Content

Image



Log

ID	REGION	CONTENT
1		Drawn marks : hard outlines
2		Spatial depth: confusing due to difference in scale of hand in relation to background, with absence of correlation,
3		hand in a room without a floor
4		Quality of light: he's made the light and shadow consistent and from the same direction on walls as well as on hand Spatial depth: hand in perspective, some foreshortening Awareness of: cut off at wrist & cut off from environment at wrist Drawn marks : sharp, linear, dense

Classification

Drawing

ATTRIBUTE	VALUE
Artist	Brian
Representation	AR
Order	3
Orientation	Portrait
Favourite	No
media	pencil
Color	No
3D Background represented	Yes

back to overview

Conn

SUMMARY TEXT PICTURE

Picture


Hand_C_3_AR
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Workshop_05_AR_3_
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Workshop_02_3DP_2
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Workshop_06_AR_3_
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Conn Word Cloud
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Image References

NO.	REGION	COVERAGE
1	0,0 - 1530,1080	100.00%

Log References

ID	REGION	COVERAGE	CONTENT
1		100.00%	CONN i Single Live hand. He had specific preference to draw from the live model first Outlines - mulple o verlapping, various line weights. Background - indicang gr ound Mark making - direcon pr edominantly left corner up to right. Loose free especially bo om right. Full variaon in t one on the actual hand subject. Quality of light: shadowy Spaal dep th: background depth indicated by direcon of shading mark s. Perspecv e - thumb occludes the palm. Ground indicated by shadow of fingers falling on it. Drawn marks : cross hatching and outline gesture sweeps
2		100.00%	Sence of looking inside the hand as if it is transparent.

See Also Links

NO.	FROM	TO ITEM	TO CONTENT
i		Cases\\Conn	

Conn

Picture

Hand_C_1_Live
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Hand_C_2_3DP
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Hand_C_3_AR
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Workshop_05_AR_3_
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Workshop_02_3DP_2
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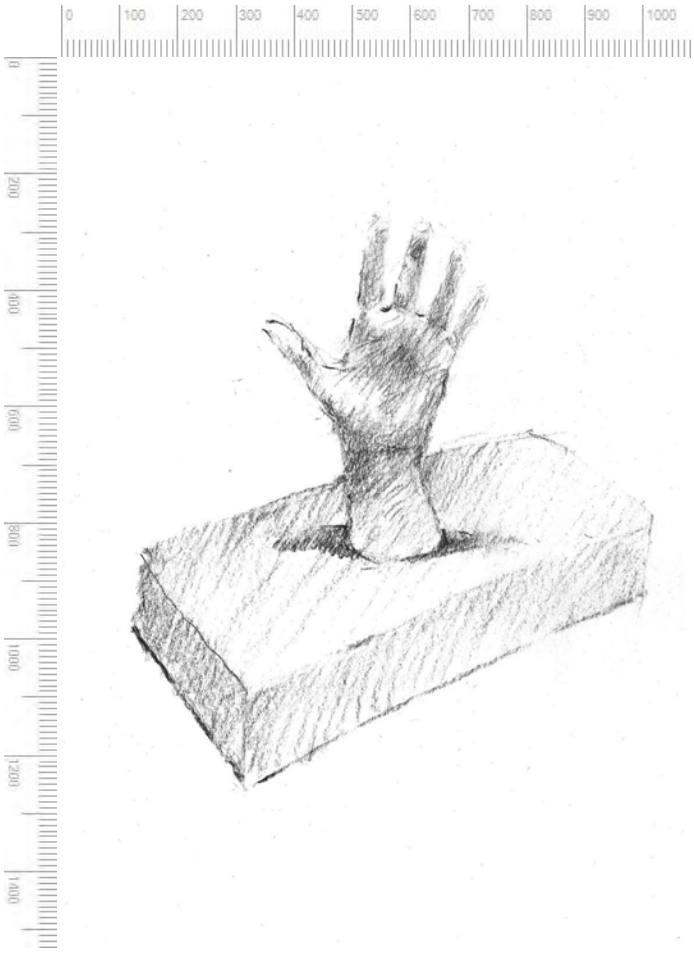


Image References

NO.	REGION	COVERAGE
1	0,0 - 1080,1530	100.00%

Log References

ID	REGION	COVERAGE	CONTENT
1		100.00%	CONN i Single hand ii 3D printed hand iii . Outlines - mulple o verlapping, various line weights. Background - indicang gr ound Mark making - direcon pr edominantly left corner up to right. Loose free especially bo om right. Full variaon in t one on the actual hand subject. Quality of light: shadowy Spaal dep th: background depth indicated by direcon of shading mark s. Perspecv e - thumb occludes the palm. Ground indicated by shadow of fingers falling on it. Drawn marks : cross hatching and etched tense outline

See Also Links

NO.	FROM	TO ITEM	TO CONTENT
i		Cases\\Conn	
ii		Files\\Workshop\\Event Photos\\Workshop_02_3DP_2_C	
iii		Files\\Workshop\\Event Photos\\Workshop_03_3DP_2_B_C	

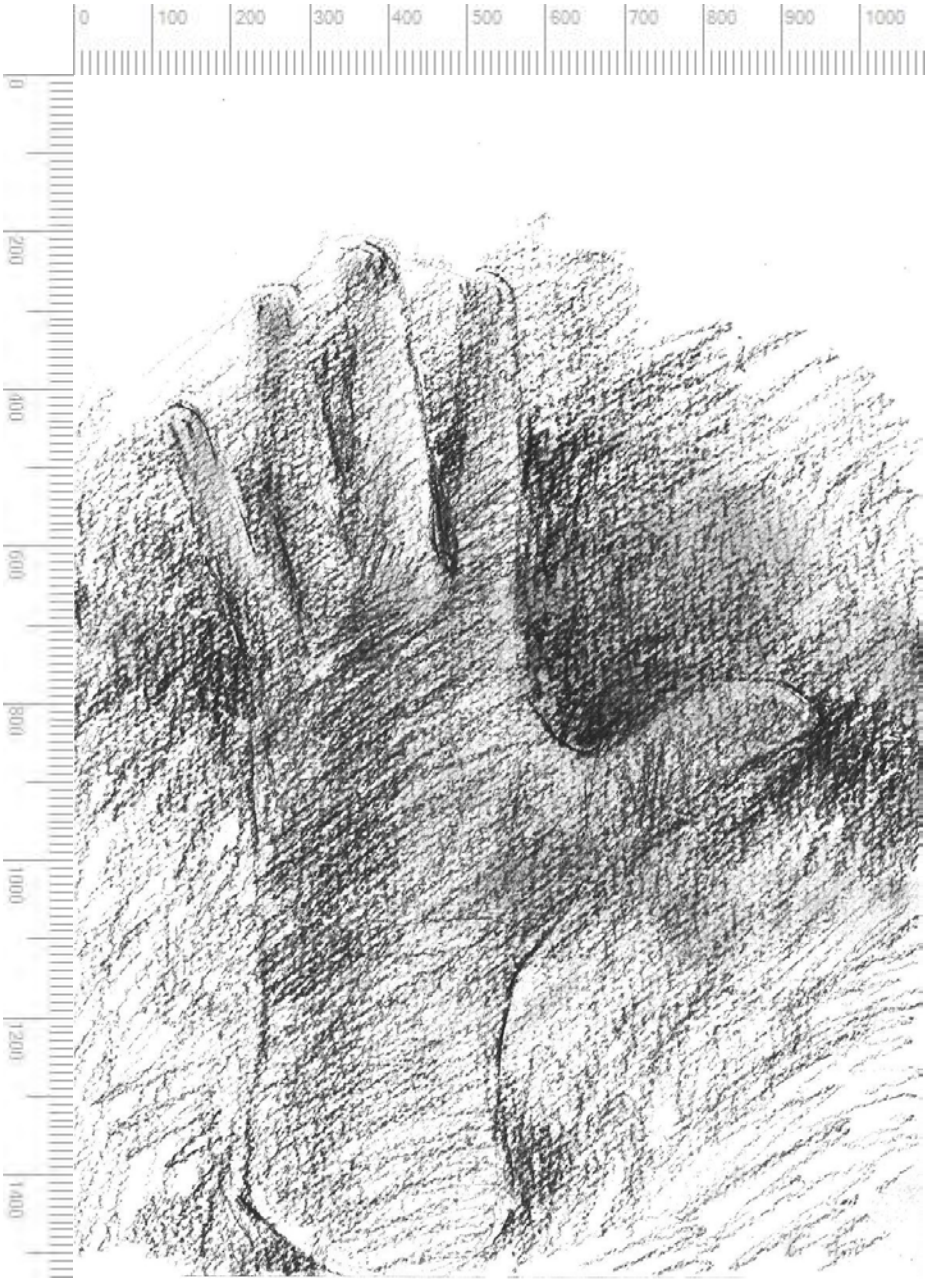
Hand_C_3_AR

Overview

TYPE	Picture	**DIMENSIONS**	1080 x 1530 pixels
CREATED ON	31/01/2020 23:10:19	**SIZE**	603 KB
CREATED BY	MC	**LOG ENTRIES**	4
CLASSIFICATION	Drawing		

Content

Image



Log

ID	REGION	CONTENT
1		CONN i AR model ii use of textured paper perhaps to give texture to the flatness of screen representaon
2		Quality of light: dim, difused Spaal dep th: yes Awareness of: background - abstract (foreground & background somemes mer ge as if on same plane - the screen much less 3D space in this drawing compared to this ars t other two. Mark making: Quite a lot of criss cross mark making in the negav e space, less variaon in t one on the actual hand object
3	480,780 - 720,1300	Sharp outlines, heavier weight than the other marks.
4		

Links

See Also Links

NO.	FROM	TO ITEM	TO CONTENT
		Cases\\Conn	
			Files\\Workshop\\Event Photos\\Workshop_05_AR_3_C

Classification

Drawing

ATTRIBUTE	VALUE
Artist	Conn
Representation	AR
Order	3
Orientation	Portrait
Favourite	No
media	pencil
Color	No
3D Background represented	Yes

back to overview

Dave

SUMMARY TEXT PICTURE

Picture

Image References

NO.	REGION	COVERAGE
1	0,0 - 1530,1080	100.00%

Log References

ID	REGION	COVERAGE	CONTENT
1		100.00%	DAVE i Pair of 3D Printed hands ii by DAVE iii
2	10,0 - 1530,1080	99.35%	Quality of light: high contrast Spaal dep th: ground indicated with white conté. Perspecv e: Hand on left looks nearer. Sense of space behind hands. Awareness of: sense of underlying anatomy of the hand Drawn marks: mostly fast parrallel straight. Outlines black pencil, deliberite, linear. Scale: scaled up from actual model sizes. DAVE said late (not in focus group that he found it quite humerous drawing fro n y hand objects)

See Also Links

NO.	FROM	TO ITEM	TO CONTENT
i		Cases\\Dave	
ii		Files\\Workshop\\Event Photos\\Workshop_10_Live_3_A_D	
iii		Cases\\Dave	

Dave

SUMMARY TEXT PICTURE

Picture


Hand_D_1_3DP
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Hand_D_2_AR
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Workshop_00_3DP_1
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Workshop_10_Live_3
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Image References

NO.	REGION	COVERAGE
1	0,0 - 1080,1530	100.00%

Log References

ID	REGION	COVERAGE	CONTENT
1		100.00%	DAVE i Quality of light: high contrast Spaal dep th: no surface indicated. Hand floats in space (centre of the page) . Perspecv e and foreshortening of the hand. Awareness of: sense of underlying anatomy of the hand Drawn marks: mostly fast parrallel straight Outlines black pencil, deliberite, linear Scale: scale equates proporonally with siz e of model on the iPad screen. No indicaon of en vironment (where does it belong?)

See Also Links

NO.	FROM	TO ITEM	TO CONTENT
i		Cases\\Dave	

Picture


Hand_D_1_3DP
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Hand_D_2_AR
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Hand_D_3_Live
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Workshop_00_3DP_1
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Workshop_10_Live_3
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Image References

NO.	REGION	COVERAGE
1	0,0 - 1530,1080	100.00%

Log References

ID	REGION	COVERAGE	CONTENT
1		100.00%	Quality of light: high contrast Spaal dep th: ground surface clearly indicated by shadow under hands. Perspecv e and foreshortening of the fingers in the upturned hand. Awareness of: sense of weight of one hand resng in the other Drawn marks: delicate free within subject. Outlines mulple o ver laid, quick, mostly soft and fluid

Image References

NO.	REGION	COVERAGE
1	0,0 - 1090,530	100.00%

Ellen

SUMMARY TEXT PICTURE

Picture


Hand_E_1_AR
1 of 8


Hand_E_2_Live
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Hand_E_3_3DP
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Workshop_01_AR_1_
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Workshop_11_3DP_3
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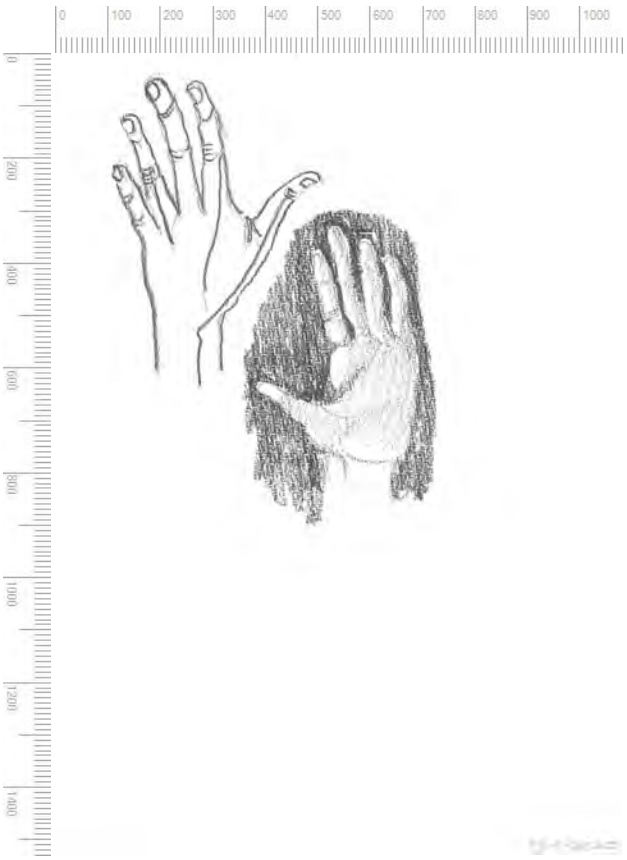

Image References

NO.	REGION	COVERAGE
1	0,0 - 1080,1530	100.00%

Log References

ID	REGION	COVERAGE	CONTENT
1		100.00%	ELLEN i Two views of the digital hand model views in the AR app ii . outlines graphic , high contrast. She only had 10 mins to draw ELLEN was one of the first parcipan ts to do an AR hand model drawing.The models would not load the program. For some unknown reason (it had opened and loaded perfectly 10 mins ago, it was buggy and went on a go slow finally a. er 10 minutes I closed the program then reopened it and it loaded.
2		100.00%	Quality of light: absent Spaal dep th: 2D Awareness of: skin Drawn marks : heavy, determined line weights iii . High contrast
3		100.00%	uses unique affordance - rotates model for two different views She was fascinated in rotang it.

See Also Links

NO.	FROM	TO ITEM	TO CONTENT
i		Cases\\Ellen	
ii		Files\\Workshop\\Event Photos\\Workshop_01_AR_1_E_F	
iii		Files\\Focus Group\\Transcript_Focus Group	Ellen You had to concentrate more I felt. You had to really concentrate on it.

Ellen

SUMMARY TEXT PICTURE

Picture


Hand_E_1_AR
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Hand_E_2_Live
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Hand_E_3_3DP
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Workshop_01_AR_1_
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Workshop_11_3DP_3
5 of 8

Image References

NO.	REGION	COVERAGE
1	0,0 - 1080,1530	100.00%

Log References

ID	REGION	COVERAGE	CONTENT
1		100.00%	ELLEN i Live models hands ii Quality of light: medium Spaal dep th: ground surface hinted to by shadow under hands. Occlusion of one hand Awareness of: sense of one holding/touching the other Drawn marks : soft marks within subject. Outlines: soft, smudgy around exterior. Heavy weighted lines when deliniang the fing ers in the foreground.
2		100.00%	Ellen said iii

See Also Links

NO.	FROM	TO ITEM	TO CONTENT
i		Cases\\Ellen	
ii		Files\\Workshop\\Event Photos\\Workshop_08_Live_2_E	
iii		Files\\Focus Group\\Transcript_Focus Group	Cos even just drawing Isabella's hands was just a lile bit kind of , "Ok well this is an exercise"

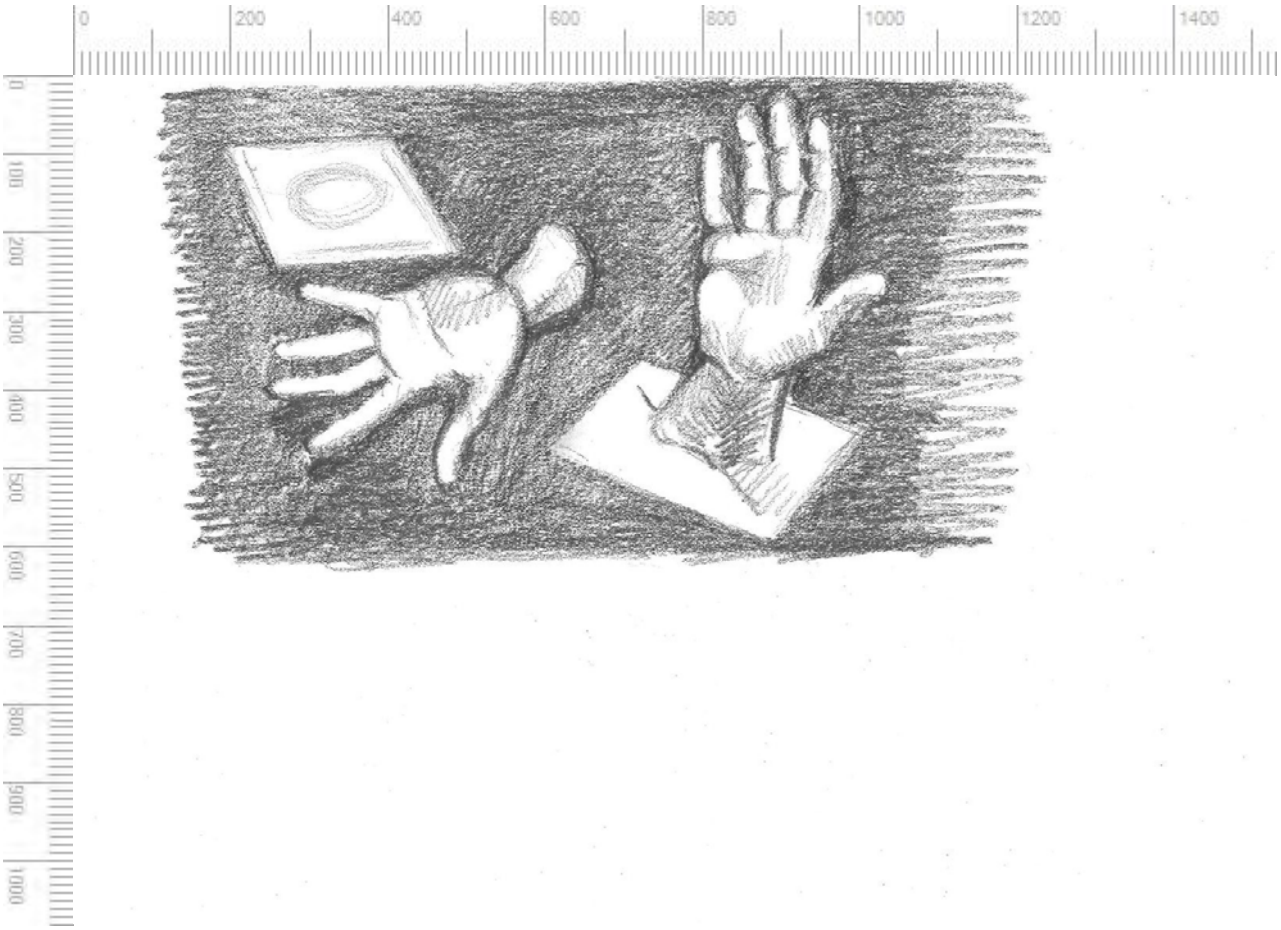
Files\\Workshop\\Drawings\\Hand_E_3_3DP

Overview

TYPE	Picture	**DIMENSIONS**	1530 x 1080 pixels
CREATED ON	01/02/2020 12:32:17	**SIZE**	314 KB
CREATED BY	MC	**LOG ENTRIES**	2
MODIFIED ON	22/02/2020 16:50:12		
MODIFIED BY	MC		
CLASSIFICATION	Drawing		

Content

Image



Log

ID	REGION	CONTENT
1		Quality of light: stark one direconal Spaal dep th: some perspecv e, shadows, Three objects. Drawn marks : dense sketching in background

Scale: so small representav e of the small objects

2 imaginav e exploraon of g eometrical composion

Classification

Drawing

ATTRIBUTE	VALUE
Artist	Ellen
Representation	3D Print
Order	3
Orientation	Landscape
Favourite	Yes
media	pencil
Color	No
3D Background represented	Yes

back to overview

Image References

NO.	REGION	COVERAGE
1	0,0 - 1090,480	100.00%

Picture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Hand_F_2_Live
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Hand_F_3_3DP
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Workshop_01_AR_1_
5 of 7

Hand_F_3_3DP

Overview

TYPE	Picture	**DIMENSIONS**	1080 x 1530 pixels
CLASSIFICATION	Drawing	**SIZE**	326 KB
		LOG ENTRIES	3

Content

Image

Log

ID	REGION	CONTENT
1		Quality of light: high contrast Spaal dep th: sence of volume strong Awareness of: space between extended fingures Drawn marks : criss cross. Outlines singular definite dividing subject from background
2		Adds imaginav e element rings at base (hand reaching up out of water)
3		Sharp contrast between the subject and background

Classification

Drawing

ATTRIBUTE	VALUE
Artist	Fred
Representation	3D Print
Order	3
Orientation	Portrait
Favourite	No
media	conté
Color	No
3D Background represented	Yes

back to overview

Hand_F_2_Live

Overview

TYPE	Picture	**DIMENSIONS**	1530 x 1080 pixels
CREATED ON	01/02/2020 12:32:44	**SIZE**	277 KB
CREATED BY	MC	**LOG ENTRIES**	1
MODIFIED ON	22/02/2020 11:51:44		
MODIFIED BY	MC		
CLASSIFICATION	Drawing		

Content

Image

CONTENT

Quality of light: medium
Spaal dep th: ground surface hinted to by shadow under hands. Occlusion of one hand
Awareness of: sense of one holding/touching the other
Drawn marks : soft marks within subject. Outlines: soft, smudgy around exterior. Heavy weighted lines when deliniang the fing ers in the foreground.

Log

ID	REGION	CONTENT
1		Quality of light: medium Spa al depth: ground surface hinted to by shadow under hands Awareness of: sense of one holding/touching the other Drawn marks : delicate loose free squigeldy marks within subject. Outlines: soft, smudgy/fudgey around exterior, multiple overlaid. Heavy weighted lines when deliniating the fingers in the foreground.

Classification

Drawing

ATTRIBUTE	VALUE
Artist	Fred
Representation	Live
Order	2
Orientation	Landscape
Favourite	Yes
media	conté
Color	No
3D Background represented	Yes

back to overview

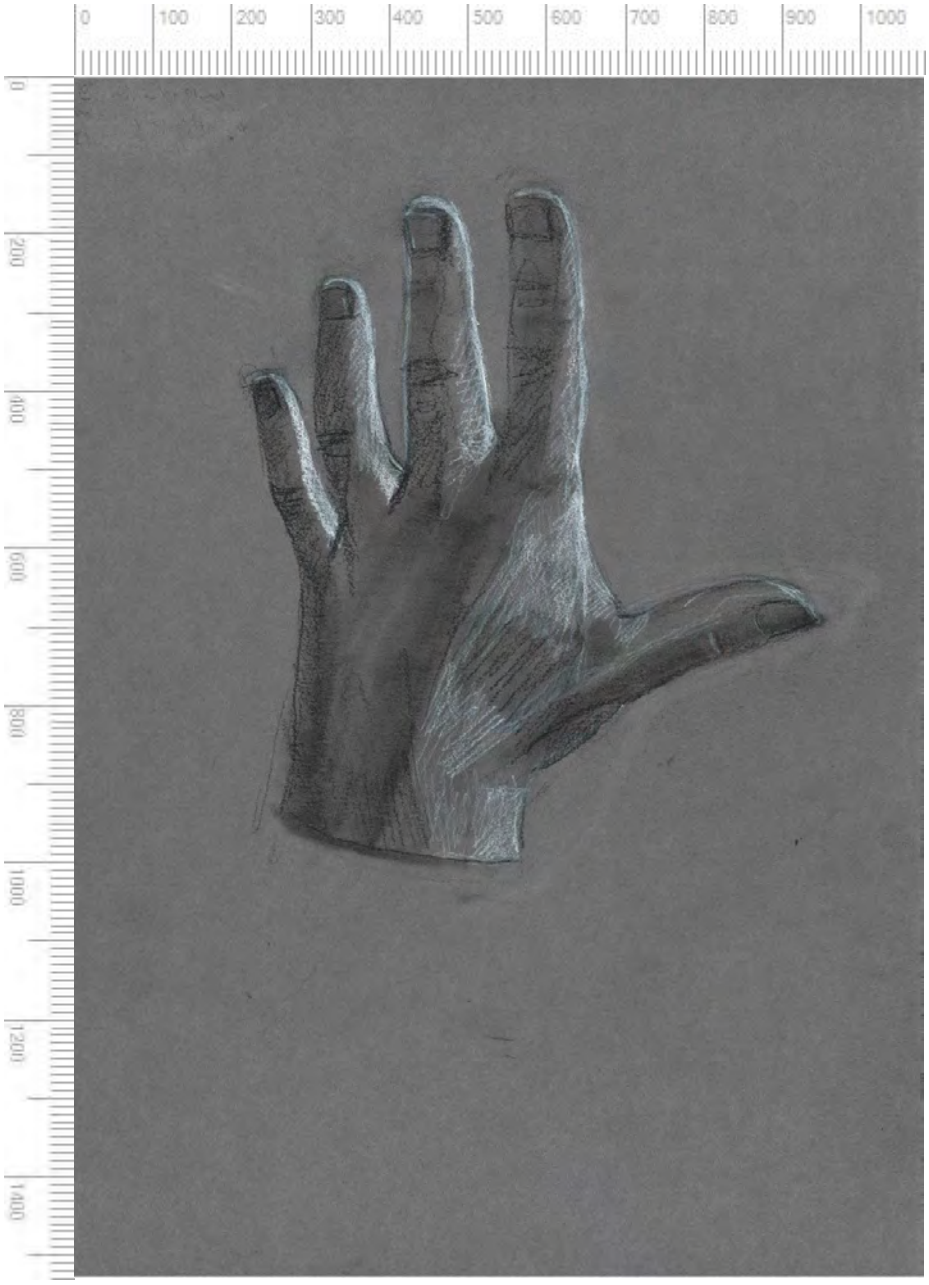
Hand_F_1_AR

Overview

TYPE	Picture	**DIMENSIONS**	1080 x 1530 pixels
CLASSIFICATION	Drawing	**SIZE**	246 KB
		LOG ENTRIE	1

Content

Image



Log

ID	REGION	CONTENT
1		Quality of light: Light of the AR digital model itself only. Spaal dep th: Only of model No backgroung/background empty. Difficult to make out if the wonky finger is bent or just shorter. Outlines Sharp, linear Drawn marks very fine straight lines.

Classification

Drawing

ATTRIBUTE	VALUE
Artist	Fred
Representation	AR
Order	1
Orientation	Portrait
Favourite	No
media	conté
Color	No
3D Background represented	No